2016 IEEE International Conference on Systems, Man, and Cybernetics

CONFERENCE DIGEST

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Conference Details

Welcome Message from the General Chair

It is a great pleasure and honor to greet you to the annual conference, 2016 IEEE International Conference on Systems, Man, and Cybernetics (SMC 2016) at Budapest, Hungary. SMC 2016 is the flagship conference of the IEEE Systems, Man, and Cybernetics Society. It provides an international forum for researchers and participants to report up-to-the-minute innovation and development, summarize state-of-the-art, and exchange ideas and advances in all aspects of systems science and engineering, human-machine systems, and cybernetics. SMC2016 is dedicated to the Hungarian born John von Neumann “a Pioneer of Modern Computer Science”. In honor of him, the theme of the conference is “A theory that transformed the world to a Cyberspace”. We hope that this conference provides a good platform for valuable meeting and you will enjoy Budapest as well, which is frequently called the “Little Paris of Middle Europe” since it has rich historical and cultural heritage.

We are pleased to report that more than 900 papers have been registered for presentation at SMC 2016. At this year’s conference, there will be three keynote talks. Monday’s keynote talk will be presented by Jose M. Carmena (UC Berkeley), it will focus on “Advances in Brain-Machine Interface Systems”. Tuesday’s keynote talk on “Spiking Neural Networks and Spatio-Temporal Data Machines: Methods, Systems, Applications” will be presented by Nikola Kasabov (Auckland University of Technology). The final keynote talk on Wednesday will be “Networked Control Systems with Industrial Applications”, given by Huijun Gao (Harbin Institute of Technology).

In the conference, there will be 7 tutorials and 3 workshops:

- Workshop on Brain-Machine Interface Systems (BMI) (Michael H. Smith, University of California, USA; Seong-Whan Lee, Korea University, Korea; Vinod A Prasad, Nanyang Technological University, Singapore; Ricardo Chavarriaga, Ecole Polytechnique Fédérale de Lausanne, Switzerland; Ljiljana Trajkovic, Simon Fraser University, Canada)
- Workshop on Women in Engineering (Levente Kovács, Óbuda University, Hungary; Clara Ionescu, Ghent University, Belgium)
- Workshop on Big Data based Technological Innovations on Intelligent Health Service in the Clouds (Hamido Fujita, Iwate Prefectural University, Japan; Enrique Herrera-Viedma, University of Granada, Spain; Ali Selamat, Universiti Teknologi Malaysia; Amedeo Cesta, Research Council of Italy (CNR); Francisco Chiclana, De Montfort University, England)

SMC 2016 program includes 49 special sessions in three topics: systems science and engineering, human-machine systems, and cybernetics; and 24 poster sessions as well. The program also includes a panel session dedicated to John von Neumann “a Pioneer of Modern Computer Science”, the theme of the panel is “A theory that transformed the world to a Cyberspace” (moderator: Ferenc Friedler, President of John von Neumann Society, Hungary).

We are pleased to present you that IEEE SMC Junior 2016 will be held for the first time as a new initiative of IEEE SMC Society, which will serves as satellite conference of the society's flagship dedicated to Students, Graduated Students and Young Professionals. This new establishment will be parallel to, but not separated from the SMC 2016 conference.

A wide range of social events are scheduled for you to make the conference more enjoyable, including Welcome Reception, Opening Ceremony, Horse Show, Conference Dinner and Junior Post Conference Tour.

Lastly and most importantly, we would like to thank all the committee members, session chairs, reviewers, and authors; without their participation and help, this conference could not run successfully. We wish for everyone a pleasant and useful experience at SMC 2016.

Imre J. Rudas
SMC 2016 General Chair
Óbuda University, Budapest, Hungary

Conference App

The SMC 2016 provides a user-friendly web-based application in sake of convenience for SMC Attendees. The application is able to provide easy session-, paper- and author-tracking during the conference.

In the *Information* menu you can find basic and important information about the conference, venues and transportation.

Asking a question after large sessions will be possible via comments. The session chair will select some questions at end of the presentation. Every single participant can write ten comments to every presentation.

We created a comment policy to guarantee the smooth operation. Inappropriate comments will be removed.

To navigate to the actual paper, the best choice is the *Calendar View*. In the *Program* menu you can find some options to order sessions. Using the *By Venue View,* you can select your venues which you interested in. The selected venues will be stored in your browser session and only these venues will be shown in the calendar page.

In the *Map View* we collected all the important POIs like hotels, restaurants and bus stops. Every POI has a description (popup will be shown after clicking).

Link for the application: www.smc2016.hu

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聖彰 阮

Conference Venue

IEEE SMC 2016 and SMC Junior 2016 will take place at two luxurious 5-star hotels, InterContinental and Sofitel, and in the Spoon Boat Restaurant, situated one next to the other and located on the enchanting Danube promenade, which is one of the most frequented parts of Budapest.

Venues & Restaurant

- Sofitel Chain Bridge Hotel
- Intercontinental Budapest
- Spoon Boat Restaurant

Walking routes

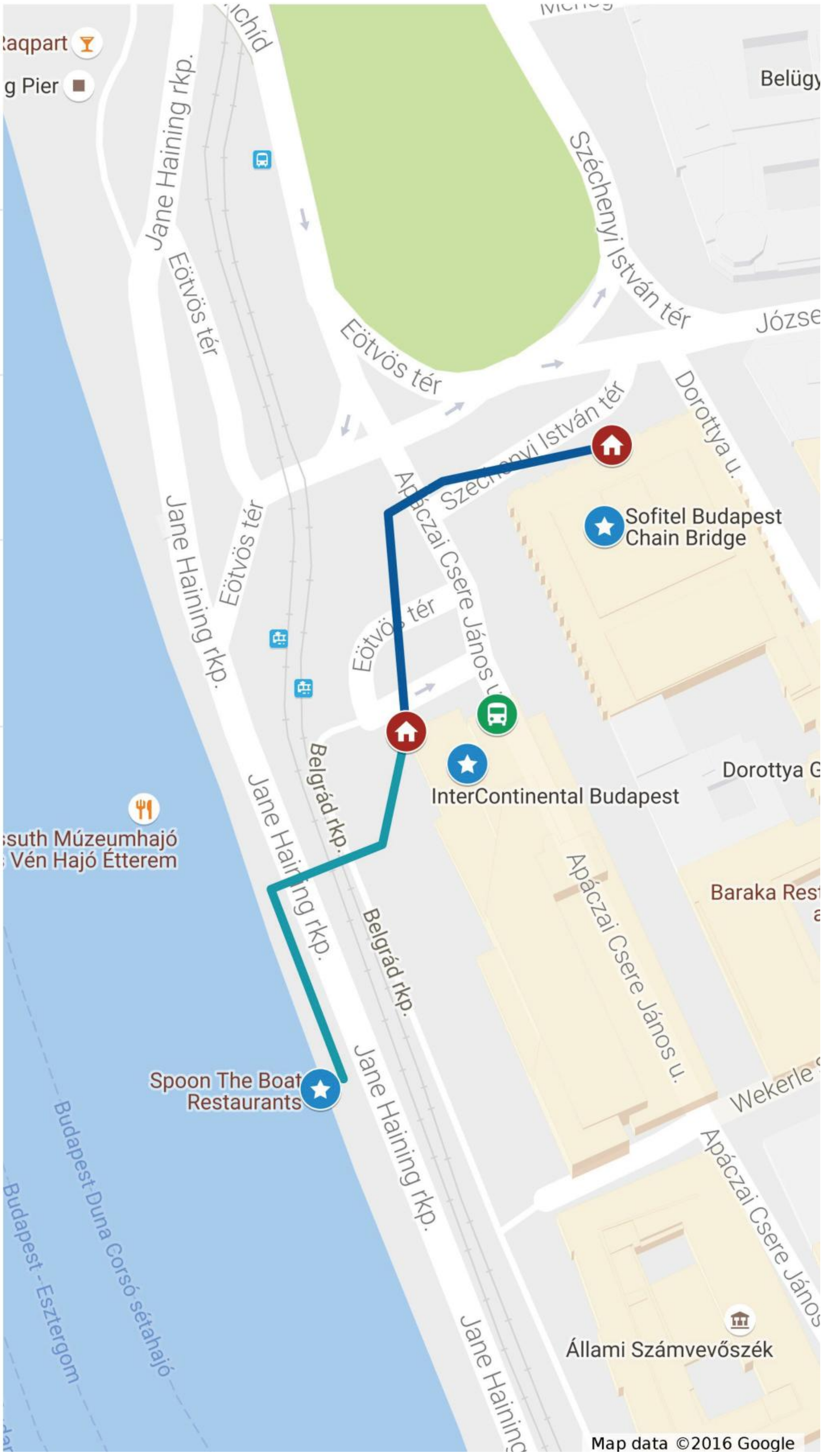
- Intercontinental-Spoon
- Intercontinental-Sofitel

Entrances

- Entrance of Intercontinental
- Entrance of Sofitel

Bus departure

- Bus departure to Lázár Equestrian Park



InterContinental Budapest
Apáczai Csere János u. 12-14, H-1052 Budapest

Sofitel Budapest Chain Bridge
Széchenyi István tér 2, H-1051 Budapest

Spoon The Boat Restaurant
Vigadó tér 3-as kikötő (Pier 3), H-1052 Budapest

InterContinental Budapest

How to get there

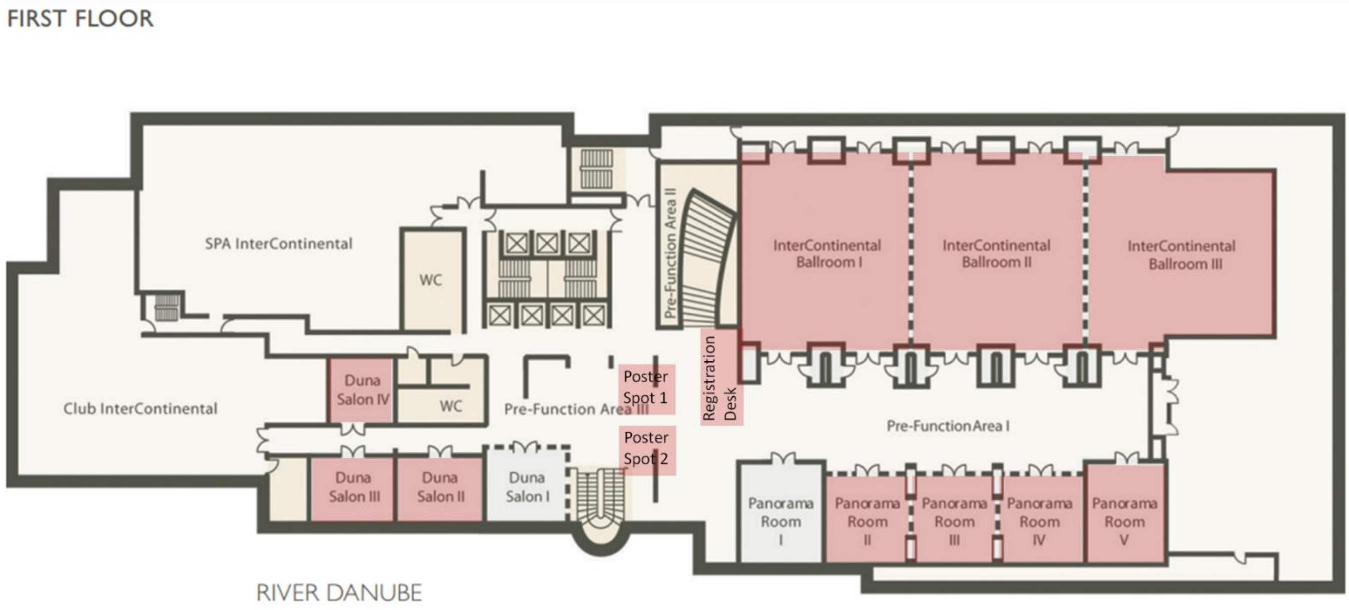
GPS coordinates:
N: 47° 49’77.19” E: 19° 04’76.74”
From West: Highway M1/M7
From North: main road N°2
From East: Highway M3
From South: Highway M5

Budapest Ferenc Liszt International Airport (BUD)
Distance: 24 KM / 14.91 MI
Taxi Charge (one way): €40.00 (EUR)
Time by taxi: 35 minutes

Railway Station name: Keleti Pályaudvar
Distance: 4.4 KM / 2.73 MI
Taxi Fee From Train Station: €25.00 (EUR)

Undeground station name: Vörösmarty tér (Line M1)
Distance: 0.3 KM / 0.19 MI
Undeground station name: Deák tér (Line M1, M2 and M3)
Distance: 0.9 KM / 0.58 MI

Floor plan



Internet Access

1. With your computer turned ON, choose from the wireless networks which is called: *InterContinental_Budapest*
2. Launch a web browser.
3. Click to the “PC Screen” as requested
4. Click on the button: Conference
5. Chose your conference name as specified here: *Smc2016Bp*
6. Enter your password as given here: *Smc2016Bp*
7. Click on: Connect

Sofitel Budapest Chain Bridge

How to get there

GPS coordinates:
Lat: 47.4983758 Long: 19.0479402
M1 Vienna highway, M2 Slovakia, M3 Ukraina, M4 Romania, M7 Croatia

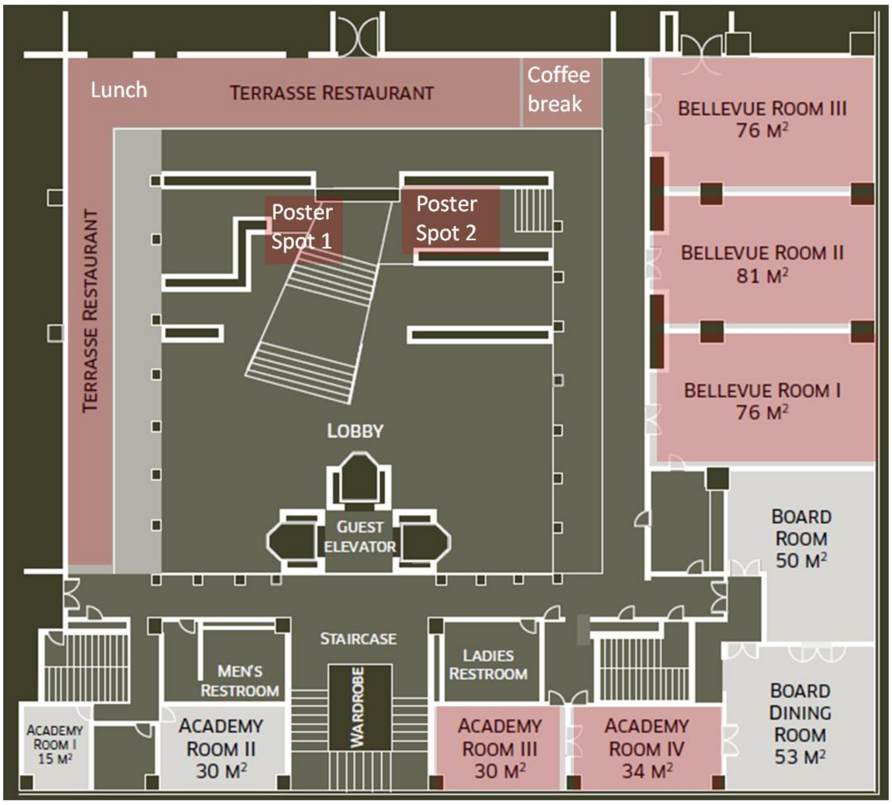
Budapest Ferenc Liszt International Airport (BUD)
Distance: 24 KM / 14.91 MI
Taxi Charge (one way): €40.00 (EUR)
Time by taxi: 35 minutes

Station name: Keleti Pályaudvar
Distance: 4.4 KM / 2.73 MI
Taxi Fee From Train Station: €25.00 (EUR)

Station name: Deák Ferenc tér (Line M1, M2 and M3) or Vörösmarty tér (Line M1)
10 minute walk from Fashion street through Vörösmarty tér, turn right and go straight onto Dorottya utca, on the left you will find the hotel.

Floor plan

MEZZANINE



Internet Access

Username: *SMC2016*
Password: *Budapest2016smc*

Spoon The Boat Restaurant

Events

Conference Lunch on October 10 (Monday, from 12:00), October 11 (Tuesday, from 12:30) and October 12 (Wednesday, from 12:30) will be served in parallel in the following places:

- InterContinental Panorama II-IV, Pre-Function Area, Duna Salon I
- InterContinental Corso Restaurant
- Sofitel Terrasse Restaurant
- Spoon Boat Restaurant

How to get there

Spoon Boat Restaurant is 4-5 minutes far on foot from InterContinental and Sofitel.

Registration Desk Open

The registration desk will be open at Hotel InterContinental at the following times:

- October 9 (Sunday): from 8:00 till 18:00
- October 10 (Monday): from 7:00 till 17:00
- October 11 (Tuesday): from 7:00 till 14:00
- October 12 (Wednesday): from 7:00 till 14:00

Social Events

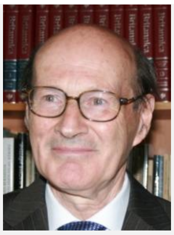
Welcome Reception

October 9 (Sunday), 18:30-21:00, InterContinental Budapest, Ballroom II-III, Panorama II-IV, Pre-Function Area, Duna Salon I

Please join us at the SMC 2016 Welcome Reception. Enjoy food and drinks, network with colleagues, meet the organizing committee and old friends and get access to the exhibitors.

Opening Ceremony

October 10 (Monday), 08:00-08:30, InterContinental Budapest, Ballroom I-III

						
Shun-Feng Su	Imre J. Rudas	Dimitar Filev	Barry L. Shoop	László Palkovics	Domokos Szász	Mihály Réger
Technical Program Committee Chair	General Chair	President of IEEE SMC Society	President of IEEEE	Secretary of State, Ministry of Human Capacity	Vice-President of Hungarian Academy of Sciences	President of Óbuda University

Banquet

October 11 (Tuesday), 17:00-21:00, Lázár Equestrian Park

Transportation to the Banquet

October 11 (Tuesday), 14:15, Bus departure to Lázár Equestrian Park from InterContinental

Lázár Equestrian Park, Horse Show

Situated 35 km from Budapest, in the heart of Domonyvölgy, the Lázár Equestrian Park is owned by the coach driving world champions, Vilmos and Zoltán Lázár. The resort nestles among the picturesque lakes of the Gödöllő Hills.

Program:

- Four-in-hand driving, pony carriage driving, horsemen
- Display of nomad warrior archery - archery on horseback, throwing a spear
- Skills of the horsemen – making the horse lie down, cracking the whip, competition between the horsemen
- Fun competition involving the guests: knocking a bottle with the whip
- Cart pulled by four oxen
- Humorous show with trained donkey
- 'Queen Elisabeth's equestrian show in contemporary costume, riding in a side-saddle with hussars
- Puszta-five
- Finale

Award Ceremony

							
Imre J. Rudas General Chair	Dimitar Filev President of IEEE SMC Society	Barry L. Shoop President of IEEEE	Philip Chen General Co-Chair of SMC 2016, Chair of SMCS Award Committee	Michael H. Smith Chair of BMI Workshop	Ljiljana Trajkovic General Co-Chair of SMC 2016	T.T. Lee Chair of SMC 2016 Award Committee	György Eigner General Co-Chair of SMC 2016 Junior

Conference Dinner

The Conference Dinner will be held at the Lázár Equestrian Park, after the Award Ceremony.

Transportation from the Banquet

21:00 Bus transfer back to Hotel InterContinental (buses will come back earlier if required).

Welcome speech at Opening Ceremony

October 10 (Monday), 08:00-08:30, InterContinental Budapest, Ballroom I-III

Welcome speech at Award Ceremony

October 11 (Tuesday), 18:15-19:00, Lázár Equestrian Park

Barry L. Shoop
2016 IEEE President and CEO
Professor and Department Head
Department of Electrical Engineering and Computer Science
U.S. Military Academy
West Point, New York, USA

Biography

Barry L. Shoop is Professor of Electrical Engineering and Head of the Department of Electrical Engineering and Computer Science at the United States Military Academy at West Point. In this role, he is responsible for an undergraduate academic department with over 79 faculty and staff supporting ABET accredited programs in electrical engineering, computer science, and information technology and serving over 2300 students annually. During his tenure at West Point, he has served in a number of leadership positions including Director of the Electrical Engineering Program and Director of the Photonics Research Center. Earlier in his career, he was a satellite communication engineer responsible for the design and installation of a high capacity, global digital communication network, and the CTO for a US$4.5B organization addressing the Improvised Explosive Device (IED) challenge worldwide. Barry received the Ph.D. from Stanford University and B.S. from the Pennsylvania State University, both in electrical engineering. He is a Fellow of the IEEE, the Optical Society of America (OSA), and the International Society for Optical Engineering (SPIE), and a member of Phi Kappa Phi, Eta Kappa Nu, and Sigma Xi. In 2008, OSA recognized Barry with their Robert E. Hopkins Leadership Award, and in 2013 he earned both the SPIE Educator Award and the IEEE Haraden Pratt Award. He holds a patent on photonic analog-to-digital conversion and has authored over 150 archival publications as well as eight books and book chapters. He is a licensed Professional Engineer in Virginia, USA.

General Information

For more information, visit: http://visitbudapest.travel/

Important telephone numbers in Hungary

- Ambulance: 104
- Fire Service: 105
- Police: 107
- S.O.S. (General): 112

Hungarian Currency

The Hungarian currency is the Forint (Ft, HUF), which has the following denominations:

- *notes*: 500 Ft, 1 000 Ft, 2 000 Ft, 5 000 Ft, 10 000 Ft and 20 000 Ft
- *coins*: 5 Ft, 10 Ft, 20 Ft, 50 Ft and 100 Ft.

Prices, such as hotel rates, sightseeing tours, etc. are often quoted in Euros. Many businesses, even including some select supermarkets accept Euros. Don't forget to check their exchange rates, as you might be better off exchanging your currency first and paying in Forints.

Exchange Rate, ATMs & Credit Cards

ATMs are easy to find in Budapest, and there are many options for exchanging cash. Most often, currency exchange kiosks located in tourist areas or shopping malls offer the best exchange rates. Currency exchange is also available at banks at a surcharge. ATMs dispense Hungarian currency at your bank's daily exchange rate; however, you may be charged a foreign fee on top of the service fees. Many international banks have branches in Hungary. Currency exchange is available at the airport at a significant surcharge (10%-15%). Following is a list of kiosks and websites for daily exchange rates and locations in Budapest and around the country:

CorrectChange has five locations in Budapest. CorrectChange publishes its exchange rates online, along with a complete list of locations and a currency converter.

Northline has several currency exchange booths in Budapest. Their website is in Hungarian, however it’s still useful for their complete list of locations plus there is a handy currency converter in the sidebar.

The *Exclusive* chain of foreign exchange companies offers locations in Budapest. They have downtown exchange booths in Budapest as well as locations in shopping plazas, malls and supermarkets. Each company has its own tab on their website and lists both exchange rates and locations.

Interchange offers several locations across Budapest including the major train stations and both airport terminals. Their website does not have a currency converter.

OTP, the National Savings Bank, offers daily cash and foreign exchange rates on their website. You can also check the Hungarian National Bank's (MNB) official daily exchange rates. While the MNB does not carry out foreign exchange activities and only shows the mid-point rates, it's a good indicator of daily exchange rates.

Post offices also offer cash advances on most major credit cards, as well as for American Express travelers' checks. Please avoid using any type of travelers' checks, they are a thing of the past and will not be accepted in most places. You will also find that even if travelers' checks are accepted there may be a fee charged.

Credit Cards, such as Visa, Master Card and American Express, are widely accepted. You will be able to use them at most hotels, shops and restaurants. You may find that most museums, smaller shops, and even some restaurants do not accept credit cards.

Budapest Public Transportation

Most of Budapest's city center and historic districts are suitable for walking. There are pedestrian precincts in downtown Pest and traffic is restricted on Castle Hill, so walking is probably the best way to get around. However, Budapest also has an excellent public transportation system.

Subway (Metro)

Budapest has four subway lines.

- *M1 or Millennium Underground (yellow line)*: runs under Andrássy Avenue in Pest, between Vörösmarty tér and Mexikói út
- *M2 (red line)*: runs east west, between Déli pályaudvar and Örs vezér tere
- *M3 (blue line)*: runs north south in Pest, between Újpest-Központ and Kőbánya-Kispest
- *M4 (green line)*: runs between Kelenföldi pályaudvar and Keleti pályaudvar

Yellow Streetcar (Tram)

Budapest has a vast system of streetcars. Here are some useful routes:

- *No. 2*: runs along the Pest riverfront connecting Margit hid and Petőfi hid
- *No. 4*: runs on the Grand Boulevard connecting Széll Kálmán tér and Október 23. utca
- *No. 6:* runs also on the Grand Boulevard connecting Széll Kálmán tér and Móricz Zsigmond körtér in Buda
- *No. 19*:runs along the Buda riverfront connecting Batthyány tér and Gellért tér and continues on to Kelenföld
- *No. 49*: runs between Buda and Pest connecting Kelenföldi Pályaudvar in Buda and Deák tér in Pest

Trolley Bus

Trolley bus service is available on 13 routes in Pest only.

Bus

The majority of people in Budapest using mass transit travel by bus. There are over 200 routes, and express buses with red number signs serve the busiest routes in the city. They travel along the same route as the regular buses with black number signs, but make fewer stops. Buses are also prevalent in the Buda Hills.

Tickets

Tickets are valid for the metro, buses, streetcars, trolley buses, the Cogwheel Railway (service in the Buda hills) and the suburban HÉV lines (only within the city limits), and are available at any subway station. To avoid lines, buy tickets from street stands and newsstands. It is also possible to buy tickets from a ticket vending machine. The basic ticket is good for one trip; if you transfer, you will need to validate a new ticket or use a transfer ticket. Be sure to validate your ticket using the orange or red ticket-punching machines as controllers may ask to see your ticket, and will fine you for having an invalid one. Some ticket-punching machines on buses and streetcars are manual. Be sure to insert your ticket into the top slot and pull the punching mechanism toward you.

Most important ticket types:

- *Single ticket: HUF 350*
  Valid for a single uninterrupted trip without transfer on the whole length of lines only within the administrative boundaries of Budapest.
- *Block of 10 tickets: HUF 3,000*
- *Transfer ticket: HUF 530*
  Valid for a single trip including one transfer on the whole length of lines only within the administrative boundaries of Budapest.
- *Budapest 24-hour travelcard: HUF 1,650*
  Valid for 24 hours from the indicated date and time (month, day, hour, minute) for an unlimited number of trips within the administrative boundaries of Budapest.

- *Budapest 72-hour travelcard: HUF 4,150*
- *Budapest 7-day travelcard: HUF 4,950*
- *Budapest Card for 24 hours: HUF 4,900*
  The Budapest Card for 24 hours provides discounts for a single person. The Budapest Card is personalised and not transferable. During the validity of your Budapest Card, you are entitled travel free of charge and take an unlimited number of trips within the administrative boundaries of Budapest. In addition to free public transport, several other services are offered through the card, such as free and discounted entry to museums and thermal baths, discounted meals and cultural events. For more information, please visit https://www.budapest-card.com/hu/
- *Budapest Card for 48 hours: HUF 7,900*
- *Budapest Card for 72 hours: HUF 9,900*

For more information about ticket types and prices, please visit http://www.bkk.hu/en/tickets-and-passes/prices/.

Budapest Taxis

Taxis can be fast and cheap in the city, especially late at night when there is limited public transportation. Taxis can be hailed on the street, but it is cheaper to call ahead of time. Residents in Budapest rarely flag down taxis in the street and our advice is to always call one of the recommended companies.

Base fare: HUF 450
Price per minute: HUF 70
Price per kilometer: HUF 280

The following are the phone numbers of reliable taxi firms charging fair rates, not 'tourist tariffs' (operators are English-speaking).

- Citytaxi: (+36-1) 211-1111
- Főtaxi: (+36-1) 222-2222
- Budataxi: (+36-1) 233-3333
- Tele5 taxi: (+36-1) 355-5555
- Rádiótaxi: (+36-1) 377-7777

Főtaxi – the officially appointed taxi company to service the airport

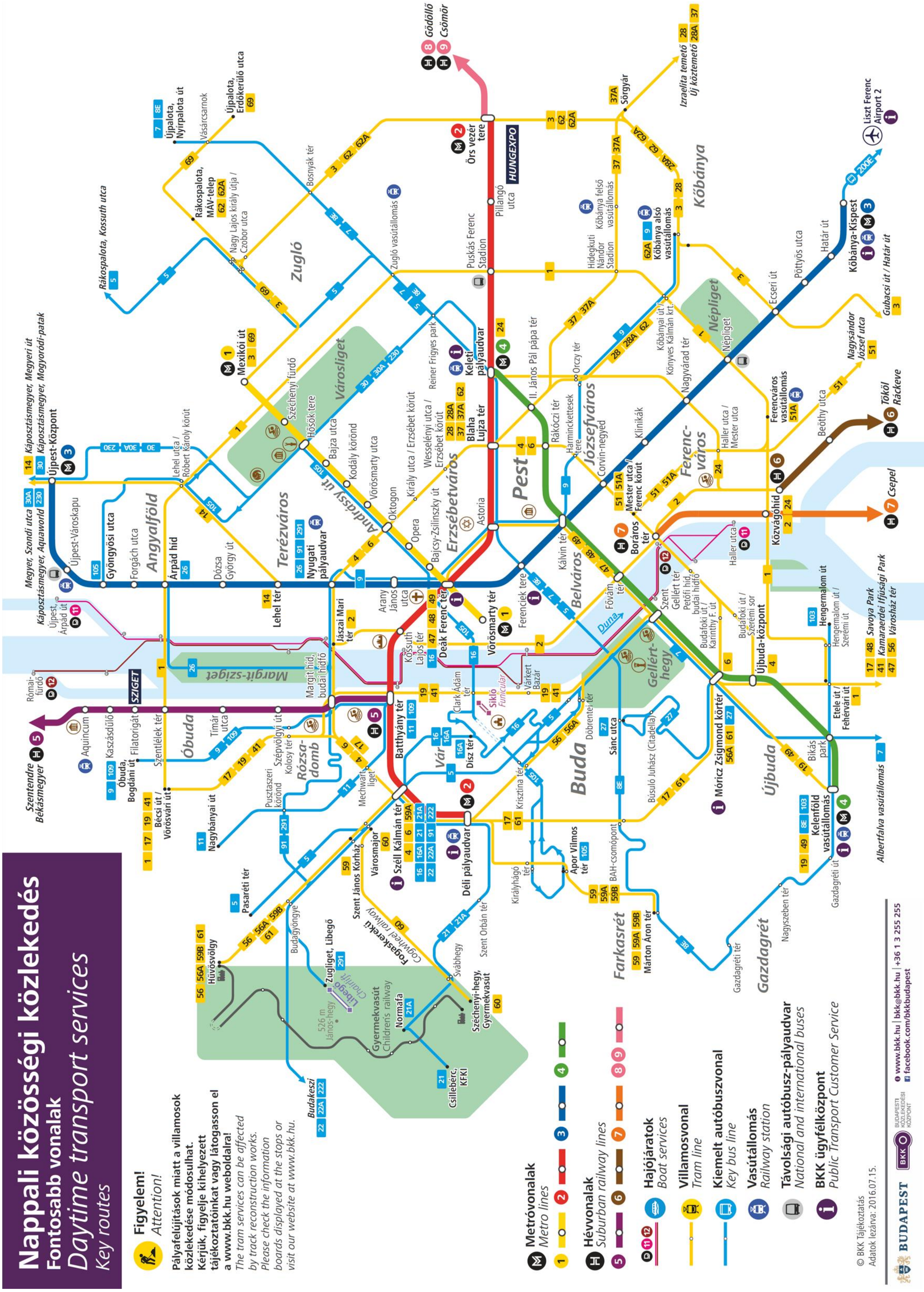
Főtaxi, the taxi company with the longest traditions (founded 1913) in Hungary transports passengers between the terminals and Budapest. Főtaxi's several hundred cars, trained and experienced colleagues ensure a safe basis to satisfy passengers' needs at a high standard.

Taxi drivers speaking at least one foreign language are in service with large, category 'A' cars younger than five years. All cars are equipped with a POS terminal; therefore credit cards are also accepted.

Reservations can be made in person at the Főtaxi booths located at the exits at Terminals 2A and 2B. At the taxi rank in front of the stands, taxis are parking continuously waiting for passengers.

From 1 September 2013 a new Taxi Decree was introduced in Hungary regulating the price* of the taxis at a fixed tariff of 280 HUF/Km (0.95 EUR/Km) in addition to the one-off basic fee of 450 HUF (1.50 EUR) and waiting fee. A ride to the city center should typically cost around 6500 HUF (22 EUR) depending on traffic conditions.

Please be aware of exposing yourself at risk by using non-regulated taxi service providers soliciting at the terminal buildings.


Nappali közösségi közlekedés
Fontosabb vonalak
Daytime transport services
Key routes
Figyelem!
Attention!
Pályafelújítások miatt a villamosok közlekedése módosulhat. Kérjük, figyelje kihelyezett tájékoztatóinkat vagy látogasson el a www.bkk.hu weboldalra!
The tram services can be affected by track reconstruction works. Please check the information boards displayed at the stops or visit our website at www.bkk.hu.
Metróvonalak
Metro lines
Hévvonalak
Suburban railway lines
Hajójáratok
Boat services
Villamosvonal
Tram line
Kiemelt autóbuszvonal
Key bus line
Vasútállomás
Railway station
Távolsági autóbusz-pályaudvar
National and international buses
BKK ügyfélközpont
Public Transport Customer Service
© BKK Tájékoztatás
Adatok lezárva: 2016.07.15.
www.bkk.hu | bkk@bkk.hu | +36 1 3 255 255
facebook.com/bkkbudapest
BUDAPEST

Driving in Hungary

Driving in Hungary is on the same side of the road as in North America. Traffic jams are frequent and parking can be challenging, as it is often hard to find a spot. If you do succeed and find space, parking must be paid for between the hours of 8am - 6pm Monday to Friday. (Parking is free on Saturdays and Sundays.) Tickets must be purchased from the nearest parking meter.

Hungary has a zero tolerance policy for driving under the influence. Police often conduct routine roadside checks where breathalyzer tests may be administered and often are. It is against the law to use a hand-held cell phone while driving anywhere in Hungary and seat belts are mandatory for everyone in the car.

The speed limit for cars and motorcycles on the motorway is 130 km per hour (approximately 80 mph); on highways the limit is 110 km per hour (approximately 65 mph); and in town and village areas the speed limit is 50 km per hour (approximately 30 mph).

Mobile Apps for Route Planning

BKK Futár (official public transport app within Budapest, available in English as well)
Play: https://play.google.com/store/apps/details?id=hu.webvalto.bkkfutar&hl=hu
Appstore: https://itunes.apple.com/fi/app/bkk-futar/id916193835?mt=8

Vonatinfo (train information, „MÁV")
Play: https://play.google.com/store/apps/details?id=hu.mavszk.vonatinfo&hl=hu
Appstore: https://itunes.apple.com/hu/app/vonatinfo/id969467518?mt=8

Menetrendek.hu (suburban bus information, „Volán")
Play: https://play.google.com/store/apps/details?id=app.mav.menetrend&hl=hu
Appstore: https://itunes.apple.com/hu/app/imenetrendek/id797449676?mt=8

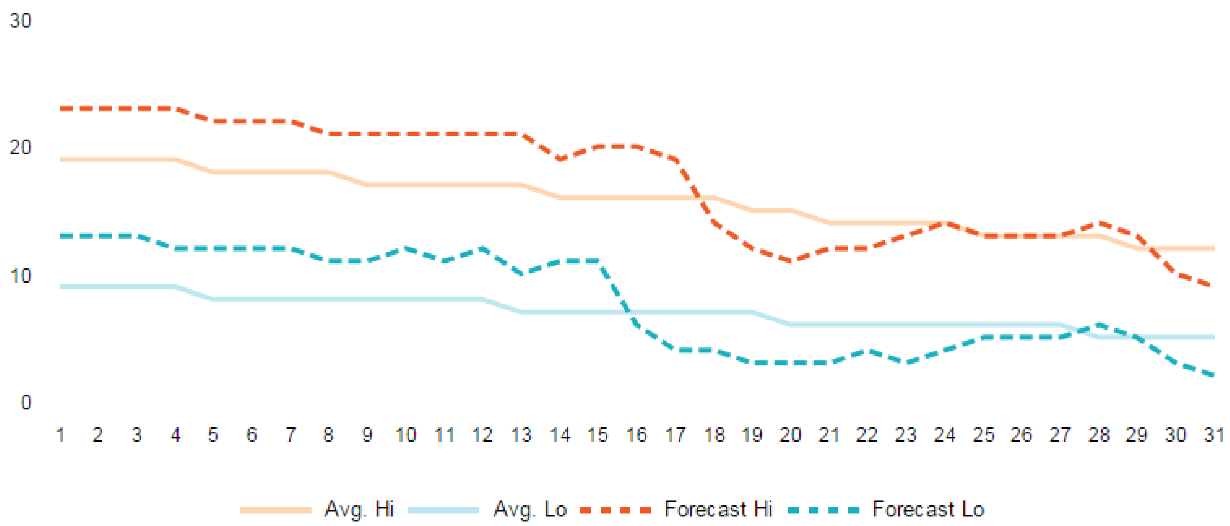
Weather in Budapest in October

The climate in october in Budapest is quite dry (with 56mm of rainfall over 8 days). The weather is worst than the previous month since in september there is an average of 52mm of rainfall over 7 days.

The climate is relatively fresh there this month, but it is endurable when dressing warm. The thermometer averaged maximum of 17°C. In the morning the temperature drops to 9°C. Thus, the mean temperature average on this month of october in Budapest is 13°C. Note that these seasonal averages are in contrast with those observed in Budapest in october with a maximum record of 27°C in 2009 and a minimum record of -1°C in 2012. You can expect to have about 35 days with temperatures up to 18°C, or 35% of time.

On this month of october, day length in Budapest is generally 10:54. Sunrise is at 6:02am and sets at 4:56pm.

Temperature forecast graph of Budapest, October 2016 (°C):



Technical Program

Program Schedule

Color legend of the program schedule:

	Panel
	Keynote Talks
	Tutorials
	Workshops
	BMI
	Sessions
	Breaks
	Social Events
	Best Paper Award Sessions

October 8 (Saturday)

InterContinental Budapest

	Pano-rama I	Pano-rama II	Pano-rama III	Pano-rama IV	Pano-rama V	Duna Salon II	Duna Salon III	Duna Salon IV	Ballroom I	Ballroom II	Ballroom III
09:00-18:00										Brain Hackathon	

October 9 (Sunday)

InterContinental Budapest

	Panorama I	Panorama II	Panorama III	Panorama IV	Panorama V	Duna Salon II	Duna Salon III	Duna Salon IV	Ballroom I	Ballroom II	Ballroom III
08:30-09:00									**BoG Meeting**		
9:00-10:30	**Tutorial I** Automatic Affective and Task Analysis for Wearable Computing			**Tutorial III** Cognitive Phase Transitions in the Cerebral Cortex: Brain Imaging Experiments, Graph Theory Models, and Engineering Applications	**Workshop on Women in Engineering (I)** **WiE session on Fractional Order Systems**		**Tutorial IV** Human-Machine Interaction	**Workshop on Big Data based Technological Innovations on Intelligent Health Service in the Clouds (I)**		**Brain Hackathon**	**IEEE Standards**
10:30-11:00	Coffee break*										
11:00-12:30	**Tutorial I** Automatic Affective and Task Analysis for Wearable Computing			**Tutorial III** Cognitive Phase Transitions in the Cerebral Cortex: Brain Imaging Experiments, Graph Theory Models, and Engineering Applications	**Workshop on Women in Engineering (II)** **WiE session on CyberMedical Systems**		**Tutorial IV** Human-Machine Interaction	**Workshop on Big Data based Technological Innovations on Intelligent Health Service in the Clouds (II)**			**IEEE Standards**
12:30-13:30	Lunch**										Lunch**
13:30-15:00	**IEEE Standards (breakout room)**					**BMI Tutorial I** Mobile BCI application: Neuroscience-based design and neuro-rehabilitation	**Tutorial V** Honest Evaluations of Shared Human-Machine Control Systems	**Tutorial II** New Ways to Look at Similarity and Association Measures and the Methods of their Construction			**IEEE Standards**
15:00-15:30	Coffee break*										
15:30-16:00	**IEEE Standards (breakout room)**					**BMI Tutorial II** Why bother with advanced modeling in BCI? Lessons from neuroimaging	**Tutorial V** Honest Evaluations of Shared Human-Machine Control Systems	**Tutorial II** New Ways to Look at Similarity and Association Measures and the Methods of their Construction			
16:00-17:00											
17:00-18:00											
18:30-21:00	Welcome reception										

* Closed coffee break for invited attendees
** Lunch is self-covered

October 10 (Monday)

InterContinental Budapest

	Panorama I	Panorama II	Panorama III	Panorama IV	Panorama V	Duna Salon II	Duna Salon III	Duna Salon IV	Ballroom I	Ballroom II	Ballroom III
08:00-08:30									**Opening Ceremony**		
08:30-10:30									Panel dedicated to John von Neumann “a Pioneer of Modern Computer Science” “A theory that transformed the world to a Cyberspace”		
10:30-11:00	**Coffee break**										
11:00-12:00									Keynote Talk I Jose Carmena: Advances in Brain-Machine Interface Systems		
12:00-13:30	**Lunch**										
13:30-14:15	Pattern Recognition and Image Processing (I)				Medical Mechatronics (I)	Modern Technology on Medicine, Health Care and Human Assist (I)	Intelligent Internet Systems (I)	Big Data Analytics	SMC Junior Keynote Talk I Tamás Haidegger: Robots, Men, and Cybernetics	IEEE President's talk: BMI Opening, Disruptive Innovations as a Vehicle to Develop Critical Thinking, Creativity and Innovation Skills , IEEE President Barry L. Shoop	
14:15-15:00									SMC Junior Keynote Talk II Clara Ionescu: Regulating Depth of Anesthesia: we are so different, yet so much alike	BMI Panel- Important Topics in Designing and Building Real World BMI Control Systems: What is New?	
15:00-15:30	**Coffee break**										
15:30-16:15	Pattern Recognition and Image Processing (II)				Medical Mechatronics (II)	Modern Technology on Medicine, Health Care and Human Assist (II)	Intelligent Internet Systems (II)	Human Centered Transportation Systems (I)	Interactive and Wearable Computing and Devices	BMI Invited Speaker - José del R. Millán Neuroprosthetics: The Role of the Brain's Error Monitoring System	
16:15-17:00										BMI Founders Keynote Session (I) From Research to Scientific Breakthroughs to Improving the Lives of People: Six Unique Paths	
17:00-18:30	Enterprise Information Systems				Intelligent Transportation Systems	Modern Technology on Medicine, Health Care and Human Assist (III)	Human-Machine Cooperation and Systems and Intelligent Internet Systems	Collaborative Wireless Sensor Networks and Internet of Things		BMI Founders Keynote Session (II) From Research to Scientific Breakthroughs to Improving the Lives of People: Six Unique Paths	
18:30-21:00									**BMI Reception**		

Sofitel Budapest Chain Bridge

	Bellevue 1	Bellevue 2	Bellevue 3	Academy 3	Academy 4
12:00-13:30	**Lunch**				
13:30-15:00	Knowledge-based and Intelligent Control Solutions for Medical Cyber-Physical Systems (I)	Granular Computing (I)	Cybermatics for Cyber-enabled Worlds (I)	Intelligent Vehicle Systems and Control (I)	Robotic Systems (I)
15:00-15:30	**Coffee break**				
15:30-17:00	Knowledge-based and Intelligent Control Solutions for Medical Cyber-Physical Systems (II)	Granular Computing (II)	System Modeling and Control (I)	Intelligent Vehicle Systems and Control (II)	Robotic Systems (II)
17:00-18:30	Computational Collective Intelligence	Model-Based Systems Engineering	System Modeling and Control (II)	Intelligent Vehicle Systems and Control (III)	Matrix Analysis and Feature Learning for Multimedia Understanding (I)

October 11 (Tuesday)

InterContinental Budapest

	Pano-rama I	Pano-rama II	Pano-rama III	Pano-rama IV	Pano-rama V	Duna Salon II	Duna Salon III	Duna Salon IV	Ballroom I	Ballroom II	Ballroom III
08:00-09:00										Keynote Talk II Nikola Kasabov: Spiking Neural Networks and Spatio-Temporal Data Machines: Methods, Systems, Applications	
09:00-09:30	Coffee break										
09:30-11:00	BMI Papers - Perfor-mance Metrics and Human Factors for BMI Training and Operation				BMI Papers - Adaptive and Self-Calibrating BMI Systems for Indepen-dent Use	Intelligent Learning in Control Systems (I)	IEEE SMC 2016 Best Paper Finalists	Proactive Healthcare Systems (I)	BMI Papers - Health and Non-Invasive Wearable BMI		
11:00-11:45	Pattern Recognition and Image Processing (III)				Intelligent Computing and Innovative Applications (I)	Intelligent Learning in Control Systems (II)	IEEE SMC 2016 Best Student Paper Finalists	Proactive Healthcare Systems (II)	BMI Invited speaker- Paul Sajda: Neural Correlates of the “Aha” Moment: Enabling Brain-Computer Interfaces for Labeling Our Environment	Intelligent Internet of Things	Junior Systems Science & Engineering (I)
11:45-12:30									BMI Panel- How Research and Metho-dologies in Systems, Human-Machine Systems, and Cybernetics can be Applied to BMI Systems		
12:30-14:00	Lunch										
14:00-15:30	Pattern Recognition and Image Processing (IV)				Intelligent Computing and Innovative Applications (II)	Junior Systems Science & Engineer-ing (II)	Deci-sion Support Sys-tems (I)	Colla-borative Techno-logies and Applications (III)	IEEE Brain Initiative Meeting	Innovative Compu-tational Intelli-gence, Learning Represen-tation of Data, and Industrial Applica-tions	Matrix Analysis and Feature Learning for Multimedia Under-standing (II)
17:00-18:00	Horse Show										
18:00-19:00	Award Ceremony										
19:00-21:00	Conference Dinner										

Sofitel Budapest Chain Bridge

	Bellevue 1	Bellevue 2	Bellevue 3	Academy 3	Academy 4
09:00-09:30	Coffee break				
09:30-11:00	Computational Awareness (I)	Discrete Event and Hybrid Systems	Intelligent Power and Energy Systems (I)	Shared Control (I)	Collaborative Technologies and Applications (I)
11:00-12:30	Computational Awareness (II)	Machine Vision and Evolutionary Computation	Intelligent Power and Energy Systems (II)	Shared Control (II)	Collaborative Technologies and Applications (II)
12:30-14:00	Lunch				
14:00-15:30	Computational Awareness (III)	Optimization	Cybermatics for Cyber-enabled Worlds (II)	Human Factors	Human-Machine Cooperation and Systems
17:00-18:00	Horse Show				
18:00-19:00	Award Ceremony				
19:00-21:00	Conference Dinner				

October 12 (Wednesday)

InterContinental Budapest

	Panorama I	Panorama II	Panorama III	Panorama IV	Panorama V	Duna Salon II	Duna Salon III	Duna Salon IV	Ballroom I	Ballroom II	Ballroom III
08:00-09:00										Keynote Talk III Huijun Gao: Networked Control Systems with Industrial Applications	
09:00-09:30	Coffee break										
09:30-11:00	BMI Papers - Real World Applications of Brain Computer Interface Systems (I)				BMI Papers - BMI for Motor/ Cognitive Rehabilitation and Assistance (I)	BMI papers – Neuroscience Based Design: Fundamentals and Applications	Robotics, Human Machine Interface, and Haptics (III)	Infrastructure Systems and Services	BMI Papers - BMI for Neurodriving		
11:00-12:30	BMI Papers - Real World Applications of Brain Computer Interface Systems (II)				BMI Papers - BMI for Motor/ Cognitive Rehabilitation and Assistance (II)	Tensor Product Applications	Robotics, Human Machine Interface, and Haptics (IV)	Junior Systems Science & Engineering (III)	BMI Papers - Multi-modal Brain Computer Interface and Physiological Computing	BMI Papers - Brain and Human-Machine Interaction Tribute to Walter J. Freeman	Junior-Cybernetics in Applied Sciences (I)
12:30-14:00	Lunch										
14:00-15:30	BMI Papers - Real World Applications of Brain Computer Interface Systems (III)				Grey System Theory and Application (I)	Model-based Healthcare (I)	Complexity and Complex Systems in Computational Cybernetics (I)	Junior Human-Machine Systems (I)	BMI Invited speakers (Sensors Council)- "Sensor Technologies for Multimodal Brain Interfacing"	BMI Papers - Recent Advances in BMI Speller	Machine Learning with Big Data
15:30-16:00	Coffee break										
16:00-16:45	Networked Systems and Networked Control (I)				Grey System Theory and Application (II)	Model-based Healthcare (II)	Complexity and Complex Systems in Computational Cybernetics (II)	Junior Human-Machine Systems (II)	BMI Invited speaker- Jose C. Principe: Toward cognitive integration of prosthetic devices	Junior Cybernetics	Conflict Resolution (I)
16:45-17:30									BMI Panel III (part a) - What Have We Learned, Where Do we Go from Here?		
17:30-18:15	Networked Systems and Networked Control (II)	Decision Support Systems (II)	Pattern Recognition and Image Processing (V)		Grey System Theory and Application (III)	Decision Support Systems based on Multi-criteria Methods	Recent Advances in Intelligent Image and Video Analysis	Advanced Methods and Applications for Increasing Control Systems Reliability, Safety and Security	BMI Panel III (part b) - What Have We Learned, Where Do we Go from Here?	Human Performance Modeling	Conflict Resolution (II)
18:15-19:00									Strategic Roadmap Discussion for BMI: Audience Participation		

Sofitel Budapest Chain Bridge

	Bellevue 1	Bellevue 2	Bellevue 3	Academy 3	Academy 4
09:00-09:30	Coffee break				
09:30-11:00	Human-Computer Interaction	BMI Papers - Machine Learning Methods for Brain-Computer Interfacing (I)	BMI Papers - Neurostimulation and BMI	Evolutionary Computation	In memory of William A. Gruver - Special Session on Distributed Adaptive Systems
11:00-12:30	Soft Computing (I)	BMI Papers - Machine Learning Methods for Brain-Computer Interfacing (II)	BMI Papers - Sensor Systems for BMI and Prosthetics	Medical Imaging Analytics and Systems Solutions (I)	Better Artificial Intelligence Methods for Bigger Data Mining (I)
12:30-14:00	Lunch				
14:00-15:30	Soft Computing (II)	Distributed Adaptive Systems and Biometric Systems	Better Artificial Intelligence Methods for Bigger Data Mining (II)	Junior-Cybernetics in Applied Sciences (II)	Behavior Modeling for Intelligent Human-Agent Interactions (I)
15:30-16:00	Coffee break				
16:00-17:30	Soft Computing (III)	Machine Learning	Robotics, Human Machine Interface, and Haptics (I)	Medical Imaging Analytics and Systems Solutions (II)	Behavior Modeling for Intelligent Human-Agent Interactions (II)
17:30-19:00	Logistics Informatics and Knowledge Acquisition in Intelligent Systems	Intelligent Media and New-Generation Software	Robotics, Human Machine Interface, and Haptics (II)	Human Centered Transportation Systems (II)	Neural Networks and Applications

Panel

Panel dedicated to John von Neumann "a Pioneer of Modern Computer Science" "A theory that transformed the world to a Cyberspace"

October 10 (Monday), 08:30-10:30, InterContinental Budapest, Ballroom I-III







Ferenc Friedler
Moderator
President of John von Neumann Society, Hungary

Bálint Dömölki
Computer Science
Honorary President of John von Neumann Society, Hungary

Domokos Szász
Mathematics
Vice-President of Hungarian Academy of Sciences

Jack Gallant
The Computer and the Brain
Professor, University of California, Berkeley

József Bokor
Quantum Mechanics, Quantum Control
Member of the Presidency of Hungarian Academy of Sciences

Katalin Hangos
Quantum Mechanics, Quantum Control
Professor, University of Pannonia, Hungary

László A. Kóczy
Game Theory
Hungarian Academy of Sciences, Centre for Economics and Regional Studies

Each speaker delivers his 15 minute presentation, summarizes the key contributions of von Neumann within a given topic and explains how it affects research today, including his own, within Cyberspace and Computer Science perspectives.

Professor **Ferenc Friedler** (1953) graduated in mathematics (1977), received CSc degree (1990) and DSc degree (1995) in chemical engineering. His research interests include process systems engineering focusing on mathematical modeling and optimization. Together with Professor L.T. Fan, he is a co-founder of the P-graph framework for process systems engineering including process network synthesis. He has published more than two hundred papers in international journals. He has been the founder, the chair and co-chair of several international scientific conferences. Dr. Friedler is the current president of the John von Neumann Computer Society in Hungary. He is a member in the Computer Aided Process Engineering Working Party of the European Federation of Chemical Engineers. He is the founder of academic organizations at University of Pannonia including department, faculty, and PhD program. He is now professor at the Pázmány Péter Catholic University in Budapest and vice-president of the National Research, Development and Innovation Office of Hungary. Dr. Friedler is honored with several awards including Knight's Cross Order of Merit of the Republic of Hungary, John von Neumann Prize, Egervary Prize, and Szechenyi Prize.

Bálint Dömölki. In 1957-59 participated in the building of the first electronic computer in Hungary, later held several leading positions in the Hungarian software industry. Managed an independent software house (IQSOFT Ltd.) in the 90s. After retirement, performs advisory activities in various national bodies and professional organizations, as well as in EU R&D programs. In 2005-10 leads a technology foresight project (Technology Perspectives of the Information Society - IT3) at the National Council of Communication and Information Technology (NHIT). Was president of the John von Neumann Computer Society (JvNCS) in 1985-90, since then its Honorary President. Founded the IT History Forum of JvNCS in 2009. Member of IFIP WG9.7 (History of Computing). Joined IEEE Computer Society in 1988, now Life Member.

Domokos Szász, a mathematician, earned his MSc at Eötvös University, Budapest in 1964 and his PhD at Lomonosov University, Moscow in 1971. His main interests are stochastics, statistical physics and dynamical systems. He founded world class schools in mathematical statistical physics and the theory of hyperbolic dynamical systems in Budapest. Several of his been students are professors at prestigious research centers at home and abroad. He is a member of the Hungarian Academy of Sciences (since 2011 he has been its Vice-President and between 2005 and 2011 he was the President of its Section of Mathematics). He served as the Director of the Mathematical Institute of the Hungarian Academy of Sciences (1993-1996) and as the Director of the Mathematical Institute of the Budapest University of Technology (1999-2005). Szász has also been a member of Academia Europaea since 2014. He was a visiting professor at Dartmouth College, Goethe-Universität (Frankfurt), Princeton University, University of Toronto and a visiting member of leading research centers like Institute for Advanced Study (Princeton), IHES (Bures-sur-Yvette), IMPA (Rio de Janeiro), Mittag Leffler Institute (Stockholm), ICERM (Providence, RI). He gave the 2014 Abel Science Lecture in Oslo.

Jack Gallant is Chancellor's Professor of Psychology at the University of California, Berkeley. He is affiliated with the Department of Electrical Engineering and Computer Science, and with the graduate programs in Bioengineering, Biophysics, Neuroscience and Vision Science. He is also a Senior Member of the IEEE. Gallant's research program focuses on functional mapping and computational modeling of the brain. These computational models of brain activity describe how information about the external and internal world are mapped systematically across the surface of the cerebral cortex during complex, naturalistic tasks. These models can also be used to decode information in the brain in order to reconstruct mental experiences. Further information about ongoing work in the Gallant laboratory, links to talks and papers, and links to an online interactive brain viewer can be found at the lab web page (http://gallantlab.org).

József Bokor received the Dr. Eng. and Pd.D. degrees from the EE Department of Budapest University of Technology and Economics. He is Professor and former Head of the Automation Department, Faculty of Transportation and Vehicle Engineering, Budapest University of Technology and Economics. He is also Research Director of the Computer and Automation Research Institute, Hungarian Academy of Sciences. He spent the year 1976/1977 at the Imperial College of Science and Technology, Computing and Control Department, London, England, the 1990/1991 year at MIT Laboratory for Information and Decision Systems as visiting Fulbright professor. His research included identification of space structures and design of multivariable robust control. He continued working with MIT under a Joint US-Hungarian Research Program in 1992-1995. He has a strong collaboration with the Laboratory for Measurement and Control, Technical University Delft, The Netherlands and with the Department of Aerospace and Mechanics, University of Minnesota, US, MN where he is an adjunct research faculty. His research includes the theory of LPV systems, fault detection, isolation and reconfiguration and applications to various modeling, identification and control problems related to spacecrafts and automotive control.

Katalin Maria Hangos received her MSc in chemistry (1976), BSc in computer science (1980), DSc (1993), and habilitations (chemical engineering, 1994, engineering informatics, 2000), respectively. She is a reseaerch professor at the Systems and Control Laboratory of the Research Institute for Computer Science and Control of the Hungarian Academy of Sciences and a full professor at the Department of Electrical Engineering and Information Systems of the University of Pannonia, both in Hungary. Her main field of interst is modelling, analysis and control of physics-inspired nonlinear systems, including process and quantum systems. She is a co-author of three books, and over 200 of research papers.

László Á. Kóczy graduated from the University of Cambridge reading mathematics and computer science, but turned to economics completing his M.Sc. and Ph.D. at the Catholic University Leuven under the supervision of Luc Lauwers. He has spent some years at Maastricht University before returning to Hungary, to Óbuda University. In 2010 he was the first social scientist to obtain the prestigious Momentum Grant of the Hungarian Academy of Sciences allowing him to set up his Game Theory Research Group at the Centre for Economics and Regional Studies. Kóczy has made contributions to scientometrics and social choice, but his main field of research is cooperative game theory: cooperative games with externalities and power indices. Cooperative game theory is one of the two fundamental branches of game theory introduced by von Neumann and Morgenstern, but the classical development ignored externalities: effects on third parties. Lucas's partition function form is rich enough to account for externalities, but in solving these games the first step was to get rid of externalities, despite the fact that in many applications the externalities are a very important element of the problem. Kóczy's recursive core for partition function form games is a novel approach to generalise one of the main solutions, the core to such games without such simplifications. It has since been widely applied to problems ranging from public good problems to communications networks. László Á. Kóczy is member of the Game Theory Society, the Society for Social Choice and Welfare and a founding member and former president of the Hungarian Society for Economists. He has published over thirty papers in journals including Games and Economic Behavior, European Journal of Operations Research and Journal of Mathematical Economics.

Keynote Talks

Keynote Talk I: Advances in Brain-Machine Interface Systems

October 10 (Monday), 11:00-12:00, InterContinental Budapest, Ballroom I-III

Jose M. Carmena
Helen Wills Neuroscience Institute
Department of Electrical Engineering and Computer Sciences
UC Berkeley, USA

Abstract

Brain-machine interfaces (BMIs) is a novel technology that holds great potential to aid large numbers of people with sensory, motor and cognitive disabilities. BMIs provide also a framework for examining basic neuroscience questions, especially those related to the understanding of how neural plasticity relates to the acquisition and consolidation of neuroprosthetic skills, i.e. accurate, readily-recalled control of disembodied actuators irrespective of natural physical movement. In this talk I will postulate that achieving skillful, natural control of a multi-degree-of-freedom prosthetic device will entail synergizing two different types of adaptation processes: natural (brain plasticity) and artificial (decoder adaptation), as well as providing realistic sensory feedback from the prosthetic device. I will present recent work from our laboratory showing that 1) neuroplasticity facilitates consolidation of neuroprosthetic motor skill in a way that resembles that of natural motor learning; 2) corticostriatal plasticity is necessary for neuroprosthetic skill learning, and 3) closed-loop decoder adaptation (CLDA) techniques can expedite the learning process by adapting the decoder parameters during closed-loop BMI operation (i.e., while the subject is using the BMI). We believe that BMI systems capable of exploiting both neuroplasticity and CLDA will be able to boost learning, generalize well to novel movements and environments, and ultimately achieve a level of control and dexterity comparable to that of natural arm movements.

Short Biography

Jose M. Carmena is Professor of Electrical Engineering and Neuroscience at the University of California-Berkeley, and Co-Director of the Center for Neural Engineering and Prostheses at UC Berkeley and UCSF. His research program in neural engineering and systems neuroscience is aimed at understanding the neural basis of sensorimotor learning and control, and at building the science and engineering base that will allow the creation of reliable neuroprosthetic systems for the severely disabled. Dr. Carmena received the B.S. and M.S. degrees in electrical engineering from the Polytechnic University of Valencia (Spain) in 1995 and the University of Valencia (Spain) in 1997. Following those he received the M.S. degree in artificial intelligence and the Ph.D. degree in robotics both from the University of Edinburgh (Scotland, UK) in 1998 and 2002 respectively. From 2002 to 2005 he was a Postdoctoral Fellow at the Department of Neurobiology and the Center for Neuroengineering at Duke University (Durham, NC). He is senior member of the IEEE (RA, SMC and EMB societies), Society for Neuroscience, and the Neural Control of Movement Society. Dr. Carmena has been the recipient of the Bakar Fellowship (2012), the IEEE Engineering in Medicine and Biology Society Early Career Achievement Award (2011), the Aspen Brain Forum Prize in Neurotechnology (2010), the National Science Foundation CAREER Award (2010), the Alfred P. Sloan Research Fellowship (2009), the Okawa Foundation Research Grant Award (2007), the UC Berkeley Hellman Faculty Award (2007), and the Christopher Reeve Paralysis Foundation Postdoctoral Fellowship (2003). More information of Prof. Carmena can be found: http://www.eecs.berkeley.edu/~carmena.

Keynote Talk II: Spiking Neural Networks and Spatio-Temporal Data Machines: Methods, Systems, Applications

October 11 (Tuesday), 08:00-09:00, InterContinental Budapest, Ballroom II-III

Nikola Kasabov
Knowledge Engineering and Discovery Research Institute
Auckland University of Technology, New Zealand

Abstract

All areas of science and human activities nowadays depend more and more on efficient and effective data analysis, modelling and event prediction. It has become obvious that the big data challenges, especially when we have to deal with massive temporal or spatio/spectro-temporal data (SSTD), could not be addressed properly with the use of traditional statistical and machine learning methods, nor with the use of traditional computational architectures. Spiking neural networks (SNN), combined with brain infortion principles for large scale information processing, offer hope to address this problem. The talk introduces a new computational architecture, called here spatio-temporal data machine (STDM), which uses brain information processing principles, such as: integrated and distributed memory and information processing among thousands an millions of spiking neurons and their connections; spatio-temporal learning rules; massive parallel computation; learning time and space interactions from multiple sources of data; predictive data processing; dynamic clustering and visualization; dynamic information exchange; model interpretation and knowledge extraction, and other, and doing all this in an energy economical way. The talk describes the details of the first implementation of a STDM, called NeuCube, developed in the author's lab KEDRI. NeuCube is also a STDM development system that makes it possible to develop applications across domain areas using various types of SSTD. It includes modules for data encoding, unsupervised learning, supervised classification and regression, visualization, pattern discovery, model optimization. It has been implemented on both von Neumann computers and on neuromorphic systems. Some examples and demonstrations of STDM developed in NeuCube are: brain data models (EEG, fMRI, DTI); Brain computer interfaces (BCI) for cognitive games and rehabilitation; multiple sensor on-line data modelling and event prediction; dynamic personalized models for stroke and CVD prediction; seismic data modelling system for earthquake prediction; financial stock prediction; radio-astronomy data modelling. A student version of NeuCube development system, along with several data sets and exemplar applications, can be downloaded from: http://www.kedri.aut.ac.nz/neucube/.

Short Biography

Professor Nikola Kasabov is Fellow of IEEE, Fellow of the Royal Society of New Zealand and Distinguished Visiting Fellow of the Royal Academy of Engineering, UK. He is the Director of the Knowledge Engineering and Discovery Research Institute (KEDRI) at Auckland University of Technology (AUT). He is Chair of Knowledge Engineering in the School of Engineering, Computing and Mathematical Sciences. Kasabov holds adjunct positions at several other universities, such as: Shanghai Jiao Tong University, ETH/University of Zurich, RGU Aberdeen. Kasabov is a Past President and Governor Board member of the International Neural Network Society (INNS) and also of the Asia Pacific Neural Network Society (APNNS). Kasabov holds MSc and PhD from the TU Sofia, Bulgaria. His main research interests are in the areas of information sciences, neural networks, intelligent information systems, soft computing, bioinformatics, neuroinformatics, data mining. He has published more than 600 publications that include 15 books, 180 journal papers, 28 patents and numerous conference papers. He has extensive academic experience at various academic and research organizations in Europe and Asia, including: TU Sofia, University of Essex, University of Otago, University of Trento, TU Kaiserslautern. Prof. Kasabov has received several awards, including: the AUT Medal for 2015; APNNA 'Outstanding Achievements Award'; INNS Gabor Award for 'Outstanding contributions to engineering applications of neural networks'; EU Marie Curie Fellowship; Bayer Science Innovation Award; RSNZ Science and Technology Medal. He has supervised to completion 38 PhD students. He has been involved in the establishment of several spin-off companies at the University of Otago and AUT. More information of Prof. Kasabov can be found on the KEDRI web site: http://www.kedri.aut.ac.nz.

Keynote Talk III: Networked Control Systems with Industrial Applications

October 12 (Wednesday), 08:00-09:00, InterContinental Budapest, Ballroom II-III

Huijun Gao
Research Institute of Intelligent Control and Systems
Harbin Institute of Technology, China

Abstract

In recent years, the analysis and synthesis of networked control systems (NCSs) have received increasing attention from both scientific and industrial communities. Compared with traditional point-to-point control systems, the main advantages of NCSs come from their low cost, their flexibility and easy re-configurability, their natural reliability and robustness to failure, and their adaptation capability. Consequently, NCSs have been finding applications in a broad range of areas such as power grids, water distribution networks, transportation networks, haptics collaboration over the Internet, mobile sensor networks, and so on. However, the introduction of communication channels in the control loop also brings some network-induced critical issues or constraints such as variable transmission delays, data packet dropouts, packet disorder, quantization errors, etc., which would significantly degrade the system performance or even destabilize the system in certain conditions. This talk will first introduce some elegant approaches to network-based control and estimation problems. Then, a novel two-layer network-based architecture for operational control of industrial processes will be discussed. It will be shown that under the proposed framework, the overall optimal operational control of networked industrial processes can be achieved.

Short Biography

Huijun Gao received his Ph.D. degree in control science and engineering from Harbin Institute of Technology, China, in 2005. He was a Research Associate with the Department of Mechanical Engineering, The University of Hong Kong, from November 2003 to August 2004. From October 2005 to October 2007, he carried out his postdoctoral research with the Department of Electrical and Computer Engineering, University of Alberta, Canada. Since November 2004, he has been with Harbin Institute of Technology, where he is currently a Professor and Director of the Research Institute of Intelligent Control and Systems. Prof. Gao's research interests include network-based control, robust/intelligent control, robotics and their engineering applications. He is an IEEE Fellow, an IEEE SMC Distinguished Lecturer and received the IEEE IES David Irwin Early Career Award. He is Co-Editor-in-Chief of IEEE Transactions on Industrial Electronics and Associate Editor of Automatica, IEEE Transactions on Cybernetics, IEEE Transactions on Control Systems Technology, IEEE/ASME Transactions on Mechatronics etc. Prof. Gao is an IEEE Industrial Electronics Society (IES) Administration Committee (AdCom) member. He is a Thomson Reuters Highly Cited Researcher and was listed among the top 17 scholars in "The World's Most Influential Scientific Minds" by Thomson Reuters, 2014. More information of Prof. Gao can be found: http://homepage.hit.edu.cn/pages/gaohuijun/2.

Tutorial I: Automatic Affective and Task Analysis for Wearable Computing

October 9 (Sunday), InterContinental Budapest, 9:00-12:30, Panorama I

Julien Epps
University of New-South Wales, Australia

Abstract

A day in anyone's life can be segmented into a series of broadly defined tasks: you begin a task, become loaded to some extent by the objects, movements, communication and/or mental challenges that comprise that task, then at some point you switch to or are distracted to a new task, and so on. A "task" is arguably the most fundamental unit of human activity from a machine perspective, and yet at present we have only extremely limited means by which to detect when a human has changed tasks and to estimate what level of emotion, physical load, mental load and other load types they experience during tasks. The growth in wearable computing presents both an opportunity and an imperative for computers to significantly better understand the user's primary task and its demands on the user in real time. Recent wearables like Google Glass and EyeSpeak show the future: content, functionality and interruptions persistently in the user's field of view, but also the opportunity to position near-field sensors directly where they are most useful for task analysis – in front of the eye, near the mouth and fixed to the head. Task analysis at present offers virtually no automatic means to detect the points at which a user transitions from one task to the next (or one emotional or mental state to the next) except when all of the user's primary tasks can be predefined and are contained within a desktop PC being monitored – this is an increasingly unrealistic view of computer use. An automatic alternative to the very dated manual analysis methods for task transition detection and task load level estimation is needed, and behavioural signals are preferable because they are noninvasive. Head-mounted wearable sensors bring within grasp the prospect of 'always-on' automatic analysis of emotion and of physical and mental tasks based on signals such as speech, eye activity and body movement. Human task analytics of this kind represent a huge opportunity for individual users to empower themselves and interact more seamlessly with machines in the age of big data.

This tutorial introduces and examines some of the key research problems in using behavioural signals in particular to automatically analyse tasks and emotions: understanding the psychophysiological basis of signals during speech production, eye activity and body movement; pre-processing and calibrating signals like eye video and accelerometry data; extracting suitable features; reducing feature variability due to illumination, movement, speaker and linguistic content; developing machine learning methods for detecting task transition and for estimating the level of affective intensity and of particular types of task load; comparing and evaluating diverse methods; constructing databases for developing and evaluating systems of this kind; and system design for continuous and robust automatic task analysis. The discussion of task analysis and task load estimation is framed within a recognition that there is a need to move beyond classifying a limited set of pre-defined, application-specific task, emotion or mental state categories, to a more general dimensional framework of assessing the levels of various types of affect and task load. The discussion includes perspectives from the wider context of affective computing and human-computer interaction, and some key insights from the signal processing domain will be covered, particularly in the areas of feature extraction, modelling, and variability compensation. The tutorial will also discuss system design, engineering applications and the use of other biomedical signals for load measurement. Participants will be exposed to likely future challenges, both during the tutorial presentation and during the ensuing discussion.

Short Biography

Julien Epps received the BE and PhD degrees in Electrical Engineering from UNSW Australia, in 1997 and 2001 respectively. After working as a Senior Research Engineer at Motorola Labs and then as a Senior Researcher at National ICT Australia, he was appointed as a Senior Lecturer at UNSW Electrical Engineering and Telecommunications in 2007 and then as an Associate Professor in 2013. A/Prof Epps is also a Contributed Principal Researcher at Data61, CSIRO, and been a Visiting Scientist at the A*STAR Institute for Infocomm Research (Singapore). He has authored or co-authored around 180 publications and three patents, which have been collectively cited nearly 3000 times. He has delivered invited tutorials to INTERSPEECH 2014 and 2015, and invited keynotes to the 4th Int. Workshop on Audio-Visual Emotion Challenge (part of ACM Multimedia 2014) and the 6th Workshop on Eye Gaze in Intelligent Human Machine Interaction (part of ACM ICMI 2013).

A/Prof Epps is serving as an Associate Editor for IEEE Transactions on Affective Computing and for Frontiers in ICT (Human-Media Interaction section), and has served as a Guest Editor for the EURASIP Journal on Advances in Signal Processing Special Issue on Emotion and Mental State Recognition from Speech. He is currently a member of the Advisory Board of the ACM Int. Conf. on Multimodal Interaction. In 2016 he is an Area Chair for the ACM Multimedia (Emotional and Social Signals in Multimedia), INTERSPEECH (Paralinguistics), ACM ETRA and ACM UMAP (Adaptive, Intelligent, & Multimodal User Interfaces) conferences. He is currently authoring an invited chapter on "Task Load and Stress" in the Wiley Handbook of Human-Computer Interaction 2016, and coordinating an invited chapter on "Multimodal assessment of depression and related disorders based on behavioural signals" in the ACM Handbook of Multimodal Multisensor Interfaces, 2017.

Tutorial II: New Ways to Look at Similarity and Association Measures and the Methods of their Construction

October 9 (Sunday), InterContinental Budapest, 13:30-17:30, Duna Salon IV

Ildar Batyrshin
National Polytechnic Institute, Mexico

Abstract

Similarity and association measures (SAMs) are used in different areas like Pattern Recognition, Knowledge Acquisition, Machine Learning, Medical Informatics, Information Systems, Computational Intelligence etc. The selection and usage of SAM that is adequate to the type of the analyzed data and to the specific data analysis problem is the crucial point of any research based on the analysis of the possible relationships between data.

The tutorial discusses the new ways to look at similarity and association measures and considers the methods of their construction recently developed by the author. The tutorial uses non-statistical approach to analysis of SAMs considered as functions satisfying some reasonable properties. The general methods of construction of association measures on sets with involution operation using similarity measures and pseudo-difference operations associated with t-conorms are discussed.

The survey of SAMs and their construction on different domains is considered. The new methods of comparative analysis of SAMs for binary variables and 2x2 tables such as Jaccard & Tanimoto, Sokal & Sneath, Ochiai, Yule, Hamann, Baroni-Urbani etc. are considered and new SAMs are proposed. The measures of association on [0,1], on bipolar scales, on the sets of fuzzy sets, time series, n-tuples etc are considered.

Short Biography

Ildar Batyrshin graduated from the Moscow Physical-Technical Institute in 1975. He received PhD and Dr. Sci. (habilitation) degrees in 1983 and 1996, respectively. During 1975-2003, he served as professor and Head of Department of Informatics and Applied Mathematics of Kazan State Technological University, Russia, and as a Leading Researcher of the Institute of Problems of Informatics of Academy of Sciences of the Republic of Tatarstan, Russia. Since 2003 he was with Research Program of Applied Mathematics and Computations of Mexican Petroleum Institute as Invited Distinguished Researcher, Leading Researcher and Project Head. Currently he is a Titular Professor "C" of the Center for Computing Research of Mexican National Polytechnic Institute. He is the Past President of the Russian Association for Fuzzy Systems and Soft Computing, member of the Councils of the International Fuzzy Systems Association (IFSA), Mexican Society for Artificial Intelligence (SMIA) and Russian Association for Artificial Intelligence, Senior Member of IEEE (CI and SMC Societies) and the member of the Board of Directors of NAFIPS. He is a member of editorial boards of several scientific journals. He served as a Co-Chair of 10 International Conferences on Soft Computing, Artificial Intelligence and Computational Intelligence. He is an author and editor of 20 books and special volumes of journals. He was awarded by the State Research Fellowship of the Presidium of Russian Academy of Sciences for Distinguished Researchers; he is an Honorary Researcher of the Republic of Tatarstan, Russia, an Honorary Professor of Óbuda University, Budapest, Hungary, the Fellow of SMIA and the member of the National System of Researchers of Mexico. He presented Plenary, Invited Talks and Tutorials on several international conferences: FSSCEF 2004, MICAI 2013, CINTI 2015, FCDM 2015, WCSC 2016 etc.

Tutorial III: Cognitive Phase Transitions in the Cerebral Cortex: Brain Imaging Experiments, Graph Theory Models, and Engineering Applications

October 9 (Sunday), InterContinental Budapest, 09:00-12:30, Panorama IV

Robert Kozma
University of Memphis, USA

Abstract

This tutorial provides a comprehensive overview of novel brain imaging results for cognitive monitoring. It introduces mathematical and computational models to interpret the experimental results, and describes several engineering applications of the findings, with special focus on bran-computer interfaces. The following main areas will be covered:

1. Overview of new experimental developments in brain imaging, including EEG, ECoG, fMRI, and MEG, which indicate discontinuities in brain dynamics at theta rates (4-8 Hz). The observed neural processes are interpreted as neural correlates of cognition.
2. Mathematical theories of brain dynamics, in which brains are viewed as open thermodynamic systems converting fluctuating sensory data into meaningful knowledge. Random graphs have unique advantages by characterizing cortical processes as phase transitions and transient percolation processes in probabilistic cellular automata. Criticality and self-organization are key components of the model of cortical phase transitions.
3. Engineering applications include novel principles of building autonomous, intelligent robotic systems. Of special interest are non-invasive Brain Computer Interface (BCI) techniques to monitor cognitive activity of the user and to support healthy brain operation.

The presented material is self-contained and it will be accessible to an audience with basic knowledge of signal processing and neural modeling. The tutorial aims at scientists interested in the newest developments of brain monitoring and it is supporting the conference focus area on BCI.

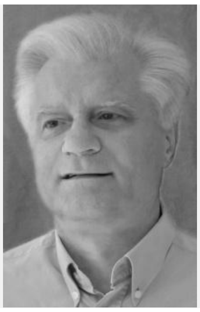
This presentation is dedicated to the memory of Walter Freeman, a pioneer of brain network dynamics, coauthor of the following reference material: "Cognitive Phase Transitions in the Cerebral Cortex - Enhancing the Neuron Doctrine by Modeling Neural Fields, " R. Kozma & W.J. Freeman, Springer (2016).

Short Biography

Robert Kozma (Fellow IEEE, Fellow INNS) is Professor of Mathematics, Director of the Center of Large-Scale Integration and Optimization Networks (CLION), at the University of Memphis, TN, USA. Dr. Kozma holds a Ph.D. in Physics (Delft, The Netherlands, 1992), two M.Sc. degrees (Mathematics, Budapest, Hungary, 1988; Power Engineering, Moscow, Russia, 1982). He serves on the Board of SMC (2016-18), and is President-Elect of INNS (2016). He conducts research on spatio-temporal brain dynamics and advanced optimization techniques inspired by brains. His main focus is neuropercolation approach to brain networks, based on random graph theory and percolation processes to describe brains as non-equilibrium systems at the edge of criticality. He has published 6 books, and over 250 research papers.

Tutorial IV: Human-Machine Interaction

October 9 (Sunday), InterContinental Budapest, 09:00-12:30, Duna Salon III



Hermann Kaindl

TU Wien, Austria

Tutorials

Abstract

Usually, courses are given on human-computer interaction these days, while in recent years there was a major shift towards (mobile) devices and machines, with new human interfaces. Of course, they include embedded computers and software, but their interaction with users poses many new challenges and offers new solutions. Unfortunately, previously educated embedded engineers are often unaware of them and only focus on the functionality and other technical properties of devices and machines.

This tutorial shows manifold usability problems as observed by the proposer in daily life, beyond those usually known from graphical user interfaces (GUIs) of traditional PCs (including laptop computers). It explains them by human factors usually unknown to embedded engineers and motivates user experience. User-centered and Usage-centered Design are compared with the result that they typically overlap but have a different focus each on Interaction Design. Usability Test and Usability Study are explained and contrasted as well. In addition, this tutorial explains key properties of Multimodal Interfaces and UIs of Mobile Devices. Finally, it culminates in a sketch of specific challenges of Human-Robot Interaction.

Short Biography

Hermann Kaindl is a full professor, the director of the Institute of Computer Technology and a member of the senate at TU Wien. Prior to moving to academia in early 2003, he has gained nearly 25 years of industrial experience at Siemens Austria. Kaindl is a Senior Member of the IEEE and a Distinguished Scientist Member of the ACM.

Tutorial V: Honest Evaluations of Shared Human-Machine Control Systems

October 9 (Sunday), InterContinental Budapest, 13:30-17:30, Duna Salon III






Tricia Gibo
Delft University of Technology, The Netherlands

Erwin Boer
Delft University of Technology, The Netherlands; University of California in San Diego

David Abbink
Delft University of Technology, The Netherlands

Makoto Itoh
University of Tsukuba, Japan

Tom Carlson
University College London, UK

René van Paassen
Delft University of Technology, The Netherlands

Abstract

As designers of support systems, we often evaluate our systems in controlled environments, showing favorable performance under conditions for which they were specifically developed. However, there is little agreement on how to honestly evaluate such a system and especially how to compare what appear to be very different types of support systems. The focus of this tutorial will be on how to evaluate and compare different human support systems (shared control systems) in a realistic manner, thereby honestly exposing the limitations of the proposed support system. This approach towards evaluation addresses the fact that people will push usage/application of support systems beyond their intended boundaries and that support system functioning is based on a large number of assumptions, all of which will not always be true in reality. The goal is to develop a framework/ontology that will give attendants: i) a way to place their type of support system in a broader context of other support systems (focus on types/levels of human-machine interaction), ii) a means to characterize how a support system alters the task structure (focus on the hierarchical decomposition of tasks), and iii) a set of methodologies to evaluate their system honestly by exploring its limitations. This framework facilitates comparison between apparently different systems, such as manual versus autonomous control or manual control versus shared control. We demonstrate the need and utility of the evaluation taxonomy in the context of driving and then apply it to the shared control application most prevalent within the audience (e.g. teleoperation, brain machine interaction, medical).

Short Biographies

David A. Abbink, PhD (1977) received his M.Sc. degree (2002) and Ph.D degree (2006) in Mechanical Engineering from Delft University of Technology. He is currently an Associate Professor at Delft University of Technology in 2009, heading the Delft Haptics Laboratory (www.delfthapticslab.nl). David was awarded the best Ph.D. dissertation in the area of movement sciences in the Netherlands (2006), and two prestigious personal grants - VENI (2010) and VIDI (2015). His research has received continuous funding by industry (Nissan, Boeing). Currently he is a co-PI on the H-Haptics project (www.h-haptics.nl), where 16 PhD students and 3 postdocs collaborate on designing human-centered haptic shared control for a wide variety of applications. David is an IEEE senior member, an associate editor for IEEE Transaction on Human-Machine Systems, and co-founder of the IEEE SMC Technical Committee on Shared Control.

Erwin R. Boer received his MSc in electrical engineering from Twente University of Technology in The Netherlands in 1990 and his PhD also in electrical engineering from the University of Illinois in Chicago in 1995. In 2000, Dr. Boer founded his own automotive human machine interaction consulting company Entropy Control, Inc. in La Jolla, CA. Currently he holds a part time associate professor of mechanical engineering position at Delft University of Technology, is Visiting Professor at the Institute for Transport Studies at the University of Leeds in the UK as well as part time associate professor of Ophthalmology in the medical school at the University of California in San Diego. His research interests include computational driver modeling, shared control, performance assessment, virtual prototyping in driving simulators, and employment of virtual reality for medical diagnostics and rehabilitation. IHe is now serving as a co-chair of IEEE SMC Technical Committee on Shared Control.

Tom Carlson (1984) received his PhD in Intelligent Robotics (2010) and his MEng in Electrical and Electronic Engineering (2006), both from Imperial College London, UK. Tom is currently a Lecturer (assistant prof.) at the ASPIRE Centre for Rehabilitation Engineering and Assistive Technology, University College London. He is also a Visiting Professor at the University of Valenciennes, France and co-directs the INRIA associated team ISI4NAVE. His research focus is on developing assistive robotic technology for people with spinal cord injuries. In addition to his academic partners, he collaborates with Invacare Europe, Dynamic Controls and Rex Bionics. Previously, he spent 3.5 years as a research scientist at the École Polytechnique Fédérale de Lausanne (EPFL), Switzerland, where he worked extensively to combine brain computer interfaces (BCI) with robotic wheelchairs and other assistive technologies. His Ph.D. thesis dealt extensively with both the design and user evaluation of shared control systems and he was subsequently invited to present his research to members of the UK Houses of Parliament at SET for Britain 2009. Tom has been an IEEE Member since 2007 and an IEEE-SMC society member since 2010. He co-founded the IEEE SMC Technical Committee on Shared Control in 2012, with which he co-edited a Special Issue of JHRI in 2015. He has published in the IEEE Transactions on Systems, Man, and Cybernetics: Part B and acted as a reviewer for all parts and their successors. Furthermore, he is on the program committee for the annual IEEE SMC Conference and co-organised special sessions at IEEE-SMC 2012-2015 as well as accompanying workshops/tutorials each year.

M.M. (René) van Paassen received the M.Sc. degree (cum laude) from the Delft University of Technology, Delft, The Netherlands, in 1988, and a Ph.D. in 1994, both on studies into the neuromuscular system of the pilot's arm. He thereafter was a Brite/EuRam Research Fellow with the University of Kassel, Germany, where he worked on means-ends visualization of process control dynamics, and a post-doc at the Technical University of Denmark. René van Paassen is an associate professor in Aerospace Engineering at the Delft University of Technology, working on human machine interaction and aircraft simulation. His work on human-machine interaction ranges from studies of perceptual processes, haptics and haptic interfaces and human manual control to design of and interaction with complex cognitive systems. René is a senior member of IEEE and of AIAA, and an associate editor for IEEE Transactions on Human-Machine System.

Tricia L. Gibo received the BS degree from the University of Southern California (California, USA) in 2007, and the MS and PhD degrees from The Johns Hopkins University (Maryland, USA) in 2009 and 2013, respectively, in mechanical engineering. She is currently a postdoctoral research fellow at Delft University of Technology (Netherlands). Her research interests include human motor control and learning, human-robot interaction, and haptics. She received the Graduate Research Fellowship from the US National Science Foundation in 2007 and the Link Foundation Fellowship in Advanced Simulation and Training in 2011.

Makoto Itoh received his B.S., M.S., and Doctor's degrees in engineering from University of Tsukuba in 1993, 1995, and 1999, respectively. From 1998 to 2002 he was a Research Associate at the University of Electro-Communications, Japan. After coming back to University of Tsukuba in 2002, he became a Professor with the Faculty of Engineering, Information and Systems in 2013. His research interests include shared control, adaptive automation, and building of appropriate trust as well as prevention of over-trust and distrust. He is now serving as a co-chair of IEEE SMC Technical Committee on Shared Control. He is also a member of IFAC TC 9.2 "Social Impact of Automation."

BMI Tutorial I: Mobile BCI application: Neuroscience-based design and neurorehabilitation

October 9 (Sunday), InterContinental Budapest, 13:30-16:00, Duna Salon II


Reinhold Scherer
Graz University of Technology, Austria

Olga Sourina
Nanyang Technological University, Singapore

Abstract

Mobile BCI application has attracted recently more attention from the research community and industry as wireless portable EEG devices became easily available on the market. Now, EEG-based technology has been applied in anesthesiology, psychology, rehabilitation, serious games, design, or even in marketing. This tutorial will provide an overview of mobile BCI applications with emphases on neurorehabilitation and neuroscience-based design. State-of the art Electroencephalogram (EEG) signal features & machine learning tools for BMI will be discussed. BMI technology has been increasingly studied in recent years with the aim to help individuals affected by neurological injuries and disorders (e.g. stroke, spinal cord injury, cerebral palsy) to improve their functional outcome. First results of this very experimental approach suggest that the combined use of BMIs that detect imagined or attempted movement, robotized rehabilitation devices and virtual reality positively impact on functional outcome. Another approach is to use BMI technology to study and model neuroplasticity with the aim to characterize mechanisms of motor learning and motor control. This second approach requires recording of behavioral and neural data from people while they are engaged in motor (rehabilitation) tasks. This allows for brain and body imaging. With the rising interest in neurorehabilitation and real-world BMI applications, obtaining high quality data during ambulatory/mobile use is crucial. Recording clean brain signals, however, is very challenging. Movement artifacts as well as interferences from dynamic environments can make an analysis difficult. We will discuss current noninvasive electroencephalogram-based (EEG) BMI-based neurorehabilitation protocols, provide insight into methods and technology, and address current open issues. Neuroscience-based or neuroscience-informed design is a new area of mobile BCI application. It takes its roots in study of human well-being in architecture and human factors study in engineering and manufacturing. We will share our research and development of an EEG-based system to monitor and analyse human factors measurements of newly designed systems, hardware and/or working places. The EEG is used as a tool to monitor and record the brain states of subjects during human factors study experiments. In traditional human factors studies, the data of mental workload, stress, and emotion are obtained through questionnaires that are administered upon completion of some task or the whole experiment. However, this method only offers the evaluation of overall feelings of subjects during the task performance and/or after the experiment. Real-time EEG-based human factors evaluation of designed systems allows researchers to analyse the changes of subjects' brain states during the performance of various tasks. We discuss real-time algorithms of emotion recognition, mental workload, stress recognition from EEG and its integration in human-machine interfaces including car driving assistant systems, air-traffic controller stress assessment and cadets/captains stress assessment systems. The tutorial includes demos of algorithms integrated in CogniMeter system, serious games demos, etc using Emotiv Epoc device.

Short Biographies

Reinhold Scherer received his M.Sc. and Ph.D. degree in Computer Science from Graz University of Technology, Graz Austria in 2001 and 2008, respectively. From 2008 to 2010 he was postdoctoral researcher and member of the Neural Systems and the Neurobotics Laboratories at the University of Washington, Seattle, USA. Since 2011, he is Assistant Professor and Deputy Head of the Institute of Neural Engineering, Laboratory for Brain-Computer Interfaces (BCI-Lab) at the Graz University of Technology, Graz, Austria and member of the Institute for Neurological Rehabilitation and Research at the clinic Judendorf-Strassengel, Austria. His research interests include BCIs based on EEG and ECoG signals, statistical and adaptive signal processing, mobile brain and body imaging and robotics-mediated rehabilitation.

Olga Sourina received her MSc in Computer Engineering from Moscow Engineering Physics Institute (MEPhI) in 1983, and her PhD in Computer Science from NTU in 1998. Dr Sourina worked as a software engineer, then as a Research Scientist in MEPhI. For her scientific achievements Dr. Sourina was awarded the honorary diploma of the Academy of Sciences of USSR, the Silver Medal of the National Exhibition Centre of USSR, and the Medal of the Ministry of Education of USSR. After receiving her PhD from NTU she worked as a Research Fellow in the Centre for Graphics and Imaging Technology (CGIT), NTU. Then, she worked as a Senior Scientist in Institute of Computing for Physics and Technology in Russia. Since 2001 Dr Sourina she worked as an Assistant Professor in NTU. In 2013, she created a Cognitive Human Computer Interaction research lab in FraunhoferIDM@NTU Center, and currently, she is Principal Research Scientist of NTU and is leading research and industrial projects in Interactive Digital Media (IDM) and Biomedical Engineering in FraunhoferIDM@NTU Center. Her research interests are in brain-computer interfaces including real-time emotion, stress, vigilance and mental workload recognition, neuroscience-based design, visual and haptic interfaces, serious games, visual data mining and virtual reality. Dr Sourina has more than 150 publications including more than 40 research papers in international refereed journals and 3 books. She gave 15 invited and keynote talks at International conferences. She is a member of program committee of international conferences, a senior member of IEEE, a member of Biomedical Engineering Society and a member of International Organization of Psychology.

BMI Tutorial II: Why bother with advanced modeling in BCI? Lessons from neuroimaging

October 9 (Sunday), InterContinental Budapest, 16:00-17:30, Duna Salon II

Maureen Clerc
Inria Sophia Antipolis Mediterranean, France

Jérémie Mattout
Lyon Neuroscience Research Center, France

Abstract

The objective of this tutorial is to describe the benefits which neuroimaging models can bring to BCI. Computational and neurophysiological models as developed in neuroimaging provide features that are closer to the neural activity and the mental processes of interests than features directly observable at sensor-level. Priors can then be incorporated (e.g. as to the location or polarity of a neural activity of interest), which may yield more relevant and more robust features.

In the first part of this tutorial session, Maureen Clerc will present the process of estimating brain activity from EEG or MEG data. For this purpose, the relationship between sensor measurements and source activity will be presented. Methods for source reconstruction will focus on those that are applicable in real-time for BCI applications. Guidelines will also be provided on when it may be wise to use neuroimaging in BCI.

In the second part of this tutorial session, Jérémie Mattout will illustrate the usefulness of generative models in human electrophysiology. Bayesian inference as a powerful and generic framework for model selection and model fitting will be highlighted. It will be shown how source reconstruction models, as introduced in Part 1, can be extended to explain electrophysiological activities in terms of modulations of effective connectivity in a cortical network. As an example often encountered in BCI, auditory oddball paradigms will be used to illustrate concrete applications of advanced computational and neurophysiological models. In particular, it will be shown how such models can address questions pertaining to mental processes such as attention or learning. Finally, the usefulness of this general framework for online use, in BCI, will be advocated through concrete examples.

Short Biographies

Maureen Clerc, research director at Inria, Sophia Antipolis, where she develops new methods for extracting dynamic information from the living human brain, and in particular, Brain Computer Interfaces. In 2014 she was awarded the Pierre Faurre prize from the French Academy of Sciences, recognizing her work in the application of mathematics and computer science to the life sciences. She had recently co-edited a 2-volume reference book on Brain-Computer Interfaces."

Jérémie Mattout is an INSERM researcher at the Lyon Neuroscience Research Center in France. He is working on methods in human electrophysiology and computational neuroscience applied to cognition and brain-computer interfaces for basic research and clinical applications. He developed advanced modelling and inference approaches for EEG and MEG data analysis that have been implemented in the SPM (Statistical Parametric Mapping) software.

Workshop on Women in Engineering

October 9 (Sunday), InterContinental Budapest, 09:00-12:30,
Duna Salon II

Levente Kovács
Óbuda University, Hungary

Clara M. Ionescu
Ghent University, Belgium

Abstract

Inspired by the liaison of IEEE Women in Engineering (WiE) and IEEE SMC Society, and following its mission to inspire, engage and advance women in SMC's technical disciplines, the idea of the proposed workshop Women in Engineering for the SMC 2016 conference is to promote WiE. As such, it represents a first initiative within the SMC conferences.

The core of the workshop will focus on Cyber-Medical Systems topic, and will cover topics in physiological control systems (tumor control, diabetes control), model-based healthcare applications (anesthesia), knowledge-based systems (cyber-medical systems), but will also embrace a broader view on SMC's control engineering applications (adaptive control, robust control, model predictive control, fractional order control).

Invited Speakers

- Pasik-Duncan Bozenna (University of Kansas, USA)
- Maria Pia Fanti (Polytechnic of Bari, Bari, Italy)
- Clara M. Ionescu (Ghent University, Belgium)
- Ioana Nascu (Imperial College London, United Kingdom)
- Johanna Sápi (Óbuda University, Hungary)
- Rita Dominika Fleiner (Óbuda University, Hungary)
- Carla M Pinto (Polytechnic of Porto, Portugal)
- Cristina I. Muresan (Technical University of Cluj Napoca, Romania)
- Eva-Henrietta Dulf (Technical University of Cluj-Napoca, Romania)

Short Biographies of the Workshop Organizers

Dr. habil. Levente Kovács got his MSc degree in electrical engineering at "Politehnica" University of Timisoara, Romania in 2000. He received his PhD from Budapest University of Technology and Economics (BME) in 2008. From 2005 he was a full-time instructor at BME, Department of Control Engineering and Information Technology; from 2010 he was an associate professor. He defended his habilitation with excellent mark at the Óbuda University in 2013, currently he is a professor. He was János Bolyai Research Fellow of the Hungarian Academy of Sciences between 2012 and 2015. From 2012 he was an associate professor in Óbuda University. He established the Physiological Controls Group in 2013. He is vice dean for education of the Óbuda University's John von Neumann Faculty of Informatics. He is an IEEE member from 2009, IFAC TC 8.2 "Biological and Medical Systems" member form 2010 and IEEE CSS TC on Medical and Healthcare Systems from 2016. From 2010 he is Membership Development officer of the IEEE Hungary Section and elected vice-chair of the IEEE Hungary Section from 2013. From 2015 he has been elected as new chair of the IEEE SMC Hungary Chapter as well. He is IEEE SMC member from 2012 recruiting several young women researchers. His fields of interest are modern control theory and physiological controls; he has published more than 250 articles having an h-index of 11 and supervised 6 PhD students. In 2015 he is winner of the highly prestigious ERC StG grant of the European Union.

Dr. Clara M. Ionescu got her PhD degree in 2009 from Ghent University and subsequently the prestigious post-doctoral award for excellence from Flanders Research Foundation (FWO) in Belgium. She has coined the term 'fractional order impedance' within the topic of respiratory system analysis and as such, her publications are leading in this domain reported in Web of Science. She is member of the IEEE Engineering and Biology Society and IEEE Control Systems Society since 2007. She became an IEEE SMC member from 2014, IEEE CSS TC on Medical and Healthcare Systems member from 2008 and IFAC TC 8.2 "Biological and Medical Systems" member. She is also IEEE member in the CSS TC on Standards since 2016. Her research aims to bridge the gap between mathematical modeling concepts and clinical practice, therefore bringing an added value to the state of art in emerging disciplines in engineering. The topics of research cover modeling respiratory system, classification of respiratory diseases, modeling drug diffusion in anesthetized patients and depth of anesthesia control. Her papers cover application areas in both biomedical engineering as well as process control and mechatronics. She has 90 publications in Web of Science, a citation index of 11 and she is co-editor of several special issues in various fields of research.

She is senior researcher and holder of the prestigious Flanders Research Foundation FWO post-doctoral fellow at Ghent University. She is author of more than 150 scientific papers, of which 90 cited in Web of Science with a citation index of 11. She is PhD supervisor since 2009 and she is currently guiding 8 PhD students. Currently she is involved in 5 international projects with both industrial and biomedical applications, for identification and control. Her main research interests include biomedical applications, with identification and advanced control objectives with special focus on anesthesia control.

Workshop on Women in Engineering (I) – WiE session on Fractional Order Systems

Organizers: Levente Kovács, Clara M. Ionescu
October 9 (Sunday), 09:00-10:30, InterContinental Budapest, Panorama V
Session Chairs: Clara Ionescu, Cristina Muresan

#1718 From viscoelastic models to lung function devices

Clara M. Ionescu (BE)

This paper presents a systematic overview of models describing viscoelastic properties in respiratory tissue during tidal breathing and afferent lung function testing devices. A technological development timeline is given and current state of art is evaluated with clinical data in healthy subjects and chronic obstructive pulmonary disease diagnosed patients. Further technological and methodological improvements are suggested.

Why I care - Personal Story about Balancing Career, Family Life, and Giving Back

Pasik-Duncan Bozenna (US)

The talk focuses on the challenges and opportunities faced by a woman scientist moving from Poland to America. It shows how she balanced career and family life in two different cultures. The excitement and passion for integrating research and teaching in stochastic adaptive control, a field that spans science, technology, engineering and mathematics (STEM) is shared. The lecture addresses how all women in science and engineering can make an important change in the modern world. It describes why she cares about giving back to different communities in different settings, and how the students in America have made her happy.

#1128 Coupled fractional spiking neurons

Carla M Pinto (PT)

We propose a fractional-order model of two symmetrically coupled Hodgkin-Huxley equations and study the patterns of the neurons' firing rates. We find that, for positive values of the coupling constant, the neurons exhibit in-phase solutions (neurons show the same behaviour at the same time). Also, the spike amplitude decreases with the order of the fractional derivative, alpha. This is observed for the three values of the temperature studied. Moreover, for smaller temperatures, the periodic solutions are sustained for smaller values of alpha. For negative values of the coupling constant the neurons show anti-phase synchronization for the integer-order model (neurons show the same behaviour with a half-period phase shift). In the case of the fractional-order model, we see the disappearance of these anti-phase symmetric solutions, as alpha decreases from 1. Another bifurcation seems thus to occur, namely a symmetry-breaking bifurcation, being again alpha a bifurcation parameter.

#1688 Accessible Indoor Navigation based on Linked Data in Hospitals

Rita Dominika Fleiner (HU), Gabriella Simon-Nagy (HU), Barnabás Szász (HU)

The paper provides a data model in the form of ontology which includes the indoor location description of hospitals, the indoor navigation features and the accessibility attributes for people with motion disabilities. The possible use of the ontology is demonstrated by outlining some SPARQL queries for the navigation features of future applications.

#1712 Fault Tolerant Distributed Control System with Robust Fractional Order Controllers

Eva Henrietta Dulf (RO), Daniel T. Timis (RO), Cristian I. Iacob (RO), Cristina Muresan (RO), Roxana Both (RO)

Fault tolerance or resiliency aspects of large-scale systems with networked embedded sensors and actuators need to be taken into consideration at design time and not be an after-the-fact addition to an already completed (not necessarily fault-tolerant) design. While there has been some important progress in fault-tolerant distributed control systems, most of the recent work has focused on specific systems and provide answers in particular domains, but offer little insight for other applications. The paper presents such fault-tolerant distributed control system architecture, using robust fractional order controllers. The controller design algorithm is based on a bio-inspired optimization method. The simulation results highlight the advantages of the control system in different fault scenarios.

Workshop on Women in Engineering (II) – WiE session on CyberMedical Systems

Organizers: Levente Kovács, Clara M. Ionescu
October 9 (Sunday), 11:00-12:30, InterContinental Budapest, Panorama V
Session Chairs: Ioana Nascu, Johanna Sápi

#1743 A Natural Ventilation Control in Buildings Based on Co-Simulation Architecture and Particle Swarm Optimization

Maria Pia Fanti (IT), Francesco Iannone (IT), Agostino Marcello Mangini (IT), Alessandro Rinaldi (IT), Michele Roccotelli (IT)

This paper presents a building automation strategy for natural ventilation control and reducing building energy consumption. An on-off control is proposed in order to manage the windows opening and realize a natural ventilation flow guaranteeing indoor thermal comfort. The control logic is based on activation thresholds that are optimized to reduce the discomfort for overheating and undercooling. In particular, the temperature comfort range dynamically varies according to the adaptive thermal comfort theory. To this aim, a co-simulation architecture is proposed: the thermal building behavior and ventilation dynamics are simulated by TRNFLOW within the TRNSYS software and a Particle Swarm Optimization algorithm is employed to optimize the thresholds of windows opening. A case study focusing on a residential building situated in the Mediterranean climatic context is presented: the thermal comfort analysis shows that the optimized control logic significantly reduces the overheating discomfort.

#1836 Multiparametric Model Predictive Control Strategies of the Hypnotic Component in Intravenous Anesthesia

Ioana Nascu (GB), Efstratios Pistikopoulos (US)

This paper presents the development of multiparametric model predictive control strategies for the control of the hypnotic part of the depth of anaesthesia. Based on a detailed compartmental model featuring a pharmacokinetic and a pharmacodynamic part, two different control strategies are employed and tested comparatively with the nominal mp-MPC. The designed strategies: a simultaneous multiparametric moving horizon estimation and model predictive control and a multiparametric model predictive control using a switch for the administration of the drug infusion, are able to tackle some of the most important challenges in control of anaetshesia. The performances of the designed controllers are tested on a set of 12 patients in the induction and maintenance phase and analyzed comparatively. The simulations show good performances and satisfactory behavior.

#1936 An Analysis of a New Continuous-to-Discrete Time Operator for the Approximation of Fractional Order Systems

Cristina Muresan (RO), Robin De Keyser (BE)

One of the methods for discrete-time approximation of fractional order systems consists in an indirect approach in which a continuous-time rational transfer function is firstly derived. Then, using different mapping techniques, the s plane transfer function is converted to the z plane. In this paper a new mapping technique is proposed. The tuning parameter of this continuous-to-discrete-time mapping operator balances the discrete-time approximation between the classical Euler and Tustin rules, ensuring an increased flexibility compared to these classical methods. An analysis of the effects of the changes in this parameter is given, along with some general guidelines for its proper selection. The authors show that for digital approximation of fractional order systems using the indirect approach, Tustin rule can lead to ringing and should be avoided. The inverse discrete-to-continuous time operator is also presented. Numerical examples are provided. The results show that high accuracy of approximation is obtained and that the proposed method can be considered as a suitable solution, compared to classical discretization methods (Tustin).

#2141 Comparison of protocol based cancer therapies and discrete controller based treatments in the case of endostatin administration

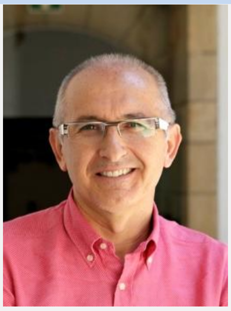
Johanna Sápi (HU), Dániel András Drexler (HU), Levente Kovács (HU)

In the medical practice, there are several methods to administer anti-cancer drugs. A commonly used method is the intermittent bolus doses (BD) administration when the patient receives drug on given days and the therapy has rest periods between the injections. The amount of bolus doses can be the maximum tolerated dose (MTD) or less. Anti-cancer drug can be administered in low doses over prolonged periods without extended rest periods which is called as low-dose metronomic therapy (LDM). In addition, continuous infusion therapy is applicable within clinical environment, not yet as a portable device. The major disadvantage of these methods is the empiricism associated with determining the optimal biologic dose (OBD). In order to solve the problem, we have designed discrete-time controllers which realize automated optimal treatments.

Workshop on Big Data based Technological Innovations on Intelligent Health Service in the Clouds

October 9 (Sunday), InterContinental Budapest, 09:00-12:30, Duna Salon IV

Hamido Fujita
Iwate Prefectural University, Japan



Enrique Herrera Viedma
University of Granada, Spain

Ali Selamat
Universiti Teknologi Malaysia

Amedeo Cesta
Research Council of Italy (CNR)

Francisco Chiclana
De Montfort University, England

Abstract

Big Data technology is new challenges to create human profiles, monitor social behavior, provide decision support based on social trends or discover new service providing opportunities. The objective of this workshop is to highlight new research directions in providing healthcare services granules represented in Cloud Semantics based on IoP (internet of People) preferences. The IoP cloud will provide ordered preference on people in connection to health needs and crisis services. These two services are represented as knowledge-based systems in IoH (internet of Health) in cloud semantics, and also internet of Crisis (IoC) in another cloud. These collaborative clouds provide health services to user (specially the elderly) based on semantical analysis in relation to their preferences. System handles these situational (different scenarios) predictions for diagnosis and healthcare services. We discuss what kind of problems and solutions tacking such technologies. We discuss the physical and mental features surroundings elderly situations and representing all as a set of criteria for decision making. We also discuss on-shelf robots like Nao and Pepper to be used for handling homecare transaction for elderly as application domain. We discuss multi-modal sensing to collect physical data on elderly, transfer the data to the cloud, for reasoning and prediction, and then provide mechanism scenario that download to on-shelf robot that can handle help tasks for the elderly. We discuss knowledge-based systems, data mining techniques, multi- dimensional feature extraction on multi-data stream. The best papers from this workshop will be invited for extended version as journal article for special issue in Knowledge-Based Systems Journal on the topic on these of the workshop.

Indicative Topics

Aspects that are to be discussed in this workshop are:

- Cooperative clouds, policies and securities
- Sentimental analysis prediction and subjective criteria of IoP, user preferences extracted from Social Network
- Trust based decision making models and consensus processes in Social Media exploiting the preferences and opinions and data from social networks.
- Recommender systems in social contexts.
- Structure of the cloud based big data context and the most representative crisis evaluation decision
- Data source clustering schemes or classification of data sources by attributes
- Feature extraction for medical multidimensional data streams in the clouds.
- Health predictions based on non-linear data analysis, (Epilepsy prediction, heart diseases, aging-associated sickness and diseases, etc.)
- Emotion space model for sentiment classification in social media on health informatics
- Structured sentiment classification via social context regularization on health informatics
- Automatic FAQ generation from social media content support on health informatics
- Sentiment Analysis of multiple language tweets related to health informatics

- Data Mining for medical diagnosis
- Model based health care for elderly and ICT robotics for health care.

Short Biographies of the Workshop Organizers

Hamido Fujita is Professor at Iwate Prefectural University (IPU), Iwate, Japan, and director of Intelligent Software Systems. He is the Editor-in-Chief of Knowledge-Based Systems, an Elsevier journal of high impact factor (4.104). He received the Doctor Honoris Causa from Óbuda University in 2013, and the title of Honorary Professor from Óbuda University, Budapest, Hungary in 2011. He received the Honorary Professorship from many distinguished universities. He is an Adjunct professor to Stockholm University, Sweden, University of Technology Sydney, National Taiwan Ocean University and others. He has supervised PhD students jointly with the University of Laval, Quebec, Canada; University of Technology, Sydney, Australia; University of Paris 1 Pantheon-Sorbonne, France, University of Genoa, Italy, and others. He led a number of projects including Intelligent HCI, a project related to Mental Cloning as an intelligent user interface between human users and computers and the SCOPE project on Virtual Doctor Systems for medical applications.

Enrique Herrera-Viedma received the B.Sc. and Ph.D. degrees in Computer Sciences, from the University of Granada (Spain) in 1993 and 1996, respectively. He is currently Vice-President for Research and Knowledge Transfer of University of Granada, and Professor with the Department of Computer Science and Artificial Intelligence at the University of Granada, Vice-Dean of Research in Library and Communication Faculty, and Director of the Quality Evaluation and Information Retrieval Research Laboratory (SECABA). He is an Associate Editor of several ISI journals: IEEE Transaction on Systems, Man, and Cybernetics: Systems; Knowledge Based Systems; Applied Soft Computing, Soft Computing; Journal of Intelligent Fuzzy Systems; Fuzzy Optimization and Decision Making, and Information Science. He has published extensively in leading international journals in this field more than 110 papers in ISI journals. His H-index is 41 and he presents more than 5500 citations in Web of Science. In 2014 he has been identified by Thomson Reuters and Shanghai Ranking Center as a Highly Cited Researcher.

Ali Selamat has received a B.Sc. (Hons.) in IT from Teesside University, U.K. and M.Sc. in Distributed Multimedia Interactive Systems from Lancaster University, U.K. in 1997 and 1998, respectively. He has received a Dr. Eng. degree from Osaka Prefecture University, Japan in 2003. Currently, he is the Director, Center of Communication and Information Technologies (CICT), UTM. He is also a professor at the Software Engineering Department, Faculty of Computing UTM. Previously he was an IT Manager at School of Graduate Studies (SPS), UTM. He is the editors of International Journal of Digital Content Technology and its Applications (JDCTA), International Journal of Advancements in Computing Technology (IJACT) and International Journal of Intelligent, Information and Database Systems (IJIIDS). His research interests include software engineering, software agents, web engineering, information retrievals, pattern recognitions, genetic algorithms, neural networks and soft-computing.

Amedeo Cesta is a senior research scientist in Artificial Intelligence at CNR and Group Lead at ISTC. He has founded and currently coordinates activities of the Laboratory on Planning and Scheduling Technologies (PST). He has conducted research in several AI areas like Multi-Agent Systems, Intelligent Human-Computer Interaction, Planning & Scheduling and always pursued the synthesis of innovative Decision Support Systems. His work focuses on the integration of planning and scheduling in software architectures, the use of constraint programming for specialized tasks such as temporal and resource reasoning, the synthesis of planning and scheduling heuristics, the interactive solution of complex planning and scheduling problems. His work in Artificial Intelligence also emphasizes the real-world aspects of automated reasoning, in particular focusing on research topics like robust and flexible problem solving, execution monitoring and mixed-initiative interactive systems. He is currently exploring the integration of planning and scheduling techniques in new applicative areas (e.g., crisis managers training) and the synthesis of new cognitive aids for old people by integrating ICTs and robotics.

Francisco Chiclana received the BSc and PhD degrees in Mathematics, both from the University of Granada (Spain) in 1989 and 2000, respectively. In August 2003, he joined De Montfort University (DMU) as a Senior Lecturer. In August 2006, he became a Principal Lecturer and in October 2007 he was awarded the title of Reader in Computational Intelligence. In May 2012, he was appointed Professor of Computational Intelligence and Decision Making.

Big Data based Technological Innovations on Intelligent Health Service in the Clouds (I)

Organizers: Hamido Fujita, Enrique Herrera-Viedma, Ali Selamat, Amedeo Cesta, Francisco Chiclana
October 9 (Sunday), InterContinental Budapest, 09:00-10:30, Duna Salon IV
Session Chairs: Hamido Fujita, Herrera-Viedma

#1076 Improving queries and representing heterogeneous information in fuzzy ontologies using multi-granular fuzzy linguistic modelling methods

Juan Antonio Morente-Molinera (ES), Ignacio Javier Pérez (ES), Cabrerizo Francisco Javier (ES), Carlos Porcel (ES), Enrique Herrera Viedma (ES)

The appearance of Fuzzy Ontologies has improved the way that crisp ontologies use to represent information. Thanks to them, it is possible to represent information in an imprecise and linguistic way using linguistic modelling and fuzzy sets. Nevertheless, there are still several restrictions that must be overcome. For instance, ontology queries must be performed using a linguistic label set with an specific granularity value. In environments where several people have to deal with the same ontology, this can be an inconvenient since the chosen representation does not have to be suitable for all of them. In this paper, multi-granular fuzzy linguistic modelling methods have been used in order to deal with heterogeneous information coming from different sources and to allow experts to choose the linguistic label set that better fits their needs.

#1142 Automated Characterization of Arrhythmias Using Nonlinear Features from Tachycardia ECG Beats

U Rajendra Acharya (SG), Hamido Fujita (JP), Muhammad Adam (SG), Oh Shu Lih (SG), Tan Jen Hong (SG), Vidya K Sudarshan (SG), Joel EW Koh (SG)

Arrhythmias are abnormal heartbeat rhythms, categorized as either harmless or life-threatening. Commonly, elderly people are more vulnerable to life-threatening arrhythmias, namely Atrial Fibrillation (A-Fib), Atrial Flutter (AFL) and Ventricular Fibrillation (V-Fib). Electrocardiogram (ECG) is the primary diagnostic tool that can be used to detect and diagnose cardiac abnormalities including serious arrhythmias. Therefore, using ECG signal beats, we have proposed a computer-aided diagnosis (CAD) system for automated diagnosis of serious arrhythmias. The ECG beats are analyzed using thirteen nonlinear features namely, Shannon entropy, Fuzzy entropy, Tsallis entropy, approximate entropy, Permutation entropy, Modified Multi Scale entropy, Wavelet entropy, Sample entropy, Renyi entropy, Signal Energy, Fractal Dimension, Kolmogorov Sinai entropy and Largest Lyapunov Exponent. Subsequently, the extracted features are ranked using ANOVA and subjected to automated classification using the K-Nearest Neighbor (KNN) and Decision Tree (DT) classifiers. In addition, the extracted features are trained and tested with ten-fold cross validation analysis. DT classifier yielded 96.3% accuracy, 99.3% sensitivity and 84.1% specificity with 14 features and the KNN classifier yielded 93.3% accuracy, 97.5% sensitivity and 75.3% specificity using 12 features. Positively, the proposed CAD system is able to assist the clinical staff in the arrhythmias diagnosis by making the process faster and simpler. Consequently, the necessary treatments can be given expeditiously.

#1144 Automated Diagnosis of Coronary Artery Disease using Nonlinear Features Extracted from ECG Signals

Chaitra Sridhar (IN), U Rajendra Acharya (SG), Hamido Fujita (JP), G. Muralidhar Bairy (IN)

Coronary Artery Disease (CAD) is one of the hazardous heart disease which results in angina, Myocardial Infarction (MI) and Sudden Cardiac Death (SCD). CAD is a cardiac disorder in which a plague develops in the interior wall of the arteries resulting in blockage of blood reaching to the heart muscles. Electrocardiogram (ECG) is the cardiac signal which represents cardiac depolarisation and repolarisation regulated at the surface of the chest. The minute variations in amplitude and duration in the ECG wave specifies different pathological conditions which are tedious to interpret visually. Hence computer aided diagnostic systems are used to monitor ECG signals. In the present work, automated diagnosis of CAD is done using Discrete Wavelet Transform (DWT) and nonlinear feature extraction techniques like; Multivariate Multi-scale Entropy (MMSE), Tsallis entropy and renyi entropies. The extracted features after DWT are ranked based on t-value and fed to K Nearest Neighbour (KNN), Support Vector Machine (SVM), Probabilistic Neural Network (PNN) and Decision Tree (DT) classifiers for automated classification of normal and CAD classes. This technique provided the highest accuracy of 98.67% using KNN classifier. Hence, the proposed system can aid clinicians in faster and accurate diagnosis of CAD and thereby provide sufficient time for proper treatment.

#1378 Proactive Healthcare and an Early Warning Mechanism for Coronary Artery Disease Patients using Internet-of-Thing Devices

Tun-Wen Pai (TW)

Ubiquitous Internet environment and matured key technologies of sensing devices provide diversified applications of Internet of Thing (IoT). IoT in intelligent healthcare is one of the major topics for convincing powerful functions of IoT regarding the promotion of national health policies, strategies, and plans. However, according to statistics reports, annual global mortality for cardiovascular diseases remained as high as 29%, of which coronary artery disease (CAD) is accounted for 42%. Unfortunately, almost half of the patients not knowing they are at risk of cardiovascular diseases until serious symptoms occurred. Here, we proposed an early warning system by integrating IoT, big data, and cloud computing technologies which physically linked among personal communication devices of patient/doctor, cloud systems, and hospital medical information systems. The system collects personal heart rate and metabolic equivalent (MET) features from calibrated fitness devices wore by users, and corresponding fitted curves are dynamically calculated and compared to previously trained curve patterns from 213 patients with heart diseases and 124 healthy individuals. The prototype system was already successfully developed and validated by a couple of testing cases with excellent performance. To ensure the robustness of the proposed system, now we are evaluating system reliability and trying to collect more testing samples for further validating effectiveness of the proactive healthcare mechanism.

#1450 Collaboration Patterns of Researchers Using Social Network Analysis Approach

Nur Hazimah Khalid (MY), Roliana Ibrahim (MY), Ali Selamat (MY), Mohd Rashdan Abdul Kadir (MY)

Researchers create larger networks of contacts through research collaboration, known as collaboration networks of researchers. In order to promote and to have effective collaboration among researchers, the collaboration patterns need to be accessed and analysed to elevate research and publication (R&P) performance. However, the collaboration patterns have not been accessed in the context of Universiti Teknologi Malaysia (UTM) researchers. Thus, it brings the aim of this research to analyse research collaboration patterns among UTM researchers using Social Network Analysis (SNA). Researchers from Faculty of Electrical Engineering (FKE) were chosen for our analysis. We have 1446 cleaned publications and 168 researchers to construct collaboration network of FKE and its departments. Our findings show that FKE researchers have fewer inter-departments collaboration. Department of Control and Mechatronic Engineering (CMED) has denser network compared to other FKE departments. Besides that, the most influential and reliable researchers were identified based on SNA measures. The findings derived from this study are very helpful to strategic decision makers in UTM to have a strategic plan in empowering research collaboration efforts. It gives an alternative to existing methods in evaluating R&P performance of researchers in UTM and promotes researchers to conduct research collaboration.

Big Data based Technological Innovations on Intelligent Health Service in the Clouds (II)

Organizers: Hamido Fujita, Enrique Herrera-Viedma, Ali Selamat, Amedeo Cesta, Francisco Chiclana
October 9 (Sunday), InterContinental Budapest, 11:00-12:30, Duna Salon IV
Session Chairs: Hamido Fujita, Herrera-Viedma

#1965 Interval Type-2 Fuzzy DSS for Unbiased Medical Diagnosis

Marco Pota (IT), Massimo Esposito (IT), Giuseppe De Pietro (IT)

Technological innovations coupled with the rapidly expanding amount of medical data digitally collected and stored have made possible to develop advanced Decision Support Systems (DSSs) able to aid physicians in medical diagnosis, by helping them in classifying among different diseases. Building this typology of DSSs preliminarily requires the extraction from huge sets of clinical data of hidden relationships between possible classes and known features. This task is very thorny due to information uncertainties affecting features as well as biases regarding prior probabilities of classes, depending on the environment and conditions of data collection. To address these problems, this paper presents an approach for building an interval type-2 fuzzy DSS able to handle information uncertainties and perform unbiased medical diagnoses, by adapting interval type-2 fuzzy sets to a medical dataset. A proof of concept is given by applying the proposed approach on a benchmark medical dataset. A comparison is performed between i) a type-1 fuzzy system with prior probabilities extracted from the dataset; ii) an interval type-2 fuzzy DSSs modelling non-biased prior probabilities; and iii) the best known classification methods. This comparison is made both when prior probabilities are fixed, i.e. when the system is evaluated by a stratified cross-validation technique, or while no assumption is made about prior probabilities. Results show that the proposed approach reach good performance in most of the cases, thus evidencing the usefulness of extracting an interval type-2 fuzzy system not based on biased prior probabilities, for obtaining more reliable results.

#1979 A hybrid reasoning system for mobile and intelligent health services

Aniello Minutolo (IT), Massimo Esposito (IT), Giuseppe De Pietro (IT)

Recently, innovative and mobile health services have been developed by embedding knowledge-based systems, with the aim of remotely promoting wellness and healthy lifestyle, monitoring patients' chronic diseases and improving their adherence to therapies. Even if different knowledge-based systems have been proposed for mobile devices, they are typically based on precise production rules built on the top of ontological primitives for describing the domain of interest. Thus, they are not able to handle medical knowledge graded and affected by uncertainty, which often underlies medical decision-making processes. In order to address this topic, this paper presents a hybrid, rule-based reasoning system for mobile devices aimed at enabling the realization of intelligent health services. This system is essentially characterized by two main features: i) a hybrid knowledge representation approach for modelling productions rules involving both precise and vague information by integrating ontological and fuzzy primitives; ii) a lazy reasoning algorithm able to efficiently process this hybrid knowledge and timely produce answers. A case study has been arranged in order to evaluate the effectiveness of the proposed system within a mobile application for detecting heart arrhythmias.

#2101 Cloud-based Health Monitoring System Based on Commercial Off-the-Shelf Hardware

Gajo Svetozar Petrovic (JP), Vladimir Dimitrieski (JP), Hamido Fujita (JP)

In this paper we propose a three-layered architecture for the implementation of cloud-based health monitoring sys- tem that utilizes ubiquitous commercial health measuring de- vices. The main advantage of such a solution over the solutions that use proprietary medical hardware, is the availability and number of existing health devices and relying on the expertise of their vendor. We also identify critical issues and problems that could arise in each layer of such a system. Finding a solution for these issues will be a main requirement for the future implementations of the system.

IEEE SMC **2016**

2016 International Conference on Systems, Man, and Cybernetics

Workshop on Brain-Machine Interface Systems

October 8-12, 2016

Hotel Intercontinental

Budapest, Hungary

Sponsored by

IEEE SMC Systems, Man, and Cybernetics Society

Welcome Message from the BMI Workshop Organizers

IEEE SMC 2016's 6th Workshop on Brain-Machine Interface Systems will be held October 8th-12th, 2016 in Budapest as part of the program of SMC 2016 - the flagship annual conference of the IEEE Systems, Man, and Cybernetics Society. This event will also host the second IEEE Brain Initiative Annual Meeting. The theme of this year's workshop, which involves the integration of Systems, Human-Machine Systems, and Cybernetics, is "New Research Opportunities and Industrial Applications in BMI Systems Arising from the IEEE Brain Initiative."

IEEE President and CEO Barry Shoop will open the BMI Workshop and give an invited talk on "Disruptive Innovations as a Vehicle to Develop Critical Thinking, Creativity and Innovation Skills".

We would like to welcome all SMC 2016 delegates who are either involved or interested in learning more about the state of the art and future challenges in BMI-related topics including sensor technologies, machine learning, big data, neurorehabilitation and standards to attend this workshop - which is offered free of charge.

The workshop is organized by the IEEE SMC Technical Committee on Brain-Machine Interfaces Systems and is technically co-sponsored by the IEEE Brain Initiative, IEEE Computational Intelligence Society, IEEE Consumer Electronic Society, IEEE Council on Electronic Design Automation, IEEE Engineering in Medicine and Biology Society, IEEE Magnetics Society, IEEE Robotics and Automation Society, IEEE Sensor Council, IEEE Signal Processing Society, IEEE Society on Social Implications of Technology, IEEE Solid-State Circuits Society, the IEEE Standards Association and the IEEE Systems Council.

The goal of the workshop is to facilitate the interaction and intellectual exchange between all researchers, developers and consumers of this technology. The latest advances, innovations, and applications will be presented. Topics such as decoding accuracy, task performance, human factors, decoding algorithms, and feedback represent both challenges to the field and a tremendous opportunity for collaborative and multidisciplinary research, involving not only peers with expertise in the field of BMI, but also expertise in systems engineering, human-machine systems, cybernetics, and/or other disciplines. The five-day workshop will feature multiple activities including tutorials, a special session on standards, three panels, a number of prominent invited speakers from industry and academia, presentations of contributed papers and a two-day Brain Computer Interface Hackathon.

A highlight of the workshop is a session on commercialization of technology held on October 10th, entitled **"**From Research to Scientific Breakthroughs to Improving the Lives of People: Four Unique Paths," with speakers Reese Jones, Founder Farallon, Netopia, BMUG; Joel Libove, Founder Furaxa, Ultraview; Stuart Mason Dambrot, Founder Transinopia, Critical Thought | TV; and Bernt R. Wahl, Founder Factle, Datahunt, Dynamic Software.

We are also pleased to have the following invited speakers:

- Jose Carmena (UC Berkeley), SMC 2016 keynote speaker: "Brain-machine interface systems: Learning to act in the cyber-physical world" held on October 10th
- José del R. Millán (EPFL): "Neuroprosthetics: The role of the brain's error monitoring system" held on October 10th
- Paul Sajda (Chair IEEE Brain Initiative; Columbia University): "Neural correlates of the "Aha" moment: Enabling brain-computer interfaces for labeling our environment" held on October 11th
- Jose C. Principe (University of Florida): "Toward cognitive integration of prosthetic devices" held on October 12th

Moreover, there will be two focused special sessions. The IEEE Sensors Council has organized a special session with five prominent invited speakers who will talk on "Sensor Technologies for Multimodal Brain Interfacing" on October 12th. In addition, a full day special session focused on BMI and neurotechnology-related standards will take place on October 9th. This session, supported by the IEEE Standards Association, will discuss how standardization of technologies such as BMI, Augmented Reality (AR)/Virtual Reality (VR), and other wearables, is needed to support integration and help accelerate the translation of these devices to commercialization.

The Brain Computer Interface Hackathon will be held on Saturday, October 8th and Sunday, October 9th. It is sponsored and organized by VSP, VSP the Shop, Vizzario, Qusp, IEEE Brain Initiative, and IEEE SMC Society. There are over $8,000 in prizes in cash and hardware prizes donated by the sponsors and organizers.

Two tutorials are held on the afternoon of Sunday, October 9th:

- Mobile BCI application: Neuroscience-based design and neurorehabilitation
- Why bother with advanced modeling in BCI? Lessons from neuroimaging

The workshop also features three panel sessions moderated by José del R. Millán (EPFL) and Jack Gallant (UC Berkeley):

- “Important Topics in Designing and Building Real World BMI: What is New?” held on October 10th
- “How Research and Methodologies in Systems, Human-Machine Systems, and Cybernetics can be applied to BMI" held on October 11th
- “What Have We Learned, Where Do We Go From Here?” held on October 12th

This year we also have 80 contributed papers. All of them were carefully peer-reviewed by at least two experts and will be published in the conference proceedings. The IEEE Brain Initiative Best Paper Award will be given to the best paper at this workshop, and five IEEE Brain Initiative student travel grants will be awarded. Besides this, all papers in the workshop will be eligible for SMC's Franklin V. Taylor Memorial Award and Best Student Paper Award. Contributions will be presented in technical sessions addressing a variety of topics including:

- Adaptive and self-calibrating BMI systems for independent use
- BMI for motor/cognitive rehabilitation and assistance and for neurodriving
- Brain and human-machine interaction
- Health and non-invasive wearable BMI
- Machine learning methods for brain-computer interfacing
- Multi-modal brain computer Interface and physiological computing
- Neuroscience based design: fundamentals and applications
- Neurostimulation and BMI
- Performance metrics and human factors for BMI training and operation
- Real world applications of brain computer interface systems
- Recent advances in BMI Speller
- Sensor systems for BMI and prosthetics

Finally, we would like to thank all the organizations and individuals who worked hard in organizing this Workshop. We especially thank the IEEE Brain Initiative for their generous funding and support of this workshop. We also thank the Brain Computer Interface Hackathon supporters: IEEE SMC Society and the IEEE Brain Initiative (sponsors, prizes, and funding), Vizzario (organizer, management, equipment, funding and prizes), Qusp (management, equipment, and prizes), Hardware/software manufacturers: (equipment and funding) Gtec, VSP the Shop, and Interaxon; (hardware) Brain Rhythm Inc., Cognionics, Emotiv, InteraXon, NCU, Neuroelectrics, NeuroSky, OpenBCI, Wearable Sensing, Thalmic Myo, Oculus Rift, HTC Vive, and DBglove.

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Brain Computer Interface Hackathon

A gathering such as IEEE SMC 2016 brings together great minds. We invite you to be a part of the Brain Hackathon, where participants are engaged in a brainstorming and collaborative round-the-clock marathon, designed to rapidly produce working prototypes. The goal of this particular Brain Hackathon is to stretch the boundaries of Brain Computer Interface (BCI) technology, to put creative minds from many disciplines together, and to provide an environment for innovation, entrepreneurship, and creation of applications/products that have great potential for commercialization. Participants will have the opportunity to participate in a number of challenges. Cost to participate is **FREE**.

Over $8,000 in cash and hardware prizes, including at least $5,000 in Vizzario/VSP Brain Hackathon Prizes, a $1,000 IEEE Brain Initiative Brain Hackathon Prize, a $1,000 IEEE SMC Brain Hackathon Prize, and a $1,000 Qusp Prize will be awarded. Individual or team participants (each up to 5 persons) are welcome, with a limitation of 130 individuals/26 teams. IEEE members will be given priority. See: https://abc-accelerator.com/budapest-hackathon-learn-more-page/.

Preliminary Schedule	
October 8, 2016	
9:00	Introduction, overview, industry talk, group formation, general rules and guidelines, choosing topic of work, starting preparation work
11:00	Submission of Project Title and start of work
12:00	Lunch Break (1 hour)
16:00	Jury making rounds (checking teams' progress, approx. 5 min per team)
18:00	Dinner Break (1 hour)
22:00	Jury making rounds (checking teams' progress, approx. 5 min per team)
00:00	Midnight Break (1 hour)
October 9, 2016	
8:00	Breakfast Break (1 hour)
10:00	Jury making rounds (checking teams' progress, approx. 5 min per team)
12:00	Lunch Break (1 hour)
13:00	Jury making rounds (checking teams' progress, approx. 5 min per team)
14:00	Project Submission, followed by Project Demos and Jury Evaluation
15:30	Awards Presentation
16:00	Hackathon ends
18:30	Selected winners have projects on display/demos at SMC reception
October 10, 2016	
13:00 – 18:30	Selected winners have projects on display/demos at SMC BMI Workshop

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October 8 (Saturday), 09:00-18:00, InterContinental Budapest, Ballroom II
October 9 (Sunday), 09:00-16:00, InterContinental Budapest, Ballroom II

BMI Standards Session

October 9 (Sunday), 08:30-17:00, InterContinental Budapest, Ballroom III and panorama I

The SMC 2016 provides an international forum for researchers and practitioners to report up-to-the-minute innovations and exchange ideas and advances in all aspects of systems science and engineering, human machine systems, and cybernetics.

During this session on BMI-related standards, organized by the **IEEE Standards Association**, the use of neurotechnologies for invasive and non-invasive practices will be discussed. How this technology is implemented for surgery, Augmented Reality (AR)/Virtual Reality (VR), or wearables, and how standardization of the technology is needed to support integration and help accelerate the translation of these devices to commercialization. This session is open to the attendants to IEEE SMC conference.

Topics to be discussed:

- What is a BMI standard?
- Should there be a separate set of standards for clinical and non-clinical applications?
- What would a framework for standards on diverse topics, plus their interoperability look like?
- What are the biggest challenges to using these technologies?
- What are the highest priorities or the biggest challenges that can be addressed by standards?
- What needs be addressed in the next 3 years?
- Is there a need for standards on the reliability of these systems in terms of performance?
- Should standards be set to protect from third-party access?
- Is it the role of standards to define which information should or should not be stored? Or whether encryption/anonymization is required.

This session will be composed of short presentations and panels with different stakeholders from the private, academic, and regulatory sectors. Ample time has been reserved for discussions with contributions from the attendants, including breakout discussion sessions on standards gaps for clinical and non-clinical BMI applications. Plenary sessions will take place on the Ballroom III. Breakout roundtables (15:00-16:30) will take place in the Ballroom III and Panorama I.

Contact persons: Bill Ash <w.ash@ieee.org>, Carole Carey c.carey@ieee.org>,
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The outcome of this workshop will be used to drive establishment of the standards committee on Neurotechnologies.

http://go.epfl.ch/smc2016_bmi_standards
http://standards.ieee.org

Program: Special Session on Standards

9:00 AM **Ballroom III**	**Welcome: Michael H. Smith, Chair SMC2016 BMI Workshop** **Opening Remarks and Moderation: Ricardo Chavarriaga (EPFL)**
9:15 – 10:30 **Ballroom III**	Signal acquisition and stimulation - **Panel I** Aureli Soria-Frisch, Neuroelectrics Barcelona, Starlabs, Spain Christoph Guger/Francisco Fernandes, g.Tec, Austria Brain, Behavior and AR/VR – **Panel II** • Gangadhar Garipelli (TBD), Mindmaze, Switzerland • Khizer Kaderi/Mohan Reddy, Vizzario/VSP, USA
10:30 – 10:45	**Break**
10:45 – 12:00 **Ballroom III**	Data analysis and sharing - **Panel III** • Tim Mullen, Qusp, USA • Louis Mayaud, Mensia Technologies, France BMI evaluation with end-users – **Panel IV** • José Contreras-Vidal, U Houston, USA • Reinhold Scherer, TU Graz, Austria
12:00 – 13:00	**Lunch**
13:00 – 14:30 **Ballroom III**	**Why do standards Matter? Moderator Bill Ash (IEEE Standards)** • Carole Carey – Standards & Brain Initiative overview • Hasan Ayaz – Brain, Behavior and AR/VR • May Wang – Needs and gaps in standards • Felipe Aguel, NIH/NINDS - Why standards are needed in medical devices • Walter Besio – EEG, sensors and signal processing
14:30 – 15:15 **Panorama I** **Ballroom III**	**Roundtable discussion: Wearables, fMRI, MEG, Invasive and Non-Invasive technologies** BMI systems are composed of several interconnected devices (e.g., EEG acquisition, AR/VR headsets, etc.) • Clinical and Non-clinical applications • How should BMI-related standards address the interoperability of these (heterogeneous) devices? • How are technologies that are different able to be integrated? Current data formats (e.g., EDF) were conceived for storing data in “open loop” settings. Is there a need to set standards on how to store and share the information gathered during BMI experiments and operations?
15:15 – 15:30	**Break**
15:30 – 16:00 **Panorama I** **Ballroom III**	**Roundtable discussion: Wrap up and readout preparation**
16:00 – 16:30 **Panorama I**	**Readouts from the roundtables**
16:30 – 17:00 **Panorama I**	**Wrap up**

BMI Founders Keynote Session

From Research to Scientific Breakthroughs to Improving the Lives of People: Four Unique Paths
Organizer: Bernt Wahl, Chair: Michael H. Smith
October 10 (Monday), InterContinental Budapest, 16:15-18:30, Ballroom II-III

Reese Jones
Founder: Farallon, Netopia, BMUG

Joel Libove
Founder: Furaxa, Ultraview

Stuart M. Dambrot
Founder: Critical Thought|TV

Bernt R. Wahl
Founder: Factle, Datahunt, Dynamic Software

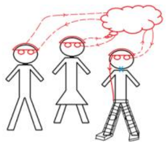
How do scientific breakthrough technologies go from a simple idea, to a few research prototypes costing millions, to products produced in the millions costing consumers/users only hundreds? Can we replace confining multi-ton, multi-million dollar fMRI machines with helmets weighing less than the brains they are imaging? Can we stream brain activity from billions of people and feed it in meaningful and selectively tailored ways to others, enabling global collaboration in an augmented environment?

What does it take to create, invent, and develop revolutionary new technologies that most cannot even envision? Some factors behind scientific breakthroughs are:

- A burning need and passion to see a longstanding problem solved.
- A wide breadth of expertise in the founder and colleagues, crossing multiple disciplines, are needed to devise a viable solution – often where others have failed.
- The tenacity to stick with a tortuous development path riddled with technical challenges, naysayers, lack of capital and other resources, regulatory issues, etc.
- The ability to quickly alter course along the way, as well as knowing when to stay the course despite overwhelming difficulties!
- Creativity - the gift of being able to visualize and analyze problems in unconventional ways. May be enhanced through exposure to external stimuli, such as art, listening to or playing music, hiking in nature and conversing and collaborating with others.
- A creative and dedicated team given the freedom to invent and take risks, tempered with guidance and encouragement from the founder.
- The ability to recognize when research results become sufficiently significant and mature to be developed into a product, and when they are not.

In this session, founders from companies collectively worth over $5 billon will share tales of pathways from research ideas to scientific breakthroughs to consumer/user products - how they went from identifying and finding solutions to scientific problems, ascertaining/recognizing/discovering customers, and building their enterprise using various models including:

- Grow as you go – letting early customers finance development
- Partner(s), consortia and virtual corporations
- Leveraging existing technologies to develop new products
- Licensing out technologies to provide revenue
- Raising investment capital



From a founder who repurposed ICs developed for defense to enable a wearable brain imager that unexpectedly shows promise for functional brain imaging, to another founder who used the power of computing to visualize chaos mathematics, to another who created high level security for mobile platforms, and finally, to another who analyzes deep-structure conceptual and neural connections between multiple areas of knowledge and creativity; each story will be exciting and unique.

Four such scientific product genesis successes, some carefully planned, others serendipitous, but all with the potential to help mankind, are briefly presented by the founders who helped make them happen.

Second IEEE Brain Initiative Meeting Held During SMC 2016 BMI Workshop

October 11 (Tuesday), 14:00-15:30, InterContinental Budapest, Ballroom I
Chair: Paul Sajda, Co-Chair: Jose Carmena

The IEEE Brain Initiative [brain.ieee.org] was launched with the mission to facilitate cross-disciplinary collaboration and coordination to advance research, standardization and development of technologies in neuroscience to help improve the human condition. After the success of the first IEEE Brain Initiative Meeting which took place December 2015 at Columbia University, we invite you to participate in the second IEEE Brain Initiative Meeting, where you will hear about the *latest brain research and developments from various IEEE Societies and Councils involved in this initiative, and be a part of the strategic discussion to plan for new endeavors and identify new opportunities*.

It is free to attend the IEEE Brain Initiative Meeting, which is held during the SMC 2016 BMI Workshop. We highly encourage participants to the IEEE Brain Initiative Meeting to also register and attend the SMC 2016 BMI Workshop. The IEEE Brain Initiative is a technical co-sponsor of this Workshop, along with eleven (11) IEEE Societies and Councils and the IEEE Standards Association.

Chair, Paul Sajda, Ph.D., Columbia University
Co-Chair, Jose Carmena, Ph.D., University of California, Berkeley
Senior Advisor, Metin Akay, Ph.D., University of Houston
Senior Advisor, Michael H. Smith, Ph.D., University of California, Berkeley

BMI Workshop Schedule

Day	9:00 - 18:00
8th October Saturday	**Brain Computer Interface Hackathon** Room: Ballroom II

Day	9:00 – 9:15	9:15 - 10:30	9:15 - 10:30	10:45 - 12:00	10:45 - 12:00	13:00 - 14:30	14:30 – 16:00	16:00 - 17:00
9th October Sunday	**BMI Standards Session, Opening Remarks: Michael H. Smith** Room: Ballroom III	**BMI Standards Session** **Panel I:** "Signal Acquisition and Stimulation" Room: Ballroom III	**BMI Standards Session** **Panel II:** "Brain, Behavior and AR/VR" Room: Ballroom III	**BMI Standards Session** **Panel III:** "Data Analysis and Sharing" Room: Ballroom III	**BMI Standards Session** **Closing Panel IV:** "BMI Evaluation with End-Users" Room: Ballroom III	**BMI Standards Session Discussion:** "Why do Standards Matter?" Room: Ballroom III	**BMI Standards Session Roundtable Discussion** Room: Panorama I Ballroom III	**BMI Standards Session Readouts from the Roundtables and Wrap up** Room: Panorama I

Day	9:00 - 16:00	13:30 - 15:00	15:30 - 17:00
9th October Sunday	**Brain Computer Interface Hackathon** Room: Ballroom II	**Tutorial I:** "Mobile BCI Application: Neuroscience-Based Design and Neurorehabilitation" Room: Duna Salon II	**Tutorial II:** "Why Bother with Advanced Modeling in BCI? Lessons from Neuroimaging" Room: Duna Salon II

Day	13:30 - 14:15	14:15 - 15:00	15:30 - 16:15	16:15 - 17:00	17:00 - 18:30
10th October Monday	**BMI Opening Session**: **Barry L. Shoop** **2016 IEEE President and CEO** "Disruptive Innovations as a Vehicle to Develop Critical Thinking, Creativity and Innovation Skills" Room: Ballroom II-III	**Panel I:** "Important Topics in Designing and Building Real World BMI Systems: What is New?" Room: Ballroom II-III	**Invited Lecture I:** "Neuroprosthetics: The Role of the Brain's Error Monitoring System" **José del R. Millán** Room: Ballroom II-III	**Founders Keynote Session I:** "From Research to Scientific Breakthroughs to Improving the Lives of People: Four Unique Paths" Room: Ballroom II-III	**Founders Keynote Session II:** "From Research to Scientific Breakthroughs to Improving the Lives of People: Four Unique Paths" Room: Ballroom II-III

Day	9:30 - 11:00	9:30 - 11:00	9:30 - 11:00	11:00 - 11:45	11:45 - 12:30	14:00 - 15:30
11th October Tuesday	**BMI-I** "Performance Metrics and Human Factors for BMI Training and Operation" Room: Panorama I	**BMI-II** "Adaptive and self-calibrating BMI systems for independent use" Room: Panorama V	**BMI-III** "Health and Non-Invasive Wearable BMI" Room: Ballroom I	**Invited Lecture II:** "Neural Correlates of the "Aha" Moment: Enabling Brain-Computer Interfaces for Labeling our Environment" **Paul F. Sajda** Room: Ballroom I	**Panel II:** "How Research and Methodologies in Systems, Human-Machine Systems, and Cybernetics can be Applied to BMI" Room: Ballroom I	**IEEE Brain Initiative Meeting** (open to all) Room: Ballroom I

Day	9:30 - 11:00					
12th October Wednesday	**BMI-IV** "Real World Applications of Brain Computer Interface Systems I" Room: Panorama I	**BMI-V** "BMI for Motor/Cognitive Rehabilitation and Assistance I" Room: Panorama V	**BMI-VI** "Neuroscience Based Design: Fundamentals and Applications" Room: Duna Salon II	**BMI-VII** "BMI for Neurodriving" Room: Ballroom I	**BMI-VIII** "Machine Learning Methods for Brain-Computer Interfacing I" Room: Bellevue 2	**BMI-IX** "Neurostimulation and BMI" Room: Bellevue 3

Day	11:00 - 12:30					
12th October Wednesday	**BMI-X** "Real World Applications of Brain Computer Interface Systems II" Room: Panorama I	**BMI-XI** "BMI for Motor/Cognitive Rehabilitation and Assistance II" Room: Panorama V	**BMI-XII** "Multi-Modal Brain Computer Interface and Physiological Computing" Room: Ballroom I	**BMI-XIII** "Brain and Human-Machine Interaction" ----------------------------- "A Tribute to Walter J. Freeman" Room: Ballroom II	**BMI-XIV** "Machine Learning Methods for Brain-Computer Interfacing II" Room: Bellevue 2	**BMI-XV** "Sensor Systems for BMI and Prosthetics" Room: Bellevue 3

Day	14:00 - 15:30		
12th October Wednesday	**BMI-XVI** "Real World Applications of Brain Computer Interface Systems III" Room: Panorama I	**Invited Speakers (Sensors Council):** "Sensor Technologies for Multimodal Brain Interfacing" Room: Ballroom I	**BMI-XVII** "Recent Advances in BMI Speller" Room: Ballroom II

Day	16:00 - 16:45	16:45 - 17:30	17:30 - 18:15	18:15 - 19:00
12th October Wednesday	**Invited Lecture III:** "Toward cognitive integration of prosthetic devices" **Jose C. Principe** Room: Ballroom I	**Panel III (part a)** "What Have We Learned, Where Do we Go From Here" Room: Ballroom I	**Panel III (part b)** "What Have We Learned, Where Do we Go From Here" Room: Ballroom I	"Strategic Roadmap Discussion for BMI: Audience Participation" Room: Ballroom I

* Room Information:
- Hotel InterContinental: Ballroom, Panorama, Duna Salon
- Hotel Sofitel: Bellevue

BMI Workshop Panels

BMI Panel I

Important Topics in Designing and Building Real World BMI Control Systems: What is New?

October 10 (Monday), 14:15-15:00, InterContinental Budapest, Ballroom II-III

Abstract

The goal of this panel is to hear about the current challenges and hot topics in BMI research from experts on the design and use of BMI/BCI systems. By identifying the challenges confronting the successful clinical translation and commercial application of BMI/BCI systems in real-world situations, this panel should identify some opportunities for SMC and other efforts to dramatically improve BMI/BCI system performance and benefits for the patients and/or users.

Session Chair

Michael H. Smith (University of California, Berkeley)

Moderator

José del R. Millán (École Polytechnique Fédérale de Lausanne)

Panelists

Jan Rabaey (UC Berkeley), Jack Gallant (UC Berkeley), Jose Luis Contreras-Vidal (University of Houston, Tecnológico de Monterrey), Reinhold Scherer (Graz University of Technology), S. W. Lee (Korea University)

BMI Panel II

How Research and Methodologies in Systems, Human-Machine Systems, and Cybernetics can be applied to BMI Systems

October 11 (Tuesday), 11:45-12:30, InterContinental Budapest, Ballroom I

Abstract

The goal of this panel is to engage leading researchers within SMC and elsewhere to discuss exploring various topics that are relevant to the development of robust and high-performance BMI systems, and to encourage the collaboration between researchers involved in BMI directly with those working in the domains of SMC and the IEEE Brain Initiative. We will also discuss whether and how SMC and IEEE Brain Initiative research lines and methodologies are becoming part of BMI.

Session Chair

Michael H. Smith (University of California, Berkeley)

Moderator

José del R. Millán (École Polytechnique Fédérale de Lausanne)

Panelists

Barry L. Shoop (IEEE President and CEO), Dimitar Filev (IEEE SMCS President), Ricardo Chavarriaga (SMC BMI TC), Paul Sajda (Chair, IEEE Brain Initiative), Jose C. Principe (University of Florida)

BMI Panel III
What Have We Learned, Where Do We Go From Here?

October 12 (Wednesday), 16:45-18:15, InterContinental Budapest, Ballroom I

Abstract

This is the final session of the workshop, in which the panelists and audience members share insights gained regarding the state-of-the-art BMI methods presented in this Workshop. Furthermore, modifications / updates to the set of relevant BMI-SMC metrics and a technology-development road map will also be discussed.

Session Chair

Michael H. Smith (University of California, Berkeley)

Moderator

Paul Sajda (Columbia University)

Panelists

Phillip Alvelda (DARPA program manager), Ricardo Chavarriaga (Center for Neuroprosthetics, EPFL), Vinod Prasad (Nanyang Technological University), Christoph Guger (CEO of g.tec), Dongrui Wu (CEO, DataNova), Joel Libove (CEO, Furaxa), Tim Mullen (CEO, Qusp), Fei-Yue Wang (Chinese Academy of Sciences), Gangadhar Garipelli (MindMaze).

Disruptive Innovations as a Vehicle to Develop Critical Thinking, Creativity and Innovation Skills

October 10 (Monday), 13:30-14:15, InterContinental Budapest, Ballroom II - III

Barry L. Shoop
2016 IEEE President and CEO
Professor and Department Head
Department of Electrical Engineering and Computer Science
U.S. Military Academy
West Point, New York, USA

Abstract

A desirable goal of engineering education is to teach students how to think critically and be creative and innovative. However, the speed of technological innovation and the continual expansion of disciplinary knowledge leave little time in the curriculum for students to formally study innovation, particularly at the undergraduate level. We have developed a novel upper-division interdisciplinary undergraduate engineering course that delivers disruptive and innovative applications of commercial technologies to an external funding agency and simultaneously develops the critical thinking, creativity, and innovation of these students. The course is structured as a deliberate interactive engagement between students and faculty that employs the Socratic Method to develop an understanding of disruptive and innovative technologies and a historical context of how social, cultural, and religious factors impact the acceptance or rejection of innovation. The course begins by developing the background understanding of what disruptive technology is and a historical context about successes and failures of social, cultural, and religious acceptance of technological innovation. To develop this framework, students read *The Innovator's Dilemma* by Clayton M. Christensen, *The Structure of Scientific Revolutions* by Thomas S. Kuhn, *The Discoverers* by Daniel J. Boorstin, and *The Two Cultures* by C.P. Snow. For each class meeting, students survey current scientific and technical literature and come prepared to discuss current events related to technological innovation. Each student researches potential disruptive technologies and prepares a compelling argument of why the specific technologies are disruptive so they can defend their choice and rationale. During course meetings students discuss the readings and specific technologies found during their independent research. As part of this research, each student has the opportunity to interview forward thinking technology leaders in their respective fields of interest. In this presentation we will describe the course and highlight the results from teaching this course over the past eight years.

Biography

Barry L. Shoop is Professor of Electrical Engineering and Head of the Department of Electrical Engineering and Computer Science at the United States Military Academy at West Point. In this role, he is responsible for an undergraduate academic department with over 79 faculty and staff supporting ABET accredited programs in electrical engineering, computer science, and information technology and serving over 2300 students annually. During his tenure at West Point, he has served in a number of leadership positions including Director of the Electrical Engineering Program and Director of the Photonics Research Center. Earlier in his career, he was a satellite communication engineer responsible for the design and installation of a high capacity, global digital communication network, and the CTO for a US$4.5B organization addressing the Improvised Explosive Device (IED) challenge worldwide. Barry received the Ph.D. from Stanford University and B.S. from the Pennsylvania State University, both in electrical engineering. He is a Fellow of the IEEE, the Optical Society of America (OSA), and the International Society for Optical Engineering (SPIE), and a member of Phi Kappa Phi, Eta Kappa Nu, and Sigma Xi. In 2008, OSA recognized Barry with their Robert E. Hopkins Leadership Award, and in 2013 he earned both the SPIE Educator Award and the IEEE Haraden Pratt Award. He holds a patent on photonic analog-to-digital conversion and has authored over 150 archival publications as well as eight books and book chapters. He is a licensed Professional Engineer in Virginia, USA.

From Research to Scientific Breakthroughs to Improving the Lives of People: Four Unique Paths

Organizer: Bernt R. Wahl
Chair: Michael H. Smith
October 10 (Monday), InterContinental Budapest, 16:15-18:30, Ballroom II-III

BMI and Brain Imaging: Gateways to Brain-Body-Internet Convergence

Reese Jones
Founder: Farallon, Netopia, BMUG

Abstract

Like a mirror, the Internet is already a reflection of who we are and how others perceive us, like our internet digital twin or an extension of our biology. From a lifetime of credit reports to medical records, from social media to recorded phone conversations, the Internet may know more about us than we know about ourselves. Today's renaissance includes our Internet twin – and to be self-aware, we must also know and care for our digital self as part of our mind, body and spirit. Brain computer interfaces are as simple as keyboards, screens, and phones. Brain imaging technologies, and more abundant, myriad, and sophisticated sensors, are exponentially enhancing the commingling of brain, body and Internet.

Biography

Reese Jones is a biophysicist, inventor and entrepreneur. He has contributed to the IPOs, acquisitions and growth of over a dozen startups, including Farallon, Netopia, Smaato, Genome Compiler, Cambrian Genomics, and Singularity University at NASA Research Park in Silicon Valley. Reese has served on boards at Santa Fe Institute, Harvard Medical School's Genetics Council, and Singularity University.

Transforming a High-Risk Idea into a Prototype

Joel Libove
Founder: Furaxa, Ultraview

Abstract

Bringing a useful but risky new technology to life can be a decade-long R&D effort that requires extreme perseverance, unconventional funding, piggybacking, and collaborative strategies, for what. VCs and other equity funders, and agencies like NIH and NSF, may not have the needed patience and risk tolerance, often wanting an idea to be proven before they will fund it. Nevertheless, interim revenue and crucial intellectual partnering can be obtained by selling elements of a new technology into non-competing defense, education and commercial applications. This presentation will describe how new IC architectures and data acquisition boards we developed for immediate military markets are now forming the basis for a wearable picosecond-pulse-based brain imager prototype. The same tiny 1.5cm^2 antenna/radar-IC assemblies designed for short-range radar can be arrayed to create rudimentary readings of real-time vascular and probable neural activity in the brain. Preliminary operating results will be presented, along with a roadmap for achieving a usable spatial image and ultimately creating a wearable 2Kg, low-cost, real-time internet-connected functional BMI/neuroimaging helmet for clinical and operational environments. Potential futuristic applications not possible with fMRI will also be proposed.

Biography

Joel Libove specializes in analog and microwave electronics, MMIC design, picosecond amplifiers, pulse generators and samplers and high dynamic range data acquisition systems. He is founder and president of Furaxa, Inc., where he leads development of a wearable radar-based helmet system for real-time brain imaging.

Libove is also chairman of Ultraview Corp, where he designed real-time parallel VMEbus and PCIbus protocol and timing violation analyzers, which won three industry awards and were used by hundreds of government agencies and corporations. He also led design of six generations of high speed data acquisition boards, with zero-dead-time hardware averaging. These boards are used in military, R&D and medical applications. A 16-channel Ultraview imager-on-a-board is used in the Furaxa imaging helmets.

Joel has 13 patents and one patent pending. He received a Ph.D. and MSEE in engineering from University of California, Berkeley, and a BSEE from Cornell University.

Beyond Innovation: Imagination, Intuition and Insight

Stuart Mason Dambrot
Founder: Critical Thought|TV

Abstract

Innovation – the action or process of creating a novel method, product or idea – requires a number of key factors to be successful. Those factors typically mentioned include passion, expertise, tenacity, flexibility, and creativity. That being said, however, not only are there two types of innovation – that is, sustaining and disruptive – but there are a number of critical factors associated with the latter, these being imagination, intuition and Insight. This presentation will focus on disruptive innovation and the often downplayed value of these three related factors in the successful creation, development and adoption of breakthrough near-and medium-term future technologies that are not yet possible. In addition, examples of renowned scientists and other individuals who have taken this approach to deliver world-changing innovations will be cited.

Biography

Stuart analyzes deep-structure conceptual and neural connections between multiple areas of knowledge and creativity, synthesizes convergent and emergent trends in a wide range of research disciplines, envisions long-term future scenarios, and creates probabilistic pathways to arrive at or avoid these scenarios. His primary interest is evolutionary neurobiology within a technological and sociocultural context. Stuart is giving a talk on Exocortical Cognition at SMC 2016, and as an invited speaker and panelist has spoken about Augmented Cognition, Synthetic Biology, Philosophy of Science, Sociopolitical Futures, Post-Scarcity Economics, and other topics at New York Academy of Sciences, Cooper-Union, World Technology Summit, Science House, and other venues. His publications include *The Zeitgeist of Change: The evolutionary neurobiology of political behavior* and *Of Mind and Money: Post-scarcity economics and human nature*, and has contributed to *IEEE Spectrum, Nature, Science, Nature Biotechnology, Scientific American, Photonics Spectra, New Scientist, Chemical Week, Electronics, Electronic Engineering Times, Japan Times, 01 Informatique, Economist, International Herald Tribune, Financial Times, InfoWorld, Managing Automation, Asian Venture Capital Journal*, and other journals and publications.

Discovery's Uncertain Paths to Success

Bernt R. Wahl
Founder and Director, Brain Machine Interface Consortium
Founder: Factle, Datahunt, Dynamic Software

Abstract

A combination of many elements (technological breakthroughs, market adaptations, strong innovation teams, sufficient resource allocation) determines whether innovation is successful when they interact in a new and effective manner with appropriate timing and convergent creation of a product market. The speaker will discuss life events that helped him navigate through five technology revolutions – Personal Computers, Chaos Theory, the Internet, Big Data/Machine Learning and Brain-Machine Interfaces – each time building on prior experience to lay the foundation for yet unproven future ideas. He will share insights learned from personal knowledge (including stories from his years of teaching entrepreneurship to over 2,000 engineering students all over the world) as well as methods learned from fellow innovators, these encompassing some of Silicon Valley's foremost pioneers as well as a new generation of innovators.

Biography

Bernt Rainer Wahl is a mathematician, mentor, entrepreneur, author, and. currently a founder and director of Brain Machine Interface Consortium. He has served as CEO of Factle Corporation, Datahunt, and Dynamic Software, and is a former UC Berkeley faculty member. Wahl teaches entrepreneurship and engineering around the world, served as an Industry Fellow at the Center of Entrepreneurship and Technology, was Executive in Residence at the Skydeck, and in 2002 was awarded a Fulbright Fellowship to Malaysia. He was an early pioneer in the fields of chaos and fractal geometry, authoring Exploring Fractals (1994) and co-authoring The Fractal Explorer (1991). His first company was in mathematical visualization at Dynamic Software, which he co-founded with Peter Van Roy in 1987, where his work was showcased in the fashion industry, including the work of designer Jhane Barnes and was featured on the cover of Apple's site.

In 2001, Bernt Wahl led the management buyout attempt of the search engine company Infoseek through the firm Datahunt. In 2002 he started Factle, a search engine focused on specialized search and local demographics. Wahl worked for United Nations on ecotourism and helped the U.S. National Park Service build its first website. He is also involved in social causes, including the work done by The International Justice Mission, and various other organizations' work on the global dissemination of information.

Neuroprosthetics: The Role of the Brain's Error Monitoring System

October 10 (Monday), 15:30-16:15, InterContinental Budapest, Ballroom II-III

José del R. Millán
Defitech Foundation Chair in Brain-Machine Interface
Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland

Abstract

Future neuroprosthetics will be tightly coupled with the user in such a way that the resulting system can replace and restore impaired upper limb functions because controlled by the same neural signals than their natural counterparts. This means that, as in natural motor control, goal-directed behavior is dynamically modulated by perceptual feedback resulting from executed actions. Current brain-computer interfaces (BCI) partly emulate human motor control as they decode cortical correlates of movement parameters—from onset of a movement to directions to instantaneous velocity—in order to generate the sequence of movements for the neuroprosthesis. A closer look, though, shows that goal-oriented motor control also incorporates the output of cognitive processes that dynamically modulate volitional interaction. A prominent example of such a kind of perceptual cognitive process is error monitoring. In this talk I will describe recent progress in our lab on decoding error-related brain potentials in a variety of paradigms, including novel BCI paradigms and continuous motor actions.

Biography

Dr. José del R. Millán joined the École Polytechnique Fédérale de Lausanne (EPFL) in 2009 as the first professor of the Center for Neuroprosthetics where he holds the Defitech Foundation Chair. He received a PhD in computer science from the Technical University of Catalonia, Barcelona, in 1992. Previously, he was a research scientist at the Joint Research Centre of the European Commission in Ispra (Italy), a senior researcher at the Idiap Research Institute in Martigny (Switzerland). He has also been a visiting scholar at the Universities of Stanford and Berkeley as well as at the International Computer Science Institute in Berkeley.

Dr. Millán has made several seminal contributions to the field of brain-computer interfaces (BCI), especially based on electroencephalogram (EEG) signals. Most of his achievements revolve around the design of brain-controlled robots. He puts a strong emphasis on the use of statistical machine learning techniques so as to achieve a seamless coupling between the user and the brain-controlled device. A key element is the design of efficient and robust algorithms for real-time decoding of patterns of brain activity associated to different aspects of voluntary behaviour. He also builds on neuroscience findings to design new interaction protocols to operate complex devices. During the last years he is prioritizing the translation of BCI to end-users suffering from motor disabilities. In parallel, he is designing BCI technology to offer new interaction modalities for able-bodied people.

Neural Correlates of the "Aha" Moment: Enabling Brain-Computer Interfaces for Labeling Our Environment

October 11 (Tuesday), 11:00-11:45, InterContinental Budapest, Ballroom I

Paul Sajda
Departments of Biomedical Engineering,
Electrical Engineering and Radiology
Columbia University

Abstract

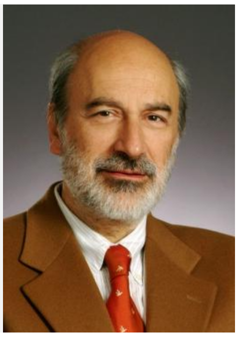
As we move through an environment, we are constantly making assessments, judgments, and decisions about the things we encounter. Some are acted upon immediately, but many more become mental notes or fleeting impressions — our implicit "labeling" of the world. In this talk I will describe our work using physiological correlates of this labeling to construct a hybrid brain-computer interface (hBCI) system or augmented navigation in a simulated 3-D environment. Specifically, we record electroencephalographic (EEG), saccadic, and pupillary data from subjects as they move through a small part of a 3-D virtual city under free-viewing conditions. Using machine learning, we integrate the neural and ocular signals evoked by the objects they encounter to infer which ones are of subjective interest. These inferred labels are propagated through a large computer vision graph of objects in the city, using semi-supervised learning to identify other, unseen objects that are visually similar to those that are labelled. Finally, the system plots an efficient route so that subjects visit similar objects of interest. We show that by exploiting the subjects' implicit labeling, the median search precision is increased from 25% to 97%, and the median subject need only travel 40% of the distance to see 84% of the objects of interest. We also find that the neural and ocular signals contribute in a complementary fashion to the classifiers' inference of subjects 'implicit labeling. In summary, we show that neural and ocular signals reflecting subjective assessment of objects in a 3-D environment can be adaptively integrated with models of that environment, resulting in an hBCI system that improves navigation and information delivery specific to the user's interests.

Biography

Paul Sajda is a professor in the Departments of Biomedical Engineering, Electrical Engineering and Radiology at Columbia University and Director of the Laboratory for Intelligent Imaging and Neural Computing at Columbia University. Much of his current research focuses on using multimodal neuroimaging and behavioral measures to track selective attention and the dynamics of cognitive state during rapid decision making. He also applies these basic scientific findings to engineer neurotechnology systems that improve human-machine interaction. He is a Fellow of the IEEE, Editor-in-Chief of IEEE Transactions on Neural Systems and Rehabilitation and Chair of the IEEE Brain Initiative. Contact him at psajda@columbia.edu.

Toward Cognitive Integration of Prosthetic Devices

October 12 (Wednesday), 16:00-16:45, InterContinental Budapest, Ballroom I



Jose C. Principe
Departments of Electrical Computer Engineering and Biomedical Engineering
University of Florida

Abstract

We are at the brink of a revolutionary technology stage, where machines may be "cognitively integrated" in the human experience, manipulated and controlled through direct brain processes in virtually the same way as we see, walk or grab an external object. But unlike the current generation of brain machine interfaces, this is done through a dialogue that requires the transfer of goals between the machine and the user. The vision is a new kind of implanted prosthetics that senses intentional brain processes (e.g. moving an arm) and translates the spatio-temporal neural signals into models that control external devices. Through the perception-action-reward cycle the brain is made aware of the machine existence and actions, which will provide the basis to be considered a body extension. Several key technological and scientific developments will be discussed to implement this vision.

Biography

Jose C. Principe (M'83-SM'90-F'00) is a Distinguished Professor of Electrical and Computer Engineering and Biomedical Engineering at the University of Florida where he teaches advanced signal processing, machine learning and artificial neural networks (ANNs) modeling. He is BellSouth Professor and the Founder and Director of the University of Florida Computational NeuroEngineering Laboratory (CNEL) www.cnel.ufl.edu . His primary area of interest is processing of time varying signals with adaptive neural models. The CNEL Lab has been studying signal and pattern recognition principles based on information theoretic criteria (entropy and mutual information).

Dr. Principe is an IEEE Fellow. He was the past Chair of the Technical Committee on Neural Networks of the IEEE Signal Processing Society, Past-President of the International Neural Network Society, and Past-Editor in Chief of the IEEE Transactions on Biomedical Engineering. He is a member of the Advisory Board of the University of Florida Brain Institute. Dr. Principe has more than 700 publications. He directed 87 Ph.D. dissertations and 65 Master theses. He wrote in 2000 an interactive electronic book entitled "Neural and Adaptive Systems" published by John Wiley and Sons and more recently co-authored several books on "Brain Machine Interface Engineering" Morgan and Claypool, "Information Theoretic Learning", Springer, and "Kernel Adaptive Filtering", Wiley.

Sensor Technologies for Multimodal Brain Interfacing

October 12 (Wednesday), 14:00-15:35, InterContinental Budapest, Ballroom I

Organized by the IEEE Sensors Council
Organizer: Walt Besio
Session Chairs: Michael H. Smith, Walt Besio

Toward Multimodal Massively Parallel Multichannel Brain-Sensing Interfaces

Mohamad Sawan, Polytechnique Montreal, Canada

Brain-Sensing Interfaces are emerging approaches and devices intended for understanding and subsequent treatment of complex neural vital functions which are provoked by Neurodegenerative Diseases. This talk covers Wearable Multimodal and implantable Biosensors-based systems intended for measurement and neurorecording respectively at action potential (AP) and neurotransmitter levels. Multichannel neurorecording of APs is achieved through compressive sampling and other compression techniques. However cell manipulation, detection, and characterization is based on either dielectrophoresis or magnetophoresis techniques followed by capacitive sensing and frequency monitoring. The wearable multimodel system offers measurement by up to 32 EEG and 256 fNIRS channels. However, for the implantable devices they are built around custom made Laboratory-on-Chip (LoC) platforms which include microelectronics and cell interfaces (microelectrode arrays and/or microfluidic structures). These circuits require power management, low-power circuit, high-data rate and reliable wireless energy and data communication. The microfluidic structures group microchannels and interfaces to bioelectronics and to in situ medium through inlets/outlets. Case studies include: 1) epilepsy on-set seizure detection, 2) monitoring pH levels in cell culture medium through arrays of complementary (P&N) ion-sensitive field effect transistors (ISFETs); 3) Biosensing through magnetic immunoassay-based microsystems for detecting protein toxins in environment. Planar microcoil arrays and system packaging technique are among the challenging issues.

Nanocomposite hydrogel-based chemo-optical transducers and amplifiers: Towards neurochemical sensing

Mike McShane, Texas A&M University, USA

Neurosensing has traditionally emphasized the measurement of biopotentials, with more recent developments in optical and fMRI imaging of blood volume/oxygenation changes as well as electrodes/arrays for electrochemical sensing of neurotransmitters. Optical devices, including fiber optic probes, are complementary tools that offer some overlapping and some complementary features. For example, some optical methods can employ enzymes and monitor reaction products or co-substrates like enzyme electrodes. “Reagentless” and “label-free” sensors are most appropriate for neural sensing; they are also more challenging to achieve because of the need for selective capture molecules or complex spectral analysis to obtain target specificity. This talk will discuss opportunities and limitations of optical devices in neurochemical sensing of energy substrates and neurotransmitters, including use of micro/nanoparticle-enabled systems, from functionalized fiber probes to implantable hydrogels that may be addressed by different interrogation strategies. Our current research emphasis is on developing miniature, injectable biosensor implants with microscale and nanoscale organization to enable observation of interstitial biochemistry. These materials provide specificity through use of various receptors and enhance sensitivity through optical amplification; specifically, the hydrogel-based biochemical sensors exhibit sensitive response by luminescence intensity and lifetime or Raman scattering. Further, they employ materials that can integrate naturally with tissue, such as porous gels and microparticle suspensions, enhancing prospects for accurate, rapid response and long-term monitoring. Research-grade and early commercial prototype instrumentation to interrogate the implants will also be discussed. To conclude, the major remaining challenges to long-term *in vivo* biochemical monitoring with these systems will be highlighted.

Microfabricated Sensors and Devices for Chronic Brain Recording and Stimulation

Vanessa Tolosa, Lawrence Livermore National Laboratory, USA

The market for neuromodulation devices for scientific discovery and clinical therapies is quickly growing. Increasingly, the demand is towards more complex technologies that can record and stimulate at high channel counts for months to years at a time. To meet these demands, the neural engineering community has adopted microfabrication techniques from the integrated circuits industry to develop chronic, implantable neural interfaces for brain recording and stimulation. At Lawrence Livermore National Lab (LLNL), we are developing advanced neural interface technologies that aim to provide closed-loop neuromodulation therapies in humans and chronic, large-scale brain recording in small and large animal platforms. We design and fabricate microelectrode arrays using flexible polymer substrates and long-lasting electrode materials. We perform extensive electrical and electrochemical testing of the arrays and electrodes to determine failure modes and lifetime. We are developing devices for several applications including a “smart” DBS system capable of closed-loop neuromodulation using 4 – 8x greater channel count than commercially available DBS devices. This allows clinicians to treat brain disorders using a larger treatment parameter space. We are also developing a system that can record single-units across thousands of channels across the whole brain. To date, we have shown high quality single-unit recordings in rat for greater than 9.5 months, with non-human primate studies underway. We are developing biocompatible, high channel count, chronic neural technologies designed to advance clinical therapies and scientific knowledge. This work was performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory, contract number DE-AC52-07NA27344. LLNL Team: V. Tolosa, A. Tooker, T. Delima, K. Lee, S. Chen, D. Soscia, A. Belle, A. Ivanovskaya, M. Crosetti, T. Datta, J. Pebbles, S. Sundaram, E. Wheeler, A. Sperry. Former Members: S. Pannu, K. Shah, S. Felix

Concentric Electrodes for Noninvasive Bidirectional Brain-Machine Interfaces

Walt Besio, University of Rhode Island, USA

Epilepsy affects more people than multiple sclerosis, cerebral palsy, muscular dystrophy and Parkinson's combined. Although there are anti-seizure drugs and surgical interventions around 30% of the people with epilepsy still have seizures. Paralysis affects approximately 1 in 50 US citizens. There are no known cures for paralysis. This talk will describe the use of unique concentric ring electrodes for noninvasive neural activity sensing and, the reverse, electrical stimulation. We have developed focal noninvasive bi-directional interfaces for automatic seizure control. We have been able to noninvasively stop acute seizures from penicillin, pilocarpine and pentylenetetrazol. Further, we have shown that electroencephalography (EEG) from tripolar concentric ring electrodes (TCREs), or tEEG, result in significantly better real-time computer cursor control. The addition of functional near infrared spectroscopy (fNIRS) with tEEG further enhances the ability to recognize imagined movements. This Research supported in part by NSF award 1539068 to WB. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Science Foundation.

Optical-based Technologies for Brain Imaging and Manipulation

Jun Ohta, Nara Institute of Science and Technology, Japan

Recently, combination of genetic engineering and optical technology makes it possible to bidirectional optical communication with brain. By introducing gene transfer technology, fluorescent protein such as GFP enables an optical tag, and photoactive protein such as ChR2 enables optical manipulation. Conventionally, a fluorescent microscope has been used for imaging and optical stimulation. It is, however, difficult to apply the method to a freely-moving mouse due to its requirement of fixing the mouse under a microscope stage. We have developed a miniaturized optoelectronic device which employs a dedicated CMOS image sensor and micro light emitting devices (LEDs), and can be implanted in the deep brain of a mouse to optically measure and control the brain functions of the mouse. The device is so light in its weight that a mouse implanted the device can move freely. In this presentation, I introduce some kinds of optoelectronic devices for measuring and controlling biological functions of freely-moving mice. Next, I describe our developed optoelectronic devices that can be implanted in a mouse deep brain. The fundamental device structure and performance are mentioned and some experimental results in vivo are demonstrated. Finally, future direction is addressed for achieving bidirectional optical communication with brain.

Joining SMCS BMI Technical Committee

You are welcome to join SMCS Technical Committee on Brain-Machine Interface Systems. You do not have to be a SMC Society member to join our TC, although we do encourage you to become one in order to benefit from a wide range of professional activities and privileges.

To join SMC's BMI TC, contact via e-mail a BMI TC Co-Chair and provide your name, title, position, affiliation, and a self-introduction.

We hope you will enhance your professional skills and potential through your activities in our Technical Committee.

Our Goal

Brain-Machine Interfaces (BMI) are about transforming thought into action, or, conversely, sensation into perception. One example of this paradigm contends that a user can perceive sensory information and enact voluntary motor actions through a direct interface between the brain and a prosthetic device in virtually the same way that we see, hear, walk, or grab an object with our own natural limbs.

The primary objective of the BMI Systems Technical Committee is to bring together specialists from the different areas that will be required as part of any real-world BMI system: systems neuroscience, system integration, sensors, integrated circuits, machine learning, control, robotics, biology, clinical studies, neurologists, system engineers, cybernetic experts, human-machine professionals, and other computer scientists and engineers working in this interdisciplinary environment. The goal of the TC is to provide a basis for the exchange of information and resources among these diverse communities, to enable interactions between groups from these fields and to bring a systems perspective to the field of BMI.

Join Us

- Interact with experts in Brain Machine Interface Systems, which is a relatively new and rapidly growing research field. Both invasive and non-invasive techniques (BCI) for interfacing the brain are included.
- Participate in interesting conferences and workshops.
- Make friends from different regions of the world.
- Exchange research ideas and possibly share research resources.

Additional Information:

http://www.ieeesmc.org/technical-activities/human-machine-systems/brain-machine-interface-systems

BMI Papers I – Performance Metrics and Human Factors for BMI Training and Operation (BMI Workshop Special Session VI)

Organizers: R. Chavarriaga, F. Lotte, C. Jeunet
October 11 (Tuesday), 09:30-11:00, InterContinental Budapest, Panorama I
Session Chairs: T. Zander, C. Jeunet

#1225 Supervision of time-frequency features selection in EEG signals by a human expert for brain–computer interfacing based on motor imagery

Alban Duprès (FR), François Cabestaing (FR), José Rouillard (FR)

In the context of brain–computer interfacing based on motor imagery, we propose a method which allows an expert to select manually time-frequency features. This selection is performed specifically for each subject, by analysing a set of curves that emphasize differences of brain activity recorded from electroencephalographic signals during the execution of various motor imagery tasks. We will show that expert knowledge is very valuable to supervise the selection of a sparse set of significant time-frequency features. Features selection is performed through a graphical user interface to allow an easy access to experts with no specific programming skills. In this paper, we compare our method with three fully-automatic features selection methods, using dataset 2A of BCI competition IV. Results are better for five of the nine subjects compared to the best competing method.

#1394 Mastery confidence influences P300 based Brain-Computer Interface (BCI) Performance

Sonja Kleih (DE)

In this study we investigated the effect of mastery confidence manipulation on BCI performance and P300 amplitude. We used a 6x6 P300 speller matrix and participants spelled words containing five letters each. Using a cover story, thirty-six participants were misinformed that they would use classification algorithms of diverse difficulty in three experimental blocks (easy, medium, hard condition). According to classification accuracy, a varying number of mistakes would occur. To support our cover story, we implemented a fake feedback which fed back one mistake in the easy condition, two mistakes in the medium condition and four mistakes in the hard condition per word. We found no significant effect of our mastery confidence manipulation. Neither P300 amplitude nor performance accuracy differed between conditions. We conclude that either we could not successfully manipulate mastery confidence or mastery confidence as a psychological variable cannot contribute to substantial explanation of variance in BCI performance.

#1918 A Task-Independent Workload Classifier for Neuroadaptive Technology: Preliminary Data

Laurens Ruben Krol (DE), Sarah Christin Freytag (DE), Markus Fleck (DE), Klaus Gramann (DE), Thorsten Oliver Zander (DE)

Passive brain-computer interfacing allows computer systems direct access to aspects of their user's cognition. In essence, a computer system can gain information about its user without this user needing to explicitly communicate it. Based on this information, human-computer interaction can be made more symmetrical, solving an age-old but still fundamental problem of present-day interaction techniques. For practical real-world application of this technology, it is important that cognitive states can be identified accurately and efficiently. Here we present preliminary data demonstrating it is possible to calibrate a task-independent classifier to identify when a user is under heavy workload across different activities. We used different types of mental arithmetic and even a semantic task. Task-independent classification is an important step towards real-world practical application of this technology.

#2083 Towards a Spatial Ability Training to Improve Motor Imagery based Brain-Computer Interface (MI-BCI) Performance: a Pilot Study

Suzy Teillet (FR), Fabien Lotte (FR), Bernard N'Kaoua (FR), Camille Jeunet (FR)

Although Mental Imagery based Brain-Computer Interfaces (MI-BCIs) seem to be very promising for many applications, they are still rarely used outside laboratories. This is partly due to suboptimal training protocols, which provide little help to users learning how to control the system. Indeed, they do not take into account recommendations from instructional design. However, it has been shown that MI-BCI performances are significantly correlated to certain aspects of the users' cognitive profile, such as their Spatial Abilities (SA). Thus, it remains to be elucidated whether training the SA of BCI users would also improve their BCI control performance. Therefore, we proposed and validated an SA training that aimed at being included in an MI-BCI training protocol. Our pre-studies indeed confirmed that such a training does increase people's SA abilities. We then conducted a pilot study with 3 participants, one with a standard MI-BCI training protocol, one with the proposed SA training integrated into a standard MI-BCI training, and another control integrating another training, here verbal comprehension tasks, into a standard MI-BCI training. While such a small population cannot lead to any strong result, our first results show that SA training can indeed be integrated into MI-BCI training and is thus worth being further investigated for BCI user training.

BMI Papers II – Adaptive and Self-Calibrating BMI Systems for Independent Use (BMI Workshop Special Session II)

Organizers: R. Chavarriaga, R. Scherer
October 11 (Tuesday), 09:30-11:00, InterContinental Budapest, Panorama V
Session Chairs: R. Chavarriaga, R. Scherer

#1123 Restricted Boltzmann Machines in Sensory Motor Rhythm Brain-Computer Interfacing: A Study on Inter-Subject Transfer and Co-Adaptation

Reinmar Josef Kobler (AT), Reinhold Scherer (AT)

Naive users often perceive calibration of a Sensory Motor Rhythm (SMR) based Brain-Computer Interfaces (BCI) as tedious and lengthy. The lack of feedback during training is assumed to be a major cause. I.e. if one had already a reasonable model to start with, feedback training could be started immediately. One concept to address this issue is learning a general model and adapting it to new observations. In this study we applied this concept by utilizing a generative model entitled Restricted Boltzmann Machine (RBM). We investigated its feature extraction capabilities by fitting a RBM to recordings of 9 subjects. Generalization was assessed in an online coadaptive study, covering 12 volunteers (10 naive). An overall median accuracy of 88.9% (83.5% naive) with a standard-error of 6.5% (6.6% naive) was achieved for a classical hand versus feet motor imagery task. The online co-adaptive training itself lasted approximately 25 minutes. Feedback was already presented after a one minute setup run, whose purpose was to estimate initial statistics and to train an online artifact detection system.

#1196 Spectral Meta-Leaner for Regression (SMLR) Model Aggregation: Towards Calibrationless BCI

Dongrui Wu (US), Vernon Lawhern (US), Stephen Gordon (US), Brent Lance (US), Chin-Teng Lin (TW)

To facilitate the transition of brain-computer interface (BCI) systems from laboratory settings to real-world application, it is very important to minimize or even completely eliminate the subject-specific calibration requirement. There has been active research on calibrationless BCI systems for classification applications, e.g., P300 speller. To our knowledge, there is no literature on calibrationless BCI systems for regression applications, e.g., estimating the continuous drowsiness level of a driver from EEG signals. This paper proposes a novel spectral meta-learner for regression (SMLR) approach, which optimally combines base regression models built from labeled data from auxiliary subjects to label offline EEG data from a new subject. Experiments on driver drowsiness estimation from EEG signals demonstrate that SMLR significantly outperforms three state-of-the-art regression model fusion approaches. Although we introduce SMLR as a regression model fusion in the BCI domain, we believe its applicability is far beyond that.

#1646 Multi-Task Logistic Regression in Brain-Computer Interfaces

Karl-Heinz Fiebig (DE), Vinay Jayaram (DE), Jan Peters (DE), Moritz Grosse-Wentrup (DE)

A brain-computer interface (BCI) is used to enable communication between humans and machines by decoding elicited brain activity patterns. However, these patterns have been found to vary across subjects or even for the same subject across sessions. Such problems render the performance of a BCI highly specific to subjects, requiring expensive and time-consuming individual calibration sessions to adapt BCI systems to new subjects. This work tackles the aforementioned problem in a Bayesian multi-task learning (MTL) framework to transfer common knowledge across subjects and sessions for the adaptation of a BCI to new subjects. In particular, a recent framework, that is able to exploit the structure of multi-channel electroencephalography (EEG), is extended by a Bayesian hierarchical logistic regression decoder for probabilistic binary classification. The derived model is able to explicitly learn spatial and spectral features, therefore making it further applicable for identification, analysis and evaluation of paradigm characteristics without relying on expert knowledge. An offline experiment with the new decoder shows a significant improvement in performance on calibration-free decoding compared to previous MTL approaches for rule adaptation and uninformed models while also outperforming them as soon as subject-specific data becomes available. We further demonstrate the ability of the model to identify relevant topographies along with signal band-power features that agree with neurophysiological properties of a common sensorimotor rhythm paradigm.

#2269 Unsupervised Adaptive Transfer Learning for Steady-State Visual Evoked Potential Brain-Computer Interfaces

Nicholas R Waytowich (US), Josef Faller (US), Javier O Garcia (US), Jean M Vettel (US), Paul Sajda (US)

Recent advances in signal processing for the detection of Steady-State Visual Evoked Potentials (SSVEPs) have moved away from traditionally calibrationless methods, such as canonical correlation analysis, and towards algorithms that require substantial training data. In general, this has improved detection rates, but SSVEP-based brain-computer interfaces (BCIs) now suffer from the requirement of costly calibration sessions. Here, we address this issue by applying transfer learning techniques to SSVEP detection. Our novel Adaptive-C3A method incorporates an unsupervised adaptation algorithm that requires no calibration data. Our approach learns SSVEP templates for the target user and provides robust class separation in feature space leading to increased classification accuracy. Our method achieves significant improvements in performance over a standard CCA method as well as a transfer variant of the state-of-the art Combined-CCA method for calibrationless SSVEP detection.

#2278 Closed-loop regulation of user state during a boundary avoidance task

Josef Faller (US), Sameer Saproo (US), Victor Shih (US), Paul Sajda (US)

Pilot induced oscillations (PIOs) are potentially catastrophic events that occur during flight when pilots attempt to control an aircraft close to a performance or physical boundary. PIO-like behavior is typically observed in boundary avoidance tasks (BAT), which simulate tight performance or physical boundaries and induce high cognitive workload. Our previous research linked the occurrence of PIO-like behavior to network level activity in the brain, where higher states of arousal reduce the flexibility of decision making networks such that less environmental information was incorporated to dynamically adjust action. This led us to hypothesize that down regulating arousal via closed-loop audio feedback of a user state could improve piloting performance by enabling increased decision flexibility. Here we show our initial results testing this hypothesis, where we use a hybrid brain computer interface (hBCI) to dynamically provide feedback to a pilot" that facilitates their ability to reduce their state of arousal. We conduct a systematic comparison relative to control and sham conditions and test to see if this feedback increases the time a "pilot" can fly before a catastrophic PIO. We find that hBCI feedback, which includes CNS components consistent with theta activity in the anterior cingulate (ACC), enables prolonged flight relative to closed-loop control and sham feedback. We also find that this feedback induces changes in pupil diameter which are absent in open-loop conditions and closed-loop conditions when feedback is not veridical. Pupil diameter has been reported as a surrogate measure of activity in the locus coeruleus-norepinephrine (LC-NE) system which is also linked to a circuit consisting of the ACC. We conclude that the feedback we induce with our hBCI provides preliminary evidence that self-regulation of LC-NE/ACC is possible and can be used to dynamically increase decision flexibility when under high cognitive workload.

BMI Papers III – Health and Non-Invasive Wearable BMI (BMI Workshop Special Session III)

Organizer: K. Khaderi
October 11 (Tuesday), 09:30-11:00, InterContinental Budapest, Ballroom I
Session Chairs: K. Khaderi, J. Libove

#2254 Cellular Wireless Energy Harvesting for EEG Applications on Smart Contact Lens

Luyao Chen (CA), Ehsan Kamrani (CA), Huayi Gao (CA)

An energy harvester for a smart contact lens that monitors epilepsy is developed here. The energy harvester is designed to rectify a portion of a cellular phone emitted uplink signal into DC power for the operations of on-lens EEG hardware. An electrically realistic human eye model is designed and fabricated using 3D printing technologies to assist in various measurements of the proposed energy harvester. A dipole antenna is fabricated and measured on the eye model to validate the power available for EEG to function.

#2280 The Visual System as a Proxy for Evaluation of Brain Function

Khizer R. Khaderi (US), Anna E. Nidecker (US), Peter Y Shen (US), Jeff H Pettey (US), Mohan K Reddy (US)

Purpose: Show how the visual system can be a proxy for brain function. Design: Original observational experiment Methods: Normal subjects underwent measurement of visual motility, pupillometry, and electroencephalogram for comparison with established and reported values Conclusion: The commercially available eye tracker and EEG band tested delivered values consistent with published normal control values. Further work with these devices on mild traumatic brain injury patients may provide important diagnostic and prognostic data for these injuries.

#2393 Auto-Powered Intraocular Lenses for Multi-Modal Brain Computer Interfacing

Ehsan Kamrani (CA)

A novel brain-machine interface (BCI) system for monitoring brain activities using functional intraocular lenses (IOL) has been introduced in this paper. It uses the correlation between the ocular signals with neural and hemodynamic activities to monitor and translate the brain dynamics to electric signal and then wirelessly delivers the data to the environment including external reader device or smartphone. A self-powered dual-modal BCI device embedded in an accommodative intraocular lens for electroencephalogram (EEG) and functional near infrared spectroscopy (fNIRS), is presented.

#2136 Wearable Brain Imager/BMI Technology for Structural, Vascular and Functional Extraction

Joel Libove (US), David Schriebman (US), Mike Ingle (US), Bernt Wahl (US)

Portable, low power, low-cost, flexible wearable Brain Machine Interfaces (BMIs) for real time brain imaging, with far higher potential spatial resolution than EEG, are being designed and prototyped using new chip architectures. Preliminary depth-indexed readings of real-time vascular and probable neural activity in the brain have been demonstrated using arrays of ultra-high dynamic range (160dB DANL) 1cm2 Ultra Wide Band (UWB) pulser/antenna/sampler assemblies. These ICs generate 5-300ps pulses and detect the resulting reflections from brain tissue boundaries. They cancel out 1/f noise, and are sensitive enough to detect energy reflected from deep tissues, as well as the signal transmitted through even the longest dimensions of the head, and display vascular pulsation and, for the first time, rudimentary indications of functional brain activity.

#2013 Real-Time Step Detection Using the Integrated Sensors of a Head-Mounted Display

Polona Caserman (DE), Patrick Hubert Krabbe (DE), Janis Wojtusch (DE), Oskar von Stryk (DE)

Recent improvements in virtual reality technology and head-mounted displays have led to a number of novel and innovative applications in entertainment, education, science and healthcare. The primary goal in most of these applications is to give the user a sensation of being part of the virtual reality. This focus on presence or immersion requires to create a connection between the user and the virtual environment but also between the user and his virtual avatar. Synchronizing the body movement of the user and his avatar can help to improve the feeling of presence by enhancing the experience of agency and body ownership over the avatar. A typical example is the combination of a head-mounted display and a treadmill to create a realistic walking or running simulation in a virtual environment. In this scenario, the synchronization of leg movement improves the feeling of presence and allows to further enhance the virtual experience, for example by adjusting gait parameters of the avatar or triggering customized stepping sounds. This paper presents a robust real-time step detector that uses the integrated sensors of a state-of-the-art head-mounted display and allows to recognize the pattern of individual steps. No additional sensors on the trunk or lower body are required. By applying a coordinate transformation and straightforward signal processing, it is possible to discriminate between left and right steps and detect the current walking speed. This information is used to animate a virtual avatar by scaling a predefined walking trajectory and to control the walking speed within a virtual environment.

BMI Papers IV – Real World Applications of Brain Computer Interface Systems (I) (BMI Workshop Special Session IV)

Organizer: V. A. Prasad
October 12 (Wednesday), 09:30-11:00, InterContinental Budapest, Panorama I
Session Chairs: V. A. Prasad, T. Mullen

#1007 Brain-machine Interfacing-based Teleoperation Control of A Wheeled Mobile Robot

Suna Zhao (CN), Zhijun Li (CN)

This paper describes the development of teleoperation control framework of a mobile robot through brain-machine interface. Utilizing the remote images of environment, transferred to the human operator, visual compressive feedback loop produces imagine errors in non-vector space, where images are considered as a set without image processing of feature extraction. Given an initial set and a goal set, EEG motion commands are evoked to make the error of the two sets converge to zero. The online BMI (Brain Machine Interface), utilizing steady state visually evoked potentials (SSVEP), analyzes the human EEG data in such a format that human intentions can be recognized by AdaBoostSVM classifier and motion commands produced for the teleoperated robot. Bezier curve is utilized to parameterize the motion commands and the low level motion controller to track the reference trajectory. Extensive experimental studies have been done to assess the performance of the proposed BMI system.

#1448 Voice Familiarity Detection using EEG-based Brain-Computer Interface

Mahesh Kallelil (IN), Smitha Kavallur (SG), Vinod Achutavarrier Prasad (SG)

Brain-Computer Interface (BCI) is a direct communication pathway between brain and external devices bypassing the natural pathway of nerves and muscles. BCI enables an individual to send commands to a peripheral device using his brain activity. Electroencephalogram (EEG) is the most commonly used brain signal acquisition method as it is simple, economical and portable. Feasibility of detecting familiar vs non-familiar voice signals using EEG signals has been investigated in this paper. The results show that combination of features such as mobility and complexity of the signal gives an average accuracy of 72.2% in classifying between familiar and unfamiliar voices among 8 subjects.

#1811 A Novel Supervised Locality Sensitive Factor Analysis to Classify Voluntary Hand Movement in Multi-Direction Using EEG Source Space

Vikram Shenoy Handiru (SG), Vinod Achutavarrier Prasad (SG), Cuntai Guan (SG)

Recent advances in EEG-based brain–computer interfaces (BCIs) have shown that brain signals can be used to decode arm movement intention and execution in multiple directions. Conventional approaches use sensor space EEG for classifying movement related tasks. Sensorspace EEG can reveal only limited information about the trivial but complex tasks that involve higher degrees of freedom of the movement. On the contrary, source space analysis is expected to provide more information about the neurophysiological mechanism relevant to the task. To this end, we propose a novel source-space feature extraction technique based on supervised locality sensitive Factor analysis which approximates the neurophysiological functioning of our experimental data in a better way than that of a solely data-driven approach. EEG recordings in the sensor space are transformed into source space using the Weighted Minimum Norm Estimate (wMNE) method. We show that for a multi-class classification problem of classifying the EEG of voluntary arm movement in 4 orthogonal directions, the source space features offer a significant improvement in the classification accuracy compared to sensor space features. One-versus-rest (OVR) approach is used for multiclass classification with Fisher's Linear Discriminant (FLD) as the primary classifier.

#1839 Brain-Computer Interfacing for Multimedia Quality Assessment

Sebastian Bosse (DE), Klaus-Robert Müller (DE), Thomas Wiegand (DE), Wojciech Samek (DE)

Multimedia quality assessment is a central research field in information and media technology. Recently, brain- computer interfacing (BCI) based methods have been proposed to assess perceived quality. In this paper we give an overview on the state-of-the art and discuss open questions and challenges relevant to the BCI community.

#1947 EEG based Stress Level Identification

Guo Jun (SG), Smitha Kavallur (SG)

This paper investigates detection of patterns in brain waves while induced with mental stress. Electroencephalogram (EEG) is the most commonly used brain signal acquisition method as it is simple, economical and portable. An automatic EEG based stress recognition system is designed and implemented in this study with two effective stressors to induce different levels of mental stress. The Stroop colour-word test and mental arithmetic test are used as stressors to induce low level and high level of stress respectively, and their relevant C# applications are developed in Microsoft Visual Studio to interface with Emotiv Epoc device. Power band features from EEG signals are analyzed and using the relative difference of beta and alpha power as feature along with Support Vector Machine as classifier, three-levels of stress can be recognized with an accuracy of 75%. For two-level stress analysis, accuracy of 88% and 96% are achieved for Stroop colour-word test and mental arithmetic test respectively.

BMI Papers V – BMI for Motor/Cognitive Rehabilitation and Assistance (I) (BMI Workshop Special Session V)

Organizer: R. Chavarriaga
October 12 (Wednesday), 09:30-11:00, InterContinental Budapest, Panorama V
Session Chairs: G. Prasad, J. M. Azorin

#1070 Evaluating decoding performance of upper limb imagined trajectories during center-out reaching tasks

Andres Ubeda (ES), Jose M Azorin (ES), Ricardo Chavarriaga (CH), José del R. Millán (CH)

In recent years, several studies have shown that there is a correlation between electroencephalographic (EEG) signals and hand-reaching kinematic parameters after applying linear decoders. These studies have been generally conducted using actual upper limb movements, but so far there has been little discussion about the possibility of applying these decoders to motor imagery tasks. Moreover, the use of these decoders is rather controversial and there is no general agreement about the metrics used to compare decoded and real kinematics. In this paper, we have applied this methodology to upper limb imagined movements using a center-out protocol. Our results show that, although decoding performance is poor, there are significant components, particularly in horizontal imagined movements, that could be translated into reliable output commands. For this purpose, we have proposed a discrete classification of reached targets showing significant classification rates when the number of classified targets decreases.

#1198 The adjustment of muscle synergy recruitment by controlling muscle co-contraction during the reaching movement

Hiep Vu Nguyen Sy (JP), Isao Nambu (JP), Yasuhiro Wada (JP)

Muscle synergy is defined as a combination of the limited number of muscle activities, which has been considered useful for controlling a large number of degrees of freedom in the musculoskeletal system. In previous studies, the robustness of muscle synergy recruitment across biomechanical tasks has been reported, i.e., the central nervous system controls a few pre- organized muscle synergies corresponding to a specific motor behavior. In contrast, the present study considers a different hypothesis wherein muscle synergy recruitment can be affected by muscle contraction. In our experiment, the subjects were instructed to perform an additional muscle contraction during the eight directional point-to-point reaching movement, on the basis of visual feedback of four levels of contraction. The result of extracted muscle synergies from electromyogram across contraction levels that as the level of contraction increases, so does the number of recruited muscle synergy. Moreover, we found a high similarity between shared muscle synergies–the first synergy under different levels of contraction. The result revealed the hypothesis that pre-organized synergies may be responding to the specific motor task but this coordination of existing muscle synergies can be adjusted by muscle contraction. This adjustment can be useful to develop the more complex myoelectric interfaces efficiently which could control not only arm motion but also arm force.

#1444 Analyzing electrode configurations to detect intention of pedaling initiation through EEG signals

Marisol Rodriguez-Ugarte (ES), Alvaro Costa (ES), Eduardo Iañez (ES), Jose M Azorin (ES)

Restoring the gait cycle is vital in motor-impaired people. To accomplish this, it is necessary to study the brain signals in different areas. This work analyzes EEG data offline and pseudo-online for different electrode configurations and different processing-time windows to detect the pedaling start initiation. Premotor cortex is the area related to movement intention. Therefore, in this study, the FZ electrode, which is located in this area, was included in the analysis of the electrode configurations, testing whether it plays an important role in the detection of pedaling start intention. Results show that using time before and after the movement onset for processing is preferred. The presence of the FZ electrode seems to be desirable when analyzing data offline, but is not statistically significant when analyzing data pseudo-online. This suggests the FZ electrode could be ignored when analyzing data in real time, since the processing is the same as pseudo-online.

#1589 EMOHEX: An Eye Tracker based Mobility and Hand Exoskeleton Device for Assisting Disabled People

Yogesh Kumar Meena (GB), Anirban Chowdhury (IN), Hubert Cecotti (GB), KongFatt Wong-Lin (GB), Shyam Sunder Nishad (IN), Ashish Dutta (IN), Girijesh Prasad (GB)

People suffering from a variety of upper and lower limb disabilities due to different neuro-muscular diseases or injuries, often find it difficult to perform day-to-day activities of mobility and grasping (pick and place) objects. This paper presents the feasibility and utility of a newly developed assistive device named EMOHEX, for disabled people to perform some activities of daily living (ADL). EMOHEX is an integrated platform that combines a low cost eye-tracking device with a powered-wheelchair mounted hand-exoskeleton, which can assist disabled people in grasping objects while moving around. A dual control panel based graphical user interface is designed wherein the user’s intention to select any command button is detected through eye-tracking. The dual control consists of wheelchair control panel and exoskeleton control panel, which are interchangeable by a switch button common to both the panels. The hand-exoskeleton is capable of assisting grasp, hold, and release action. Experiments conducted on 16 healthy subjects revealed that performance metrics were significantly ($p<0.01$) similar for the same task complexity while for different task complexities the performance metrics were significantly ($p<0.01$) different across all the subjects. These results showed the feasibility and stability of the system, respectively. Moreover, the information transfer rate (ITR) of eye-tracker was found satisfactory at 55.281.29 bits/min and 51.021.72 bits/min for simple and complex task, respectively. Thus, EMOHEX has the potential as a quality assistive device for disabled people.

BMI Papers VI – Neuroscience Based Design: Fundamentals and Applications (BMI Workshop Special Session I)

Organizers: R. Scherer, O. Sourina, S. C. Wriessneger
October 12 (Wednesday), 09:30-11:00, InterContinental Budapest, Duna Salon II
Session Chairs: R. Scherer, O. Sourina, S. C. Wriessneger

#1256 Evaluation of a Neurofeedback-based Cognitive Telerehabilitation System for Neurological Patients

Silvia Erika Kober (AT), Daniela Pinter (AT), Siegrid Fuchs (AT), Christa Neuper (AT), Christian Enzinger (AT), Guilherme Wood (AT)

Aim of this study was to provide a proof-of-principle for a neurofeedback-based cognitive telerehabilitation system. Here we describe the implementation of the system and its application and evaluation in two neurological patients with multiple sclerosis suffering from cognitive deficits. The portable telerehabilitation system consists of a small EEG amplifier, an easy-to-use semi-dry EEG headset and a laptop enabling home-based neurofeedback training. The patients performed ten home-based neurofeedback training sessions, which were supervised remotely by an EEG expert. During neurofeedback training, participants tried to voluntarily increase the amplitude of the sensorimotor rhythm (SMR, 12–15 Hz) in the EEG. Before and after neurofeedback training, cognitive functions were assessed using standardized neuropsychological tests. Results demonstrate the feasibility and efficacy of the neurofeedback-based cognitive telerehabilitation system on different levels. On the technical level, we could show that the system works flawlessly and can be easily used by neurological patients on their own at the patients' home. On the behavioral level, our results indicate that the effects of the home-based neurofeedback training are comparable to effects of conventional neurofeedback training performed in a standard lab or clinical environment. The patients were able to voluntarily modulate their own brain activity in the desired direction and they showed cognitive improvements after neurofeedback training compared to a pre-measurement. Hence, our study demonstrates the great potential value of such a neurofeedback-based telerehabilitation system for future cognitive rehabilitation.

#1499 Brain-Computer Interface adaptation for an end user to compete in the Cybathlon

Andreas Schwarz (AT), David Steyrl (AT), Gernot R Müller-Putz (AT)

Non-invasive brain-computer interfaces (BCI) aim to assist severely motor impaired persons in their daily life routine, however only a few BCIs have made it out of the laboratory. To foster further development, the Cybathlon, an international multi-discipline tournament, has been founded. One of the disciplines is the BCI-Race, where end users control avatars in a virtual race game by their thoughts. The game supports 4 different commands which accelerate the avatar and increase the chance to win. So far, no gold standard procedure has been established on how to enable, train and individualize multiclass BCI control for users. In this work we present a 4-stage procedure to closely tailor a multi-class BCI to an end user who will participate in the Cybathlon. In stage I we test for basic BCI-capability, in stage II we evaluate the most suitable mental tasks for the user and in stage III we test user compliance while perceiving feedback. Finally in stage IV the user is playing the competition game. Our procedure provides a promising way to guide users from first contact with BCI technology to actually play a videogame by thoughts. We demonstrate the feasibility of our procedure at the pilot of the GRAZ-BCI racing team MIRAGE91.We believe that an evidence based procedure, maybe similar to the one presented in this work is a necessity to introduce BCI technology in the daily life of potential end users.

#1722 Using Support Vector Regression to Estimate Valence Level from EEG

Zirui Lan (SG), Gernot R Müller-Putz (AT), Lipo Wang (SG), Yisi Liu (SG), Olga Sourina (SG), Reinhold Scherer (AT)

Emotion recognition is an integral part of affective computing. An affective brain-computer-interface (BCI) can benefit the user in a number of applications. In most existing studies, EEG (electroencephalograph)-based emotion recognition is explored in a classificatory manner. In this manner, human emotions are discretized by a set of emotion labels. However, human emotions are more of a continuous phenomenon than discrete. A regressive approach is more suited for continuous emotion recognition. Few studies have looked into a regressive approach. In this study, we investigate a portfolio of EEG features including fractal dimension, statistics and band power. Support vector regression (SVR) is employed in this study to estimate subject's valence level by means of different features under two evaluation schemes. In the first scheme, a SVR is constructed with full training resources, whereas in the second scheme, a SVR only receives minimal training resources. MAE (mean absolute error) averages of 0.74 and 1.45 can be achieved under the first and the second scheme, respectively, by fractal feature. The advantages of a regressive approach over classificatory approach lie in continuous emotion recognition and the possibility to reduce training resources to minimal level.

#1894 Assessing Haptic Video Interaction with Neurocognitive Tools

Shahzad Rasool (SG), Xiyuan Hou (SG), Yisi Liu (SG), Alexei Sourin (SG), Olga Sourina (SG)

Haptic interaction is a form of a user-computer interaction where physical forces are delivered to the user via vibrations, displacements and rotations of special haptic devices. When quality of the experience of the haptic interaction is assessed, mostly subjective tests using various questionnaires are performed. We proposed novel neurocognitive tools for assessing both overall experience of the haptic interaction, as well as particular time-stamped activities. Our assessment tools are based on recognition of emotions and stress obtained from Electroencephalograms (EEG). We used them in a feasibility study on adding haptic interaction to Skype video conversation.

#2112 Lets play Tic-Tac-Toe: A Brain-Computer Interface case study in cerebral palsy

Reinhold Scherer (AT), Andreas Schwarz (AT), Gernot R Müller-Putz (AT), Viktoria Pammer-Schindler (AT), Mariano Lloria Garcia (ES)

Operating Brain-Computer Interfaces (BCIs) that are based on the detection of changes in oscillatory non- invasive electroencephalogram (EEG) typically involves learning. Commonly, the learning process is distributed between the user (reliable EEG pattern generation) and the machine (robust EEG pattern detection). Standard training approaches, however, typically do not allow users to gain meaningful levels control. A better understanding of brain functioning or the use of sophisticated machine learning are ways to enhance control. Rethinking training paradigms is another option. In this paper, we enhance our game-based training approach by adding competitive elements. Winning is a powerful motivator that increases user engagement of the typically boring BCI training experience. We report on an end user with cerebral palsy who successfully gained BCI control and played the classical Tic-Tac-Toe game against his caregiver.

BMI Papers VII – BMI for Neurodriving (BMI Workshop Special Session VII)

Organizers: S-W. Lee, J.d.R. Millán
October 12 (Wednesday), 09:30-11:00, InterContinental Budapest, Ballroom I
Session Chairs: S-W. Lee, J.d.R. Millán

#1221 Dynamic Potential-Model-Based Feature for Lane Change Prediction

Hanwool Woo (JP)

We propose a prediction method for lane changes of other traffic participants. According to previous research, over 90% of car crashes are caused by human mistakes, and lane changes are the main factor. Therefore, if an intelligent system can predict a lane change and alarm a driver before another vehicle crosses the center line, this can contribute to reducing the accident rate. The main contribution of this work is to propose a new feature describing the relationship of a vehicle to adjacent vehicles. We represent the new feature using a dynamic characteristic potential field that changes the distribution depending on the relative number of adjacent vehicles. The new feature addresses numerous situations in which lane changes are made. Adding the new feature can be expected to improve prediction performance. We trained the prediction model and evaluated the performance using a real traffic dataset with over 900 lane changes, and we confirmed that the proposed method outperforms previous methods in terms of both accuracy and prediction time.

#1417 Classification of Movement-related Cortical Potentials for Multi-Command Control based on Brain-Machine Interface

Ji Yong Kim (KR), Seong-Whan Lee (KR)

Decoding of various motor intentions for generating command is one of the important factors in brain-based wheelchair system. The goal of this study focuses on classifying four types of trunk-related motor execution and imagery intentions. By brain components which are related to the trunk-related movements (waist, shoulder, and trunk) are generated in the very small and very close brain areas; therefore, decoding of trunk-related motor intentions are not easy for providing reliable system commands. To the best of our knowledge, the problems mentioned above have not been explored in the literature. In this study, we first validated the decoding accuracy of trunk-related motor intention based movement-related cortical potential. A set of binary classification performance which are shoulder extension (SE), waist rotation (WR), trunk flexion (TF), and rest (RE) have validated in respect to execution movement as well as imagery movement across six subjects. All binary classification results showed performance that is higher than the chance level. The best decoding accuracy shows 68.5% in the motor imagery task of shoulder extension vs. waist rotation.

#1496 A Hand Gesture based Driver-Vehicle Interface to Control Lateral and Longitudinal Motions of an Autonomous Vehicle

Udara Eshan Manawadu (JP), Mitsuhiro Kamezaki (JP), Masaaki Ishikawa (JP), Takahiro Kawano (JP), Shigeki Sugano (JP)

Autonomous vehicles would make the future roads safer by keeping the human driver out of the loop. However, reduced degree of human-control could result in loss of the feeling of driving for some drivers. Therefore, in this study we proposed a method of interaction between the driver and autonomous vehicle by allowing the driver to control the vehicle's lateral and longitudinal motions. We adopted hand gestures as input modality because it can reduce driver's visual and cognitive demands. We first derived seven fundamental vehicle maneuvers to improve driver experience, and related them to seven independent hand gestures. We then created a hand gesture interface to control an autonomous vehicle, using Leap Motion as the gesture recognition platform. We conducted driving experiments involving twenty drivers in a virtual reality driving simulator to investigate the effectiveness of this interface for vehicle control. We evaluated the driving experience and drivers' opinions regarding the gestural interface. The results proved that semi-autonomous controlling using the hand gesture interface significantly reduced drivers' perceived workload.

#1667 Towards an EEG-based Intelligent Wheelchair Driving System with Vibro-tactile Stimuli

Keun-Tae Kim (KR), Seong-Whan Lee (KR)

Nowadays, the electroencephalography (EEG)-based wheelchair driving system, one of the major applications of brain-computer interface (BCI), that allows an individual with mobility impairments to perform daily living activities independently. In this context, user's intention identifying methods were developed by several research groups using various paradigms for the wheelchair driving. In this study, we use a steady-state somatosensory evoked potential (SSSEP) paradigm, which elicits brain responses to vibro-tactile stimulation of specific frequencies, for a user's intention identification to driving a wheelchair. The main focus of this study is to validate an effectiveness of our SSSEP-based wheelchair driving system via an online experiment with more challenging tasks than our recent study. In our system, a subject concentrated on one of vibro-tactile stimuli (attached on left-hand, right-hand, and foot) selectively for driving wheelchair (corresponding to turn-left, turn-right, and move-forward). Five healthy subjects participated in the online experiment, and the experimental results show that our SSSEP paradigm is suitable to EEG-based intelligent wheelchair driving system.

BMI Papers VIII – Machine Learning Methods for Brain-Computer Interfacing (I) (BMI Workshop Special Session VIII)

Organizer: R. Chavarriaga
October 12 (Wednesday), 09:30-11:00, Sofitel Budapest Chain Bridge, Bellevue 2
Session Chairs: R. Chavarriaga, M. Clerc

#1179 Spatial filters yield stable features for error-related potentials across conditions

Iwane Fumiaki (JP), Ricardo Chavarriaga (CH), Inaki Iturrate (CH), José del R. Millán (CH)

Error-related potentials (ErrP) have been increasingly studied in psychophysical experiments as well as for brain- machine interfacing. In the latter case, the generalisation capabilities of ErrP decoders is a crucial element to avoid frequent recalibration processes, thus increasing their usability. Previous studies have suggested that ErrP signals are rather stable across recording sessions. Also, studies using protocols of serial stimuli presentation show that these potentials do not change significantly when the presentation rate. Here we complement these studies by analysing the decoding generalisation capabilities. Using data from monitoring experiments, we evaluate how much the performance degrades when tested in a condition different than the one the decoder was trained with. Moreover, we compare different spatial filtering techniques to see which preprocessing steps yield less-sensitive features for ErrP decoding.

#1192 Agreement Rate Initialized Maximum Likelihood Estimator for Ensemble Classifier Aggregation and Its Application in Brain-Computer Interface

Dongrui Wu (US), Vernon Lawhern (US), Stephen Gordon (US), Brent Lance (US), Chin-Teng Lin (TW)

Ensemble learning is a powerful approach to construct a strong learner from multiple base learners. The most popular way to aggregate an ensemble of classifiers is majority voting, which assigns a sample to the class that most base classifiers vote for. However, improved performance can be obtained by assigning weights to the base classifiers according to their accuracy. This paper proposes an agreement rate initialized maximum likelihood estimator (ARIMLE) to optimally fuse the base classifiers. ARIMLE first uses a simplified agreement rate method to estimate the classification accuracy of each base classifier from the unlabeled samples, then employs the accuracies to initialize a maximum likelihood estimator (MLE), and finally uses the expectation-maximization algorithm to refine the MLE. Extensive experiments on visually evoked potential classification in a brain-computer interface application show that ARIMLE outperforms majority voting, and also achieves better or comparable performance with several other state-of-the-art classifier combination approaches.

#1193 Offline EEG-Based Driver Drowsiness Estimation Using Enhanced Batch-Mode Active Learning (EBMAL) for Regression

Dongrui Wu (US), Vernon Lawhern (US), Stephen Gordon (US), Brent Lance (US), Chin-Teng Lin (TW)

There are many important regression problems in real-world brain-computer interface (BCI) applications, e.g., driver drowsiness estimation from EEG signals. This paper considers offline analysis: given a pool of unlabeled EEG epochs recorded during driving, how do we optimally select a small number of them to label so that an accurate regression model can be built from them to label the rest? Active learning is a promising solution to this problem, but interestingly, to our best knowledge, it has not been used for regression problems in BCI so far. This paper proposes a novel enhanced batch-mode active learning (EBMAL) approach for regression, which improves upon a baseline active learning algorithm by increasing the reliability, representativeness and diversity of the selected samples to achieve better regression performance. We validate its effectiveness using driver drowsiness estimation from EEG signals. However, EBMAL is a general approach that can also be applied to many other offline regression problems beyond BCI.

BMI Workshop

#1359 Classification of 17 Voluntary Movements Using Principal Component Analysis for Myoelectric Prosthetic Hand

Emi Nakanishi (JP), Trongmun Jiralerspong (JP), Asuka Kambayashi (JP), Jun Ishikawa (JP)

This paper proposes a signal processing technique to classify 17 voluntary movements from electromyographic (EMG) signals. In the proposed method, EMG signals are acquired from six EMG sensors. The features of the voluntary movements are extracted from these EMG signals using principal component analysis and later classified using artificial neural network (ANN). To evaluate the validity of the proposed method, online classification experiments are conducted on one male and one female participants. A total of 15 data sets, where each set consists of EMG signals characterizing the 17 motions, are acquired from each participant. From this total, five data sets are used as training data, while the other 10 data sets are acquired for online testing. The same experiments are repeated on a different day. The validity of the algorithm, evaluated based on the mean correct and incorrect classification rates of both days are calculated from testing data. Results show that using all five training data to train the ANN yields higher accuracy than using only one training data. The best classification result shows that there are 10 out of 17 motions with an accuracy of over 50% and mean incorrect rate of 2%. Furthermore, classification where ANN is trained using training data of a different day is also conducted. The results show that the proposed algorithm can achieve an overall correct rate of 46% at best. Based on the above results and considering the fact that users can promptly modify any erroneous actions by looking at the actual output of the prosthesis, the proposed algorithm has demonstrated the potential to classify 17 voluntary movements from 6 EMG sensors.

#1590 Novel Parameter Tuned Methodology for Under-damped Stochastic Resonance Applied to EEG Signal Enhancement

Lucio Fidel Rebolledo-Herrera (MX), Guillermo Espinosa F.V. (MX)

In this article, motor imagery ElectroEncephalographic (EEG) signals for Brain-Computer interfaces (BCI) are processed under a weak signal detection (WSD) paradigm, due to low signal to noise ratio (SNR) presented in EEG. Based on results from our previous work, Stochastic resonance (SR) is first time proposed as a WSD method for EEG signals thus, taking advantage of the noise transitions on a double well system. These transitions are synchronized with the brain rhythms embedded in the EEG signal, enhancing desired brain waves. This way, a novel parameter tuned SR was applied, based on bi-stable well separation and depth modulation on the Duffing system, recovering most of the input waveform shape. On the other hand, a recognized international EEG dataset, generated under BCI paradigms, was used in this work. The estimated SNR was 24dB and, after SR processing, signal recovery on the desired mu-beta band was observed, with an output SNR of 1.31dB during motor imagery and 1.41dB during resting states. Single EEG signal is reported from 17 channels processed, in order to demonstrate the signal processing methodology. Also for comparative purposes, dyadic wavelet transform (DWT) was also applied to the same EEG signal. The results have shown comparable or, even a better signal enhancement than DWT.

BMI Papers IX – Neurostimulation and BMI (BMI Workshop Special Session IX)

Organizer: C.S. Nam
October 12 (Wednesday), 09:30-11:00, Sofitel Budapest Chain Bridge, Bellevue 3
Session Chairs: C.S. Nam, M.C. Thompson

#1339 Comparison of Reaction Times in Response to Electrical and Visual Stimulation Using a High-speed Camera

Sho Tatsuno (JP), Tomohiko Hayakawa (JP), Masatoshi Ishikawa (JP)

Recently, information about reaction times in response to perceptive stimulation has been used to develop several applications focused on movement instruction. However, knowledge is still lacking about reaction time related to haptics, especially electrical stimulation. Therefore, in this study we measured and analyzed reaction time in response to electrical and visual stimulation in human participants using a 250 fps high-speed camera. In our experimental process, participants were placed in a separate room and they wore soundproof headphones to shield them from external noise. Subsequently, they conducted reaching tasks involving visual and electrical stimuli. Using a high-speed camera, we recorded participants' hand motions from a top view (thereby focusing on the backs of their hands) and calculated their reaction time via image processing. The results show that reaction time in response to electrical stimulation is approximately 200 ms, which is more than 35% faster than reaction time in response to visual stimulation. Consequently, our results could augment basic knowledge about electrical stimulation in real-time feedback systems. The data obtained may help in electrical application in high-speed use.

#1650 A Hybrid BCI-Controlled FES System for Hand-Wrist Motor Function

Inchul Choi (US), Kyle Bond (US), Chang Soo Nam (US)

Motor imagery (MI) based Brain-Computer Interfaces (BCIs) controlled Functional Electrical Stimulation (FES) can help people with severe neuromuscular impairments to control their limbs by bypassing peripheral nerves and muscle pathways. However, there are still four major limitations with current MI-based BCIs for FES control: 1) They require relatively longer training and the training procedures are not clear. 2) Classification of different MI tasks within the same limb is difficult 3) MI features cannot be utilized during passive hand-motions induced by FES due to movement artifacts. 4) Few FES units are available which have real-time parameter control functionality. This study addresses these limitations by applying a hybrid BCI paradigm with a modified low-cost commercial off-the-shelf Transcutaneous Electrical Nerve Stimulation (TENS) unit. Four subjects were asked to mimic visual cues to imagine either closing or opening their dominant hand at different rates, such as fast or slow. After FES was initiated, the subjects were asked to attend to visual stimulus to elicit Steady-State Visual Evoked Potential (SSVEP) to stop FES. Results of this study showed that the modified TENS unit was able to successfully control hand motion in real-time. The classification results of different MI tasks within the same hand were promising. Furthermore, all subjects could stop the FES within 6 seconds and the average completion time was 2 seconds. The results of this study could provide insights towards future research of rehabilitation for stroke patients.

#1840 A Study on the Effect of Electrical Stimulation During Motor Imagery Learning in Brain-Computer Interfacing

Saugat Bhattacharyya (FR), Maureen Clerc (FR), Mitsuhiro Hayashibe (FR)

Functional Electrical Stimulation (FES) stimulates the affected region of the human body thus providing a neuroprosthetic interface to non-recovered muscle groups. FES in combination with Brain-computer interfacing (BCI) has a wide scope in rehabilitation because this system can directly link the cerebral motor intention of the users with its corresponding peripheral mucle activations. Such a rehabilitative system would contribute to improve the cortical and peripheral learning and thus, improve the recovery time of the patients. In this paper, we examine the effect of electrical stimulation by FES on the electroencephalography (EEG) during learning of a motor imagery task. The subjects are asked to perform four motor imagery tasks over six sessions and the features from the EEG are extracted using common spatial algorithm and decoded using linear discriminant analysis classifier. Feedback is provided in form of a visual medium and electrical stimulation representing the distance of the features from the hyperplane. Results suggest a significant improvement in the classification accuracy when the subject was induced with electrical stimulation along with visual feedback as compared to the standard visual one.

#1866 Demonstration of a stable chronic electrocorticography-based brain-computer interface using a deep brain stimulator

Margaret Claire Thompson (US), Jeffrey Herron (US), Timothy Brown (US), Jeffrey Ojemann (US), Andrew Ko (US), Howard J Chizeck (US)

Chronic electrocorticography (ECoG) studies will be necessary to understand how end-users of assistive brain-computer interface (BCI) technologies will control their devices on a long-term scale. A BCI platform consisting of a deep brain stimulator (DBS) and a cortical electrode strip, theoretically suitable for use over multi-year periods, is validated in a single human subject with essential tremor (ET). At the time of this writing, stable ECoG recordings have been demonstrated for four months after implantation. Additionally, the patient has performed a BCI cursor-control task with better-than-chance accuracy using both (1) an overt movement control scheme and (2) a motor imagery control scheme. These results validate the sensing-enabled DBS with cortical strip system as an exciting platform for chronic ECoG BCI experiments and as a scientific tool for long-term cortical recordings in different patient populations.

#1938 Multichannel Cuff Electrodes for Peripheral Nerve Stimulation and Recording

Emma Brunton (GB), Christoph Blau (GB), Kianoush Nazarpour (GB)

In the development of neuroprostheses to restore sensory and motor function to disabled patients the choice of the electrodes to be used remains an important consideration. The optimal electrode design should be minimally invasive and be capable of recording or stimulating selectively a large number of nerve fibers. Additionally, the electrodes should be capable of delivering stimulation within electrochemically safe limits. Here we report on the use of a multi-contact cuff electrode for stimulation and recording from peripheral nerves. Nerve cuffs with 16 electrodes, comprising 4 rings of 4 electrodes, were implanted around the sciatic nerve of two rats. The electromyogram signal (EMG) was recorded in response to electrical stimulation delivered by the electrodes, and the electroneurogram signal (ENG) was recorded in response to sensory stimulation applied to the ipsilateral foot. Visually detectable muscle movements were elicited with charge injections ranging from 4.6 to 8.2 nC. ENG recordings in response to sensory stimulus allowed for the onset and culmination of sensory stimulation to be detected using mean absolute value of the signal. Initial results indicate that flexion and extension of the ankle joint can be differentiated by combining information recorded from pairs of electrodes. The results of this study indicate that multi-contact cuffs can be used for decoding neural signals; however, more data needs to be collected for classification of sensory movements to be tested.

BMI Papers X – Real World Applications of Brain Computer Interface Systems (II) (BMI Workshop Special Session X)

Organizer: V. A. Prasad

October 12 (Wednesday), 11:00-12:30, InterContinental Budapest, Panorama I

Session Chairs: V. A. Prasad, A. Nürnberger

#1086 A Study on the Impact of Neurofeedback in EEG Based Attention-driven Game

Kavitha P Thomas (SG), Vinod Achutavarrier Prasad (SG)

Multi-disciplinary study of human computer interaction has provided significant impact in the fields of neural engineering, cognitive neuroscience, rehabilitation and brain-computer interaction. This paper evaluates the impact of neurofeedback in the context of a simple computer game controlled by attention based brain signals. The designed game protocol requires the player to memorize a set of numbers displayed in a matrix format, and to correctly fill the matrix using his attention based brain patterns. Attention level of the player, quantified using sample entropy values of Electroencephalogram (EEG) signals, is the core control parameter of the game. A comparative study using a single neurofeedback group and 2 control groups (each group consists of 8 subjects) has been carried out to examine the impact of neurofeedback on enhancing attention score and cognitive skill in the context of the attention-driven game. Experimental results explicitly demonstrate the significance and usefulness of neurofeedback in EEG based games.

#1963 Individual Alpha Peak Frequency Based Features for Subject Dependent EEG workload classification

Wei Lun Lim (SG), Olga Sourina (SG), Lipo Wang (SG), Yisi Liu (SG)

The individual alpha peak frequency (IAPF) is an important biological indicator in Electroencephalogram (EEG) studies, with many research publications linking it to various cognitive functions. In this paper, we propose novel Power Spectral Density (PSD) alpha features based on IAPF to classify 2 and 4 levels of EEG multitasking workload data. When optimized IAPF was considered, a 1.55% and 1.56% increase in average accuracy for 48 subjects' data, with 35 and 33 subjects showing improvement was observed for 2 and 4 class cases respectively. This trend suggests that individual specific features are able to improve classification performance compared to generalized features for subject dependent cases. The proposed features, which incorporates the biological meaning of the IAPF and provides subject specific information, can be considered as a viable alternative to the general alpha power feature when designing novel subject dependent feature sets for BCI workload recognition applications.

#2008 Biometric Identification of Persons Using Sample Entropy Features of EEG During Rest state

Kavitha P Thomas (SG), Vinod Achutavarrier Prasad (SG)

Biometric recognition of persons using brain waves has been identified as an attractive topic of research today. Existing popular biometric modalities of face, finger prints and voice signals are vulnerable to various kinds of attacks and spoofing techniques, whereas the emerging biometric trait extracted from brain wave is expected to act as an ideal biometric feature offering high degree of uniqueness, stability and universality. This paper analyses the efficacy of the complexity of Electroencephalogram (EEG) signals recorded during rest state for recognizing individuals from a publicly available EEG dataset consisting of 109 subjects. Sample entropy features extracted from delta, theta, alpha, beta and gamma bands of 64 channel EEG have been evaluated for subject-identification in the proposed system. It is found that beta band entropy has the highest inter-subject variability. Based on a Mahalanobis distance based classifier, beta entropy gives an average correct recognition rate of 98.31%. It has also been observed that concatenation of entropy features with power spectral density (PSD) values improves the system performance. Further analysis is essential to investigate the stability of results over time and to optimize the recognition performance at a reduced number of channels.

#2255 Predicting decision accuracy and certainty in complex brain-machine interactions

Victor Shih (US), Ludan Zhang (US), Christian Kothe (US), Scott Makeig (US), Paul Sajda (US)

A promising application of brain machine interfaces (BMIs) is predicting user cognitive state, particularly in complex and demanding scenarios, so that automation can dynamically and adaptively adjust task parameters to optimize joint human-machine performance. In this paper we analyze neural, physiological and behavioral data recorded during a complex two-person crew station" task and investigate whether these measures provide information for inferring user decision state. Specifically, we investigate how measures of EEG, pupil dilation, heart rate and response time, can be fused to infer decision confidence and accuracy in two side-tasks occurring throughout a three hour experimental session. One side-task is an auditory task, the other a visual task, both occurring within the context of the crew station scenario (auditory alert and a visual satellite map N-back task). We find that the best prediction performance always fuses EEG and pupil dilation measures, with results yielding between 70%-75% accuracy with respect to whether the subject(s) will skip making the decision (i.e. have high uncertainty) or whether he/she makes an error. Interestingly, the results suggest a possible mechanistic explanation for the utility of the fused measures, specifically the interaction between the locus coeruleus (LC), whose activity is linked to arousal state and can be inferred from pupil dilation, and the anterior cingulate (ACC), which has been linked to decision formation, and monitoring and whose activity is typically measured via EEG. In general, our results demonstrate the potential in using fused neuro/physio measures to infer and track human operator decision uncertainty during demanding complex tasks, possibly enabling BMIs to eventually be employed as "cognitive orthotics" for improving man-machine interaction and performance.

#2281 A Robust Interval Type-2 based BCI System

Ankit Das (SG), Suresh Sundaram (SG), Narasimhan Sundararajan (SG)

This paper presents a BCI system which addresses the key problems of robust feature extraction, non-stationarity and subject-specific spectral filter selection. It employs the Robust Common Spatial pattern (RoCSP) feature extraction algorithm which eliminates trials affected by artifacts and discards redundant channels to improve the robustness of the CSP algorithm. Next, it handles the non-stationarity in EEG signals using the Self-Regulated Interval Type-2 Neuro-Fuzzy Inference System (SRIT2NFIS). It uses the input features generated by the RoCSP algorithm and handles the non-stationarity as uncertainty using the interval type-2 fuzzy sets in the antecedent of fuzzy rules. A five layered modified Takagi-Sugeno-Kang interval type-2 fuzzy inference mechanism forms the structure and the learning algorithm uses a self-regulatory mechanism. Further, the SRIT2NFIS classifier is used to find the desired spectral filters by eliminating those frequency bands that do not affect the classification performance. The performance of the proposed system has been evaluated using two publicly available BCI competition data sets and compared with other existing algorithms like FBCSP, DFBCSP and BSSFO. The results indicate improved performances of the proposed algorithm. Finally, the proposed system is employed to control the movement of a quadcopter.

BMI Papers XI – BMI for Motor/Cognitive Rehabilitation and Assistance (II) (BMI Workshop Special Session XI)

Organizer: R. Chavarriaga

October 12 (Wednesday), 11:00-12:30, InterContinental Budapest, Panorama V

Session Chairs: R. Chavarriaga, S. Kleih

#1643 SSVEP Based BMI for a Meal Assistance Robot

Chamika Janith Perera (LK), Isira Naotunna (LK), Chameera Sandaruwa, (LK), R.A.R.C Gopura (LK), Thilina Dulantha Lalitharatne (LK)

Meal assistance robots provide disabled individuals the access to one of the important activities in daily living, self-feeding. This paper proposes a Steady State Visually Evoked Potential (SSVEP) based Brain Machine Interface (BMI) for controlling of a meal assistance robot. In the proposed system, the user has the facility to select any solid food item that he would like to eat from 3 different bowls just by looking at the respective LED matrices blinking at different frequencies. The generated SSVEP signals while looking at the LEDs are extracted from EEG signals acquired using OpenBCI EEG signal acquisition system. Extracted SSVEP signals are used to identify the intention of the user and subsequently the detected intentions are used to operate the meal assistant robot. Experiments are carried out to validate the system and results indicate the effectiveness of the proposed method.

#1841 Comparison of Hand and Forearm Muscle Pairs in Controlling of a Novel Myoelectric Interface

Jessica Barnes (GB), Matthew Dyson (GB), Kianoush Nazarpour (GB)

With commercial prosthetic hands, executing some everyday movements, for example, concurrent grasp and bending of the wrist to pick up an object from a high shelf, is very challenging. We hypothesised that after the loss of the hand, the flexibility of the nervous system enables prosthesis users to bypass the innate biomechanical constraints on upper-limb muscles and joints. We show that users are able to learn to operate a myoelectric-controlled interface by flexibly contracting pairs of hand and forearm muscles. The use of these novel activity patterns can have a transformative effect on the control of future prosthetic hands.

#1850 The Temporal Limits of Agency for Reaching Movements in Augmented Virtuality

Guillermo Roman Bernal (US), Oliver Alan Kannape (GB)

The sense of agency (SoA) describes the feeling of being the author and in control of one's movements. It is closely linked to automated aspects of sensorimotor control and understood to depend on one's ability to monitor the details of one's movements. As such SoA has been argued to be a critical component of self-awareness in general and contribute to presence in virtual reality environments in particular. A common approach to investigating SoA is to ask participants to perform goal-directed movements and introducing spatial or temporal visuomotor mismatches in the feedback. Feedback movements are traditionally either switched with someone else's movements using a 2D video-feed or modified by providing abstracted feedback about one's actions on a computer screen. The aim of the current study was to quantify conscious monitoring and the SoA for ecologically valid, three dimensional feedback of the participants' actual limb and movements. This was achieved by displaying an Infra-Red (IR) feed of the participants' upper limbs in an augmented virtuality environment (AVE) using a head-mounted display (HMD). Movements could be fed back in real-time (46ms system delay) or with an experimental delay of up to 570ms. As hypothesized, participant's SoA decreased with increasing temporal visuomotor mismatches ($p<.001$), replicating previous findings and extending them to AVEs. In-line with this literature, we report temporal limits of 222±60ms (50% psychometric threshold) in N=28 participants. Our results demonstrate the validity of the experimental platform by replicating studies in SoA both qualitatively and quantitatively. We discuss our findings in relation to the use of virtual and mixed reality in research and implications for neurorehabilitation therapies.

#2286 Classification of Gait from EEG Using Inverse Brain Mapping

Lea Hehenberger (AT), Martin Seeber (AT), Reinhold Scherer (AT)

Long-term impairment, disability and handicap are major issues after stroke. A wide range of interventions have been developed that aim to promote motor recovery in affected persons. High-intensity and task-specific training protocols show promising results. A better understanding of brain functioning in the context of motor learning and motor control may help to further improve rehabilitation outcome. Mobile brain imaging has brought advances that led to the development of models that characterize different aspects of the cortical involvement in movement. We are interested in translating those findings into online applications and lay a basis for novel rehabilitation interventions. In this paper, we use a model of gait consisting of two parameters: The state of walking (compared to upright standing) and the dynamics of the movement, i.e. the gait cadence. To this end, we perform mobile electroencephalography (EEG) measurements combined with inverse brain imaging and time-frequency analyses optimized for online application.

#2415 Imagined 3D Hand Movement Trajectory Decoding from Sensorimotor EEG Rhythms

Attila Korik (GB), Ronen Sosnik (IL), Nazmul H. Siddique (GB), Damien Coyle (GB)

Reconstruction of the three-dimensional (3D) trajectory of an imagined limb movement using electro-encephalography (EEG) poses many challenges. However, if achieved, more advanced non-invasive brain-computer interfaces (BCIs) for the physically impaired could be realized. The most common motion trajectory prediction (MTP) BCI employs a time-series of band-pass filtered EEG potentials for reconstructing the 3D trajectory of limb movement using multiple linear regression (mLR). Most MTP BCI studies report the best accuracy using low delta (0.5-2Hz) band-pass filtered EEG potentials. In a recent study, we showed spatiotemporal power distribution of theta (4-8Hz), mu (8-12Hz), and beta (12-28Hz) EEG frequency bands contain richer information associated with movement trajectory. This finding is in line with the results in the extensive literature on traditional sensorimotor rhythm (SMR) based multiclass (MC) BCI studies, which report the best accuracy of limb movement classification using power values of mu and beta frequency bands. Here, we show the reconstruction of actual and imagined 3D limb movement trajectory with an MTP BCI using a time-series of bandpower values (BTS model). Furthermore, we show the proposed BTS model outperforms the standard potential time-series model (PTS model). The BTS model yielded best results in the mu and beta bands (R~0.5 for actual and R~0.2 for imagined movement reconstruction) and not in the low delta band, as previously reported for MTP studies using the PTS model. Our results show for the first time how mu and beta activity can be used for decoding imagined 3D hand movement from EEG.

BMI Papers XII – Multi-modal Brain Computer Interface and Physiological Computing (BMI Workshop Special Session XII)

Organizer: V. A. Prasad

October 12 (Wednesday), 11:00-12:30, InterContinental Budapest, Ballroom I

Session Chairs: Sadasivan P., A. Stoica

#1620 Improved target recognition response using collaborative brain computer interfaces

Adrian Stoica (US), Kyongsik Yun (US)

The benefit of using collaborative brain computer interfaces in improving human response in visual target recognition tests was investigated. We used an EEG dataset by Delorme et al. 2004, created from recordings using 32-channel EEG system. The 14 participants performed a go/no-go categorization task on natural photos with animals, defined as targets, and non-animal distractors, presented very briefly. First, we compared the two evoked responses between the target and distractor images and determined that the P300 response was significantly higher in the target images than in the distractor images. Second, we calculated and compared the classification accuracy using one, two, and three EEG signal sets. We applied linear support vector machine with 5-fold cross validation. Compared to the results of a single brain prediction (79.4%), the overall accuracy of two and three brains prediction was better (89.3% and 88.7% respectively). Furthermore, the time to achieve the 90% accuracy was significantly faster when using EEGs from two and three brains (100ms) than that of one brain (230ms). These results bring supporting evidence to the hypothesis that one can achieve higher levels of perceptual and cognitive performance by leveraging the power of multiple brains through collaborative brain computer interfaces.

#2038 Inactive-State Recognition from EEG Signals and its Application in Cognitive Load Computation

Rahul Gavas (IN), Rajat Das (IN), Pratyusha Das (IN), Debatri Chatterjee (IN), Aniruddha Sinha (IN)

Extraction of desirable information from electroencephalogram signals require same level of active involvement from the participants throughout the entire duration of the task. However, this is hard to attain due to environmental, personal and internal factors including thought processes. This poses a major challenge in realizing accurate evaluation of mental workload. This study is aimed at detection of the inactive mental states of the participant during an experimental task. Conventionally cognitive load is computed with respect to the baseline period. Here a novel approach is adopted based on the detection of most inactive mental state during the rest period. It is observed that alpha rhythms (8 – 12 Hz) are dominant than theta rhythms (4 – 7 Hz) during the rest state and this information is used in determining the most inactive mental states. Galvanic skin response (GSR) is also analyzed for the same purpose to validate the decoded mental state from the brain signals. Results indicate that the proposed approach of inactivity detection, improves the overall accuracy of detection of cognitive load by 15.57%.

#2486 Optical EEG (OEEG): A Novel System Towards Portable Real-Time Brain-Computer Interfacing

Ehsan Kamrani (CA)

Typical brain-computer interfaces are mainly based on the monitoring of neural activities using electroencephalogram. However, in order to track and translate the human brain activities more accurate and in real-time, monitoring the hemodynamic activities of the brain is also necessary. Here we've introduced a new technique towards monitoring both the neural and the hemodynamic activities of the brain using a single portable device, for more accurate and real-time brain-computer interface applications.

#1962 An Investigation of Annotation Smoothing for EEG-based Continuous Music-emotion Recognition

Nattapong Thammasan (JP), Ken-Ichi Fukui (JP), Masayuki Numao (JP)

As emotional responses of a human to stimuli could evolve over the course of time, continuous emotion reporting is essential for the construction of a computational model to capture the temporal evolution of the human emotions. However, continuous emotion assessment is confronting various challenges, especially when using the continuous arousal-valence space. Manipulating emotion annotation data prior to performing emotion recognition is, therefore, necessary. In this paper, we present a study of applying three different signal filtering techniques to smooth annotation data; moving average filter, Savitzky-Golay filter, and median filter. We performed experiments of arousal and valence recognition in music listening tasks employing signals from electroencephalogram (EEG). Fractal dimension approach was adopted to extract informative features from brain dynamics and emotional states were then derived by classification and regression techniques. Our empirical results suggested the promise of the moving average filter that could enhance the performance of emotion classifying and tracking.

BMI Papers XIII – Brain and Human-Machine Interaction (BMI Workshop Special Session XIII)

Organizers: V. A. Prasad, S-W. Lee, R. Chavarriaga
October 12 (Wednesday), 11:00-11:45, InterContinental Budapest, Ballroom II
Session Chairs: T. Bonaci, R. Kozma

#1190 Online Eye State Prediction from EEG Data Using Deep architectures

Tharun Reddy (IN), Laxmidhar Behera (GB)

In the past decade, improvements in the production of in-expensive PC equipment and software has permitted more refined real-time signal processing in BCI systems. In the literature, Deep learning concepts have not been applied to EEG data analysis in a systematic manner. This paper applies various existing Deep learning architectures and algorithms for the classification of EEG data applied to eye state detection. The deep learning based classifier systems presented in this work are comparable to the state of the art classifiers devised by Roesler and Suenderman (2013), and Cameron et al.(2015). The goal of this work is to construct a system producing accuracies comparable to Roesler's K* classifier, Cameron et al. 's (RRF+K*) classifiers and at the same time providing enough speed to be used in an online BCI framework. In order to meet the constraints, following architectures were designed: A Multi layered neural network with ReLU and drop-out, deep belief networks based unsupervised learning, drop-out masks on deep neural networks. Specifically, we compare our results with K*, RRF, (K*+RRF), ada(RJ48F) classifiers. Also an in-depth analysis of binary class features has been done using t-SNE based visualizations while fitting elliptical contours to the features. Prior research suggests that instance-based/lazy learners like the K* algorithm are likely to be too slow to be used in a BCI framework, with ada(RJ48F) model performing decently well. But our chosen deep neural network architectures produce higher classification accuracies and have lower convergence times making them even faster within the time specifications of real-time classification and control applications.

#1549 Frequency Detection for SSVEP-Based BCI using Deep Canonical Correlation Analysis

Hanh Thi Vu (KR), Bonkon Koo (KR), Seungjin Choi (KR)

Canonical correlation analysis (CCA) has been successfully used for extracting frequency components of steady-state visual evoked potential (SSVEP) in electroencephalography (EEG). Recently, a few efforts on CCA-based SSVEP methods have been made to demonstrate the benefits for brain computer interface (BCI). Most of these methods are limited to linear CCA. In this paper consider a deep extension of CCA where input data are processed through multiple layers before their correlations are computed. To our best knowledge, it is the first time to apply deep CCA (DCCA) to the task of frequency component extraction in SSVEP. Our empirical study demonstrates that DCCA extracts more robust feature, which has about 27% higher signal to noise ratio (SNR) compared to those of CCA, and it results in better performance in classification with the averaged accuracy of around 91%.

#2231 Exocortical Cognition: Heads in the Cloud

Stuart Mason Dambrot (US)

From a neurocentric perspective, H. sapiens-generated technology can be described as our neocortex – primarily the prefrontal and sensorimotor areas – augmenting our physiological cognitive, perceptual, and movement-generating structures by projecting itself into the external environment. In this context, the emerging capability of neuroprosthetics to directly augment neurocognitive function presents a unique and highly promising scientific and technological undertaking, in that it (1) suggests the possibility of dramatically increasing cognitive function on a species-wide basis, and (2) is universally applicable to the enhanced ideation, investigation and comprehension of all areas of inquiry. Here I propose Exocortical Cognition (ECC) – a transdisciplinary augmented cognition framework based on a review of the literature, accelerating progress in and convergence of a range of independent areas of science and technology, and the application of technology forecasting techniques. If realized, Exocortical Cognition would significantly enhance human cognitive function and memory capacity while bridging the often-presumed gap between human and future machine intelligence.

BMI Papers XIII – A Tribute to Walter J. Freeman (BMI Workshop Special Session XIII)

Organizers: J. Carmena, R. Kozma, and J. Principe
October 12 (Wednesday), 11:45-12:30, InterContinental Budapest, Ballroom II
Session Chairs: J. Carmena, R. Kozma, J. Principe

#2363 Mass Action in Brains and Computers – A Tribute to Walter J. Freeman

Robert Kozma (US)

This contribution presents a brief review of experimental and theoretical approaches to brain dynamics, including concepts describing the unity of brain, mind, and body. We dedicate this essay to the memory of Walter J. Freeman, III, with a focus on his pioneering work in the past 60 years establishing the new field of computational neuroscience, including mass action in the nervous system, field theories of cognition and intelligence, and his quest towards inventing novel engineering approaches for brain-machine interfaces.

BMI Papers XIV – Machine Learning Methods for Brain-Computer Interfacing (II) (BMI Workshop Special Session XIV)

Organizer: R. Chavarriaga

October 12 (Wednesday), 11:00-12:30, Sofitel Budapest Chain Bridge, Bellevue 2

Session Chairs: D. Wu, B. Lance

#1649 PNN for EEG-based Emotion Recognition

Jianhai Zhang (CN), Ming Chen (CN), Sanqing Hu (CN), Cao Yu (US), Robert Kozma (US)

The effort to integrate emotions into human-computer interaction (HCI) system has attracted broad attentions. Automatic emotion recognition enables the HCI to become more intelligent and user friendly. Although numerous studies have been performed in this field, emotion recognition is still an extremely challenging task, especially in real-world practice usage. In this work, probabilistic neural network (PNN) , with advantage of simple, efficient, and easy to train, was employed to recognize emotions elicited by watching music videos from scalp EEG. The publicly available DEAP emotion database was used to validate our algorithms. The powers of 4 frequency bands of EEG were extracted as features. The results show that the mean classification accuracy of PNN is 81.21% for valence (≥5 and <5) and 81.26% for arousal(≥5 and <5) across 32 subjects, similar with the results of SVM. In addition, they demonstrate that higher frequency bands (beta and gamma) play more important role in emotion classification than lower ones (theta and alpha). For the purpose of practical emotion recognition system, we proposed a ReliefF-based channel selection algorithm to reduce the number of used channels for convenience in practical usage. The results show that while using PNN, the 98% of the maximum classification accuracy can be obtained with only 9 (for valence) and 8 (for arousal) best channels, however, 19 (for valence) and 14 (for arousal) channels are needed while using SVM.

#1928 A Separability Marker Based on High-Dimensional Statistics for Classification Confidence Assessment

Nathalie Therese Helene Gayraud (FR), Nathanael Foy (FR), Maureen Clerc (FR)

This work provides a theoretical analysis framework for features that belong to the high dimensional Riemannian manifold of symmetric positive definite matrices. In non-invasive EEG-based Brain Computer Interfaces, such as the P300 speller, these are sample covariance matrices of the epoched EEG signal, that are classified into two classes. An analysis of the class shape on the manifold is performed, and the level the separability of the two classes is evaluated. The main contribution is a method that appends a confidence marker to the prediction of a binary classifier whose decision function is based on the comparison of Riemannian distances, called the SM-confidence method.

#2114 Alternative CSP approaches for multimodal distributed BCI data

Stephanie Brandl (DE), Klaus-Robert Müller (DE), Wojciech Samek (DE)

Brain-Computer Interfaces (BCIs) are trained to distinguish between two (or more) mental states, e.g., left and right hand motor imagery, from the recorded brain signals. Common Spatial Patterns (CSP) is a popular method to optimally separate data from two motor imagery tasks under the assumption of an unimodal class distribution. In out of lab environments where users are distracted by additional noise sources this assumption may not hold. This paper systematically investigates BCI performance under such distractions and proposes two novel CSP variants, ensemble CSP and 2-step CSP, which can cope with multimodal class distributions. The proposed algorithms are evaluated using simulations and BCI data of 16 healthy participants performing motor imagery under 6 different types of distraction. Both methods are shown to significantly enhance the performance compared to the standard procedure.

#2361 A Hybrid ICA - Wavelet Transform for Automated Artefact Removal in EEG-based Emotion Recognition

Alain Desire Bigirimana (GB), Nazmul H. Siddique (GB), Damien Coyle (GB)

Removing artefacts from electroencephalographic (EEG) recordings normally increases their low signal-to-noise ratio and enables more reliable interpretation of brain activity. In this paper we present an evaluation of an automatic independent component analysis (ICA) procedure, a hybrid ICA - wavelet transform technique (ICA-W), for artefact removal from EEG correlated to emotional-state. Spectral and statistical features were classified with support vector machines (SVM) to assess the performance of ICA-W against the regular ICA, in terms of the accuracy of classifying emotional states from EEG. Accuracies on data from 14 subjects are reported and the results indicate that ICA-W performs better than traditional ICA in statistical and wavelet based features whilst the best overall performance is achieved when combining ICA-W with statistical features with an average accuracy across subjects of 74.11% for classifying four categories of emotion. ICA-W is therefore demonstrated to enhance EEG-based emotion recognition applications in terms of performance and ease of application.

#2381 Superposition model for steady state visually evoked potentials

Cardona Jaiber (CO), Caicedo Eduardo (CO), Wilfredo Alfonso (CO), Ricardo Chavarriaga (CH), José del R. Millán (CH)

Steady State Visually Evoked Potentials (SSVEP) are signals produced in the occipital part of the brain when someone gaze a light flickering at a fixed frequency. These signals have been used for Brain Machine Interfacing (BMI), where one or more stimuli are presented and the system has to detect what is the stimulus the user is attending to. It has been proposed that the SSVEP signal is produced by superposition of Visually Evoked Potentials (VEP) but there is not a model that shows that. We propose a model for a SSVEP signal that is a superposition of the response due to the rising and falling edges of the stimulus and that can be calculated for different frequencies. We fixed the model for 4 subjects that gazed stimuli in the frequencies of 9Hz, 11Hz, 13Hz and 15Hz, and duty-cycles of 20%, 35%, 50%, 65%, and 80%. Since the phases of SSVEP signals are stable over the time, these were used to fix the model, without the amplitude; however, signals of scattered phases were discarded. The model parameters were found using the Oz electrode signals and a genetic algorithm. The mean absolute error (MAE) between the measured phase and the obtained one was calculated for each subject (named S1, S2, S3, and S4). The model was fixed for the subjects in the fundamental frequencies, just two of them in the second harmonic, and one in the third harmonic. We obtained a maximum MAE for 3 subjects (S1, S2, and S4) in the fundamental frequencies at 0.30 rad and one of them (S2) with 0.21 rad in the second harmonic. The last one (S3) signals show poor results with a MAE between 0.46 rad and 1.79 rad by including fundamental frequencies, and second and third harmonics. The results show similarities among the different model parameters such that it suggests that a general model could be obtained. We fixed the model for 4 subjects that gazed stimuli in the frequencies of 9Hz, 11Hz, 13Hz and 15Hz, and duty-cycles of 20%, 35%, 50%, 65%, and 80%. Since the phases of SSVEP signals are stable over the time, these were used to fix the model, without the amplitude; however, signals of scattered phases were discarded. The model parameters were found using the Oz electrode signals and a genetic algorithm. The mean absolute error (MAE) between the measured phase and the obtained one was calculated for each subject (named S1, S2, S3, and S4). The model was fixed for the subjects in the fundamental frequencies, just two of them in the second harmonic, and one in the third harmonic. We obtained a maximum MAE for 3 subjects (S1, S2, and S4) in the fundamental frequencies at 0.30 rad, and one subject (S2) of them got 0.21 rad in the second harmonic. The last one (S3) signals show a poor performance with a MAE between 0.46 rad and 1.79 rad by including fundamental frequencies, and second and third harmonics. The results show similarities among the different model parameters such that it suggests that a general model could be obtained.

BMI Papers XV – Sensor Systems for BMI and Prosthetics (BMI Workshop Special Session XV)

Organizers: V. A. Prasad, S-W. Lee, R. Chavarriaga
October 12 (Wednesday), 11:00-12:30, Sofitel Budapest Chain Bridge, Bellevue 3
Session Chairs: S-W. Lee, T. Zander

#1528 Variable admittance control in pHRI by measuring muscle co-activation with EMG

Fotios Dimeas (GR), Stavros Grafakos (GR), Nikos Aspragathos (GR)

In this paper, the co-activation level of the arm muscles is used as an indication of the end-point stiffness for improving human-robot cooperation. A variable admittance controller is proposed to adjust the virtual damping in real time by measuring the operator's muscle activation by means of surface EMG. An experimental user study is conducted that simulates both high accuracy and fast transition movements, involving human-robot interaction with a 7-DOF LWR serial manipulator. The proposed method is compared to constant admittance and is evaluated in terms of movement accuracy, execution time, and the operator's energy consumption. The results demonstrate that there is a significant reduction of the operator's effort and an improvement of the cooperative motion accuracy.

#1658 Patient Simulator Using Wearable Robot to Estimate the Burden of Knee-Osteoarthritis Patients during Sitting-down and Standing-up Motions

Ryu Kubo (JP), Ayaka Hirukawa (JP), Shogo Okamoto (JP), Naomi Yamada (JP), Yasuhiro Akiyama (JP), Yoji Yamada (JP)

The estimation of the physical burdens from which people with motor impairment suffer helps us establish welfare techniques comprising personal care equipment and assessment of critical risks, such as fall risks. However, the involvement of actual patients in the evaluation and development of this equipment is costly and involves the exposure of patients to long and exhausting experiments. To solve this problem, we developed a robot wearable by a healthy person and the associated control algorithm to simulate typical motions of patients with knee osteoarthritis, which is a common symptom for the elderly and causes pain during movement. To estimate the physical burdens inflicted by knee malfunctions, we computed the knee flexion and extension moment of the simulated patient during the standing-up and sitting-down motions. The moments, estimated under certain conditions, are qualitatively consistent with those considered clinically, which corroborates the validity of our patient simulation techniques.

#2116 Control of Artificial Human Finger using Wearable Device and Adaptive Network-Based Fuzzy Inference System

Seyed Reza Larimi (CA), Hojatollah Rezaei Nejad (CA), Mina Hoorfar (CA), Homayoun Najjaran (CA)

This paper demonstrates a new approach for the use of multiple strain sensors on a wearable flexible finger band to measure the posture and movement of a human finger accurately. The system is further developed to repeat the human finger motion on a robotic finger. Here, we used adaptive network-based fuzzy interface system (ANFIS) to relate the strain sensor readings to human finger posture and motion. The input and output measurements used to train ANFIS are obtained from the strain sensors of the wearable platform and a 3 degree of freedom (DOF) exoskeleton testbed, respectively. The ANFIS model is then used to predict human finger posture and motion directly from the strain sensors installed on the finger band. We made additional experiments and generated testing data using the exoskeleton testbed to verify the ANFIS model. Finally, we demonstrate that the robotic finger closely follows the human finger motion by reading the wearable finger band output and calculating the posture and motion parameters in real time.

BMI Papers XVI – Real World Applications of Brain Computer Interface Systems (III) (BMI Workshop Special Session XVI)

Organizer: V. A. Prasad

October 12 (Wednesday), 14:00-15:30, InterContinental Budapest, Panorama I

Session Chairs: V. A. Prasad, J. Dauwels

#2485 EEG based Biometric Recognition Using Subject-Specific Alpha Peak Frequency and Delta Band Power

Kavitha P Thomas (SG), Vinod Achutavarrier Prasad (SG)

Brain activities are inherently determined by a person's unique pattern of neural pathways and are closely associated with his/her specific personality traits. Brain activity, recorded by electroencephalogram (EEG), has recently been identified as potential candidate in future generation biometric systems. In this paper, a biometric identification system is proposed combining subject-specific alpha peak frequency, peak power and delta band power values to form representative feature vectors as well as discriminative templates. In order to study the inter-subject and intra-subject variabilities of the EEG patterns, a public dataset of EEG signals recorded from 109 healthy subjects during eyes open/closed (EO/EC) relaxed rest states has been analyzed. Employing simple similarity measurements based on correlation and distance measures of the test EEG sequences in comparison with the template vectors, an average recognition rate of up to 90% has been achieved using a set of selected 19 electrodes. The achieved results explicitly show the usefulness of combining subject-specific alpha and delta bands in future biometric recognition systems.

#2494 EEG hyperscanning study of inter-brain synchrony during cooperative and competitive interaction

Justin Dauwels (SG), Sinha Nishant (SG)

Social cognition is the study of how people interact with each other in a social situation. An effective interaction would require higher degree of cognitive involvement between the participants and consequently, an enhanced synchrony between their neural mechanisms. In this study, twelve pairs of subjects interacted with each other via a cognitively engaging experimental paradigm in which they either competed or cooperated with each other for performing a task. While they were performing the task we incorporated electroencephalographic (EEG) hyperscanning techniques by simultaneously recording the EEG activities of the interacting subjects. We quantified these interactions by computing the inter-brain synchrony (IBS) and studied the changes in IBS under different experimental conditions. We found that the inter-brain synchrony between the subjects was significantly higher when they cooperated with each other as compared to the competitive scenario. Furthermore, we found that IBS was significantly enhanced when the subjects were physically separated i.e. they cooperated via an intranet network. In this work, we have demonstrated how EEG hyperscanning technique can be employed to study inter-brain synchronization under different conditions.

#2151 Spatial Filter Feature Extraction Methods for P300 BCI Speller: A Comparison

Eleni Chiou (DK), Sadasivan Puthusserypady (DK)

Brain Computer Interface (BCI) systems enable subjects affected by neuromuscular disorders to interact with the outside world. A P300 speller uses Event Related Potential (ERP) components, generated in the brain in the presence of a target stimulus, to extract information about the user's intent. Several methods have been proposed for spatial filtering and classification of the P300 components. In this study, xDAWN algorithm, Independent Component Analysis (ICA) and Principal Compo- nent Analysis (PCA) methods are used and evaluated based on the classification performance of two different classifiers, namely the Support Vector Machine (SVM) and Fisher's Linear Discriminant Analysis (FLDA). In addition, it is shown that the incorporation of some prior knowledge regarding the location of P300 elicitation on the scalp can reduce the computational load while maintaining or even improving the classification performance.

#1194 A Simple Action of Right Index Finger Induces Rubber Hand Illusion to Static Left Hand

Masayuki Hara (JP), Noriaki Kanayama (JP), Daisuke Yamaguchi (JP), Yuji Ishino (JP), Masaya Takasaki (JP), Takeshi Mizuno (JP)

The rubber hand illusion (RHI) is a bodily illusion that a fake rubber hand is felt as if it was one's own hand when both the hands are synchronously stimulated. Also, it is well-known that people can experience the RHI when the movements of the visible fake and invisible real hands are synchronized. However, underlying mechanism of the RHI and relationship between action and body ownership are still open questions. Based on the RHI paradigm, the present paper discusses how the agency of a body part affects the sense of body ownership at the other body part. In this study, we examined if a simple up-and-down action of right index finger induces the RHI to left hand which was kept still by using virtual reality and robotics technologies. Our experimental results indicated that the action of the right index finger allowed the embodiment of the virtual hands at both the right and left hands. This implies that only a simple action of a body part increases the sense of body ownership at the other body part.

#2097 A Novel Multimodal Gaze-Controlled Hindi Virtual Keyboard for Disabled Users

Yogesh Kumar Meena (GB), Hubert Cecotti (GB), KongFatt Wong-Lin (GB), Girijesh Prasad (GB)

Over the last decade, there has been a speedy an increase in the number of persons with mobility and speech impairments who require novel communication devices. Most of the recent works that have been carried out to focus on the Latin script; there is a lack of appropriate assistive devices for scripts that are specific to a country. In this paper, we propose a novel multimodal Hindi language virtual keyboard based on a menu selection with eight commands providing access to spell and type 63 different Hindi language characters along with other functionalities such as the delete command for corrections. The system has been evaluated with eight able-bodied individuals who performed a specially designed typing task. The spelling task has been achieved in three different modalities using: (i) a mouse, (ii) a portable eye-tracker, and (iii) a portable eyetracker combined with a soft-switch. The performance has been evaluated over the changes that occur with the use of each modality in terms of typing speed and information transfer rate (ITR) at both the command and letter levels for each subject. The average speed across subjects with mouse only, eye-tracker only, and eye-tracker with soft-switch were 17.12 letters/min, 10.62 letters/min, and 13.50 letters/min, respectively. The ITRs at the command and letter levels were about 67.58 bits/minute and 62.67 bits/minute, respectively, with only the eye-tracker option. Based on its robustness, the proposed system has the potential to be used as a means of augmentative communication for patients suffering from mobility and speech impairment, and can contribute to substantial improvement in their quality of life.

BMI Papers XVII – Recent Advances in BMI Speller (BMI Workshop Special Session XVII)

Organizers: S-W. Lee, B. Blankertz

October 12 (Wednesday), 14:00-15:30, InterContinental Budapest, Ballroom II

Session Chairs: S-W. Lee, B. Blankertz

#1415 Analysis of Steady State Visual Evoked Potential based on Viewing Distance Changes for Brain-Machine Interface Speller

No-Sang Kwak (KR), Dong-Ok Won (KR), Keun-Tae Kim (KR), Hee-Jin Park (KR), Seong-Whan Lee (KR)

Recently, steady-state visual evoked potential (SSVEP)-based brain-machine interface (BMI) speller systems have shown a great performance increase with high information transfer rate (ITR) and short response time. In previous BMI speller systems, however, users should utilize the systems at fixed viewing distance environment for evoking SSVEP signals because a variation of the SSVEP signals according to changes of viewing distance was not considered during system design process. For a real-world application of BMI speller, reliable speller systems which are robust to the various viewing distance environment are needed. In this study, hence, we investigate the effects of viewing distance on SSVEP by changing distance between a user and visual stimuli. Here, we used four visual stimuli which have different frequencies using LED monitor. In the subsequent analysis, we present classification results with several methods. Our analysis and results show a possibility that SSVEP under various viewing distance environment could be facilitated.

#1523 OpenBMI: A Real-Time Data Analysis Toolbox for Brain-Machine Interfaces

Min-Ho Lee (KR), Keun-Tae Kim (KR), Young-Jin Kee (KR), Ji-Hoon Jeong (KR), Seon-Min Kim (KR), Siamac Fazli (KR), Seong-Whan Lee (KR)

Recently, there has been an increased demand for Brain-Machine Interface (BMI) toolboxes for neuroscientifc research. In many BMI applications, speller systems can provide an efficient communication channel for users with disabilities. Here, we introduce an open-source BMI toolbox termed 'OpenBMI', which supports the various signal processing chains for common BMI paradigms, such as event-related potentials (ERPs) and steady-state visual evoked potentials (SSVEP). The OpenBMI framework consists of ready-to-use experimental paradigms, offline data analysis techniques, online feedback as well as evaluation modules. The data analysis modules provide essential pre-processing steps (segmentation, baseline correction, etc.) as well as signal processing algorithms such as temporal and spatial filtering, artifact rejection, among others. The experimental paradigms of ERP and SSVEP are available with fully open-sourced demo scripts. Users can easily modify or extend the demo scripts for their needs. In this article, the OpenBMI framework, its features as well as its future development plan is introduced.

#1793 How to identify the user specific stimulation frequencies for SSVEP-based BCI

Izabela Rejer (PL), Lukasz Cieszynski (PL)

The aim of this paper is to compare some approaches used for detecting user specific stimulation frequencies in terms of the number of detected Steady State Visual Evoked Potentials (SSVEPs). We performed our analysis with 6 subjects with respect to three factors: channels, time windows and harmonics/subharmonics used for power spectrum calculations. Results: 1. The best results across original channels and their combinations were obtained for O2 referenced to Pz and for the average of O2 and O1 referenced to Pz. 2. The length of time window (2, 5, or 10 seconds) did not have an influence on the average results. 3. The best results across the harmonics/subharmonics used for power spectrum correction were obtained when the first harmonic was added to the original power spectrum. 4. While with the best combination of all three factors (the average of O2 and O1 referenced to Pz; time window of 10 seconds; fundamental frequency + first harmonic in the power spectrum), we were able to detect 41% out of all 85 stimulation frequencies used in the survey, only 13% was detected with the worst combination (the O1 referenced to O2; time window of 2 seconds; fundamental frequency + first subharmonic in the power spectrum).

#2187 Notes on the Assessment of BCI-Driven Spellers

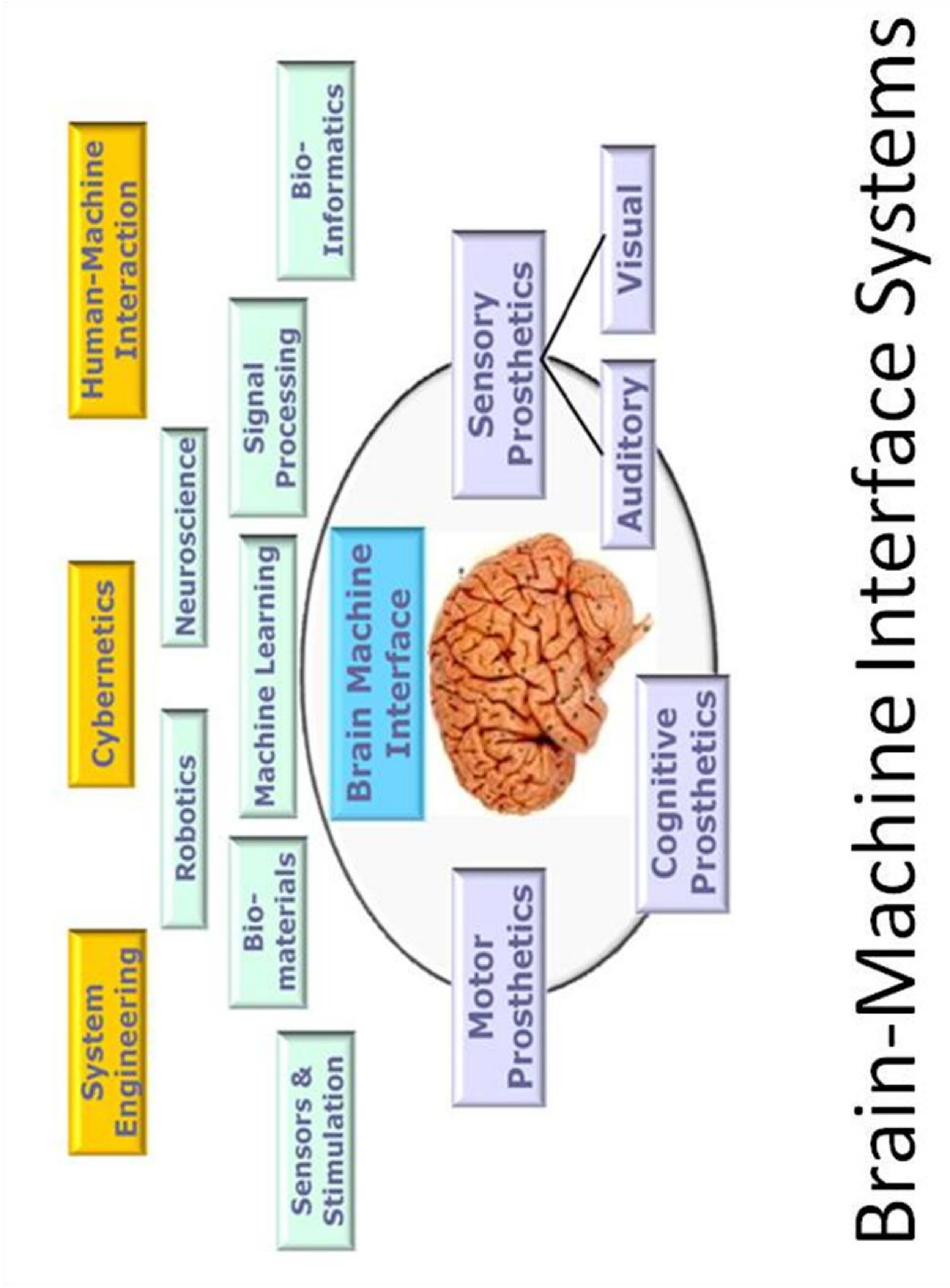
Benjamin Blankertz (DE), Matthias Treder (GB)

A Brain-Computer Interface (BCI) is a system that allows its user to control an application by real-time 'decoding' of brain signals. A fair comparison and evaluation of BCI systems from the literature is intricate due to the fact that different performance metrics are used. Many metrics draw on information theoretic approaches that model a communication channel in which the user has to code the message in order to make it error tolerant -- an unrealistic model for BCI. This contribution discusses how to measure and compare the performance of BCIs that are used for communication (so-called 'mental typewriters' or 'spellers'). We advocate a simple and intuitive metric: the number of symbols written in a certain amount of time, while accounting for the actions that have to be performed in order to correct errors that are based on misclassifications of the BCI system. It is discussed how this proposed measure differs from the widely used information transfer rate (ITR). Other aspects of comparing speller performances are cover as well, such as speed/accuracy trade-off, extrapolation to longer stimulation sequences and comparing systems with different sized vocabulary.

#2493 A comparison of face speller approaches for P300 BCIs

Christoph Guger (AT)

Brain-Computer Interfaces (BCIs) can provide users with communication, control, and other capabilities based on specific types of brain activity. In the "P300 BCI" approach, a user views a matrix containing letters or other characters and silently counts each time a target item flashes. Classically, characters flashed by briefly reversing color or other basic changes. Recent work has shown that the new "face speller" approach can improve P300 BCI performance. In this approach, each character changes to a human face during each "flash" instead of simply reversing color or other simple changes. The neural activity required to process the attended face, as well as other stimulus changes, may elicit more distinct evoked potentials that can improve classification. While the "face speller" has shown that face presentation may improve BCI performance, it raises the broader possibility that other stimulus changes could provide further performance improvements. The present study explored P300 BCI performance across four conditions. A control condition used "upturned" black and white stimuli that simply reversed color during each flash. Three other conditions explored different face conditions, varying color and the number of different faces presented during each flash. Accuracy was higher in all three face speller conditions than in the conventional "upturned" condition. Colored faces may yield higher accuracy than black and white faces.


Brain-Machine Interface Systems
System Engineering
Cybernetics
Human-Machine Interaction
Robotics
Neuroscience
Sensors & Stimulation
Bio-materials
Machine Learning
Signal Processing
Bio-Informatics
Brain Machine Interface
Motor Prosthetics
Cognitive Prosthetics
Sensory Prosthetics
Auditory
Visual

Computational Collective Intelligence

Organizers: Ngoc Thanh Nguyen, Bay Vo, Dosam Hwang, Piotr Jedrzejowicz
October 10 (Monday), 17:00-18:30, Sofitel Budapest Chain Bridge, Bellevue 1
Session Chairs: Ngoc Thanh Nguyen, Bay Vo

#1897 Local and Global Consensus in Asynchronous Group Communications
Marcin Maleszka (PL)
Knowledge integration is a process that is used more and more often in different theoretical and practical works. It is usually understood as an instantaneous change of knowledge states. In our research we consider integration as a process and study its different elements. Here we focus on using asynchronous communication between agents in a decentralized system. We add a structure of preferred connections and simulate different types of groups. We show that this approach works similar to the classical centralized one, while removing the need for a single critical agent. We also use this approach in a prototype of a weather prediction system to show that the results are similar to obtained with other modes of agent communication.

#1927 A Method for Ontology based User Profile Adaptation in Personalized Document Retrieval Systems
Bernadetta Maleszka (PL)
Information overload is one of the most important problems in context of personalized document retrieval systems. In this paper we propose to use ontology-based user profile. Ontological structures are appropriate to represent relations between concepts in user profile. We present a method for determining user profile based on his current activities. Results obtained in experimental evaluation are promising.

#2353 Academic event recommendation based on similarity research and exploring interaction of authors
Dinh Tuyen Hoang (KR)
In this study, a new academic event recommendation method is proposed. This method analyzes author interactions, academic event attendance records, research related, and textual descriptions of attended academic events to measure interaction strength between authors. Experiments on the DBLP dataset and Wiki Calls for Papers (WikiCFP) showed that the proposed method is helpful in improving the accuracy of a recommendation system in comparison with other methods. In addition, this method can be applied to various recommended tasks such as collaboration recommendation, papers recommendation, etc.

#2453 Bisimilarity for Paraconsistent Description Logics
Ngoc Thanh Nguyen (PL), Linh Anh Nguyen (PL), Thi Hong Khanh Nguyen (VN), Quang Thuy Ha (VN)
We introduce comparisons with respect to information between interpretations in paraconsistent description logics and use them to define bisimilarity for such logics. As bisimilarity is a natural notion for characterizing indiscernibility in modal and description logics, it is useful for concept learning in description logics also when inconsistencies occur. We give preservation results and the Hennessy-Milner property for comparisons with respect to information in paraconsistent description logics. As consequences, we also obtain invariance results and the Hennessy-Milner property for bisimilarity in paraconsistent description logics.

#2499 An Approach to Machine Classification Based on Stacked Generalization and Instance Selection
Ireneusz Czarnowski (PL), Piotr Jedrzejowicz (PL)
This paper focuses on the machine classification with data reduction. The aim of the data reduction techniques is decreasing the quantity of information required to learn a high quality classifiers. In this paper the data reduction is carried out by selection of relevant instances, called prototypes. To solve the machine classification problem with data reduction an agent-based population learning algorithm is proposed. The discussed approach bases on the assumption that the selection of prototypes is carried-out by a team of agents and that the prototype instances are selected from clusters of instances. The proposed procedure is called the stack generalization. It aims at improving the quality of the learning process and increasing the generalization capacity of the learning model. The paper includes the description of the approach and the discussion of the validating experiment results.

Granular Computing (I)

Organizers: Shusaku Tsumoto, Tzung-Pei Hong, Shiyue-Liang Wang, Chun-Wei Tsai
October 10 (Monday), 13:30-15:00, Sofitel Budapest Chain Bridge, Bellevue 2
Session Chairs: Chun-Wei Tsai, Shusaku Tsumoto

#1212 Ant Colony Optimization Solutions for Logistic Route Planning with Pick-up and Delivery

Eric Hsueh-Chan Lu (TW), Ya-Wen Yang (TW), Zeal Li-Tse Su (TW)

Online shopping behaviors lead to a large number of goods need to be transported in the real world. Researches on logistics have attracted extensive attentions. One of popular topics is logistic route planning. Although various previous studies have discussed some classical routing problems, real logistic constraints are not considered such as the vehicle capacity, various logistic requirements, etc. Thus, these solutions may not be directly applied to the logistic route planning. In this paper, we propose a novel solution based on Ant Colony Optimization (ACO) to find high quality logistic routes not only meeting real logistic constraints but also taking pick-up and delivery requirements into account. To the best of our knowledge, this is the first work using ACO to plan the logistic routs that considers various logistic requirements, simultaneously. Through extensive experimental evaluations by a semi-real logistic dataset, the proposed ACO-based solution was shown to deliver excellent performance.

#1368 Wun-Miner: A New Method For Mining Frequent Weighted Utility Itemsets

Vo Bay (VN), Bui Huong (VN), Nguyen Ham (VN)

In this paper, we propose the WUN-set (Weighted Utility Nodeset) structure, an extension of the Nodeset structure, to solve the problem of mining frequent weighted utility itemsets from a quantitative database. Firstly, some theorems are developed to compute quickly the weighted utility support of an itemset. An algorithm is then proposed for the fast mining frequent weighted utility itemsets. The experimental results on both sparse and dense databases show that the proposed method outperforms existing methods.

#1258 Trajectory Optimization with Memetic Algorithms: Time-to-Torque Minimization of Turbocharged Engines

Dan Simon (US), Yan Wang (US), Oliver Tiber (US), Dawei Du (US), Dimitar Filev (US), John Ottavio Michelini (US)

A general memetic trajectory optimization method is introduced. The method is comprised of an evolutionary algorithm (EA) for global optimization, followed by local optimization. The global optimization algorithm consists of biogeography-based optimization (BBO), which is an EA which is motivated by the migratory behavior of biological organisms. For local optimization, we identify the local linearized model within the region of the BBO solution by approximating the linear model as a Jacobian matrix, and then iteratively update the Jacobian matrix when moving to a different location in state space. After the linear model is identified, the optimum trajectory is found using a gradient method. We apply these optimization methods to a time-to-torque minimization problem for a gasoline turbocharged direct injection automotive engine. Intuitively, the quickest way to reach a torque setpoint is to use bang-bang controls to transition to the setpoint torque. Simulation results show that BBO decreases time-to-torque by 48% relative to bang-bang controls, and adaptive optimization decreases time-to-torque by an additional 26%. These results have significant implications for improved automotive engine performance.

#1456 Application of Granular Computing and Three-way decisions to Analysis of Competing Hypotheses

Matteo Gaeta (IT), Giuseppe D'Aniello (IT), Angelo Gaeta (IT), Vincenzo Loia (IT), Marek Reformat (CA)

We present an application of Granular Computing and Three-way decisions to intelligence analysis. In particular we extend the Analysis of Competing Hypotheses with an additional perspective devoted to support analysts in reasoning with groups of hypotheses that can be equivalent on the basis of partial and incomplete evidence, and in classifying these groups of hypotheses with respect to a decisional attribute of interest for the analyst, such as dangerous or safe. Creating and reasoning with granules and multi-level granular structures give to our approach an added value when dealing with a large number of evidence and hypotheses. Three-way decision making offers the possibility of a rapid understanding of how granules of hypotheses approximate a class of dangerous hypotheses, with clear benefits when analysts have to take decision on classifying a group of hypotheses or setting a proper level of attention to group of equivalent hypotheses.

#1521 Parallel Coral Reef Algorithm for Solving JSP on Spark

Ming-Chao Chiang (TW), Chun-Wei Tsai (TW)

A high-performance scheduling algorithm, called MapReduce coral reef (MRCR), is presented in this paper. The basic idea of the proposed algorithm is to apply the MapReduce programming model of Spark to the coral reef optimization algorithm to speed up its response time. This means that MRCR will distribute its solutions to as many cluster nodes as it needs for calculating the objective value of solutions using the MapReduce technology. To evaluate the performance of the proposed algorithm, several benchmarks are used with different algorithms. Our experimental results show that the proposed algorithm is able to speed up the response time of the coral reef optimization algorithm in solving complex optimization problems, especially when the size of benchmarks is large.

Granular Computing (II)

Organizers: Shusaku Tsumoto, Tzung-Pei Hong, Shiyue-Liang Wang, Chun-Wei Tsai
October 10 (Monday), 15:30-17:00, Sofitel Budapest Chain Bridge, Bellevue 2
Session Chairs: Shusaku Tsumoto, Tzung-Pei Hong

#1738 Communication Scheduling Scheme Based on Big-Data Regression Analysis and Genetic Algorithm for Cyber-Physical Factory Automation

Chao-Chun Chen (TW), Chao-Lieh Chen (TW), Che-Yang Ciou (TW), Jia-Xuan Liu (TW)

In the Industry 4.0 era, enterprises are eager to add intelligent and cyber-physical technologies to further enhance the factory automation. However, in cyber-physical factory environment, more than hundreds of or thousands of IoT devices could send data at the same time, which affect the completeness of data collection and also diminish the consequent decision correctness. In this work, we proposed a novel communication scheduling scheme based on big-data regression analysis and genetic algorithm for IoT-enabling devices to collect data in cyber-physical factory automation. The basic idea is to discover collection behaviors of IoT devices and apply the extracted behavior in finding optimal communication schedules. Our proposed scheme asks each IoT device moderately utilize the network bandwidth with their in-memory buffer for maximizing the global benefit, rather than only self benefit. Then we conducted experiments to verify and analyze the proposed scheme. The results of the experiments indicate that our proposed scheme successfully achieve the long-term data collection in scenarios of 200 IoT devices working together. This work provides developers useful experiences for creating manufacturing systems of cyber-physical factory automation.

#1900 Efficient Mining of Short Periodic High-Utility Itemsets

Chun-Wei Lin (CN), Jiexiong Zhang (CN), Philippe Fournier-Viger (CN), Tzung-Pei Hong (TW), Chien-Ming Chen (CN), Ja-Hwung Su (TW)

Mining of high-utility itemsets in transactional databases is emerging topic in recent years since it can be used to reveal more information for decision making, which has been widely used in many real-life applications. For the traditional high-utility itemset mining (HUIM), only the utility values of the itemsets are considered without timestamps or periodic constraints. In this paper, we present a new short periodic high-utility itemset mining (SPHUIM) to mine the set of short periodic high-utility itemsets (SPHUIs) by considering both the period and utility measures. A baseline two-phase SPHUI-TP algorithm is first presented to mine SPHUIs in level-wise manner. To reduce the search space of SPHUI-TP algorithm, two pruning strategies are also developed to speed up the mining performance of the SPHUI-TP algorithm. Substantial experiments both on real-life and synthetic datasets showed the efficiency and effectiveness of the designed approaches.

#2138 A Novel method for stock prediction by using relationship between various stock prices fluctuation

Yao-Hsin Chou (TW), Shu-Yu Kuo (TW)

Stock price forecasting is an important issue for investors since extreme accuracy in forecasting can bring about high profits. Many studies about predicting stock price all based on technical analysis. The principle of technical analysis is based on the history will repeat itself. Therefore, in this paper, it uses different sets to standardize the stock prices change range then using the tool of common sub-sequence to find the relationship between these sets to predict future stock prices. In the experiment, the proposed method perform better than traditional methods in terms of prediction accuracy and, furthermore, it is easy to implement.

#2395 Construction of Linguistic Variables in Information Table based on Rule Induction and Concept Hierarchy

Shusaku Tsumoto (JP)

Application of attribute-oriented generalization to an informatation often lead to inconsistent results of rule induction, which can be viewed as generation of fuziness with partialization of attribute information. This paper focuses on fuzzy linguistic variables and proposes a solution for inconsistencies. The results show that domain ontology may play an important role in construction of linguistic variables.

#1113 DSS: A biclustering method to identify diverse and state specific gene modules in gene expression data

Jungrim Kim (KR), Yunku Yeu (KR), Jeongwoo Kim (KR), Youngmi Yoon (KR), Sanghyun Park (KR)

The biclustering method is a useful co-clustering technique to identify biologically relevant gene modules. In this paper, we propose a novel method to find not only functionally-related gene modules but also state specific gene modules by applying a genetic algorithm to gene expression data. To identify these gene modules, the proposed method finds biclusters in which genes are statistically overexpressed or under expressed, and are differentially-expressed in the samples in the bicluster compared to the samples not in the bicluster. In addition, we improve the genetic algorithm by adding a selection pool for preserving the diversity of the population. The resulting gene modules exhibit better performances than comparative methods in the GO (Gene Ontology) term enrichment test and an analysis connection between gene modules and disease. This is especially the case with gene modules that receive the highest score in the breast cancer dataset; they are closely linked to the ribosome pathway. Recent studies show that dysregulation of ribosome biogenesis is associated with breast tumor progression.

Intelligent Internet Systems (I)

Organizers: Shyi-Ming Chen, Tan-Hsu Tan, Yung-Fa Huang, John W.T. Lee
October 10 (Monday), 13:30-15:00, InterContinental Budapest, Duna Salon III
Session Chairs: Tan-Hsu Tan, Shyi-Ming Chen

#1371 Fuzzy-Based Indoor Zone Positioning System in Wireless Sensor Networks

Chia-Hsin Cheng (TW)

This paper proposes a zone-based indoor positioning scheme by using the fuzzy-based algorithm in Wireless Sensor Networks (WSNs). In wireless transmission, the received signal strength indicator (RSSI) is inversely proportional to distance. This propagation characteristic has been used to construct a signal propagation channel model. We divide the RSSI into several power levels according to the rate of signal attenuation over distance. In indoor position, the area could be split up into zone lots. In order to find out the position zone of the target node, the fuzzy inference system (FIS) algorithm is used to improve the accuracy of the location zone. The RSSI values from several reference nodes are used as input in this FIS. Then, the FIS generate an estimation of the zone location of the target node. The performance of indoor zone positioning system with different split methods of zone will be analyzed in this paper.

#1599 Action Classification Using Data Mining and Paris of SURF-Based Trajectories

Salah Alghyaline (TW), Jun-Wei Hsieh (TW), Hui-Fen Chiang (TW)

A new action classification approach is proposed to improve the accuracy of the state-of-art frameworks from three folds: (1) Association rule mining is used with dense trajectories approach to discover strong relations between different visual words in the video clips, then a new histogram is built for each video clip based on such relations. (2) The second proposed approach is based on SURF descriptor to extract the most similar pairs of dense trajectories' features, and then the most similar trajectories' features are used to describe the video clip. (3) Finally, a symmetrical SURFs approach is used to detect the symmetrical pairs of trajectories in the video; the most symmetrical features in the video clip are extracted and used to describe the video clip. The above three new features are used in addition to the original desne trajectories' features for action classification. The importance of these new features is that many features are not related to the background and can significantly increase the overall recognition accuracy.

#1669 A Compact Self-Decoupling Dual Band MIMO Antenna

Jwo-Shiun Sun (TW), Hansheng Fang (TW), Ching Song Chuang (TW), Tan-Hsu Tan (TW)

This paper presents a compact self-decoupling dual band MIMO antenna that meets wireless local area network communication standards. The self-decoupling is taken place by purposely using a folded loop-shape element in the MIMO antenna. Furthermore, the feeding point of the element antenna is deliberately selected so as to produce both the two desired frequency bands. The whole loop structure is constructed to produce the lower frequency band while a portion of the loop is resonant to the higher frequency band. The MIMO antenna contains two folded loop-shape elements situated back-to-back with a closed inter-element distance of one-tenth wavelength of the lower band. The novelty of this MIMO antenna is attributed to the achievement of good isolation without using any other supplementary decoupling mechanisms. In addition, the properties of small in size, simple in structure, nearly omni-directional in radiation pattern with moderate radiation gain make the proposed MIMO antenna fully compatible and fairly attractive to the wireless and internet network applications.

#1703 Design of a secure medical data sharing system via an authorized mechanism

Chin-Ling Chen (TW), Jin-Xin Hu (CN), Chun-Long Fan (CN)

In recent years, the electronic medical records can be easily stored with the rapid development of healthcare technology and cloud computing. However, the security of patient's medical information is currently concern issue. Despite of many literatures discussed about it, these literatures still face many security challenges. Therefore, we propose an authentication scheme based on cloud environment. In our scheme, we allow people to use the digital develop mechanism to achieve the sharing medical data. By the way, the biometric fingerprint feature and digital signature is used to ensure the security of medical information in our scheme.

#1875 Selecting the Best Model of Particle Swarm Optimization Based on the Previous Performance

Yen-Ching Chang (TW), Yu-Tien Huang (TW), Bei-Lin Zhuang (TW), Sheng-Hao Chen (TW), Guan-Ru Huang (TW), Hui-Ci Shi (TW)

Particle swarm optimization (PSO) has been proven to be a simple yet effective algorithm for searching the optimal solutions of objective functions. The main advantage of PSO is its simplicity, but it easily gets stuck in local optima. In order to remain the original merit and raise its performance, a novel idea is proposed in this paper, which selects the best model of PSO based on the previous performance through a scheme of PSO with a switch of multiple models. Experimental results show that the PSO through the scheme outperforms any with its individual setting alone. In the future, PSO algorithms with a switch of multiple models will be a promising research field. In addition, the idea can be easily extended to select the best from multiple optimization methods.

Intelligent Internet Systems (II)

Organizers: Shyi-Ming Chen, Tan-Hsu Tan, Yung-Fa Huang, John W.T. Lee
October 10 (Monday), 15:30-17:00, InterContinental Budapest, Duna Salon III
Session Chairs: Yung-Fa Huang, Shyi-Ming Chen

#1913 On Design of A Dynamic Carpooling System Based on Vehicle Information Shared Through the VANET

Ing-Chau Chang (TW)

Because both drivers and passengers may have different time constraints and preferences for carpooling, it is hard to manually find the best carpooling match, i.e., the lowest fuel-cost route, between them in the traditional carpooling web site. With the help of real-time traffic information exchanged among nearby vehicles through the vehicular ad-hoc network (VANET), this paper proposes the dynamic Carpooling System with real-time Vehicular Information (CSVI) system architecture, algorithms and message flows to calculate the route with the lowest fuel cost, according to dynamic route planning results of the VBA* algorithm that we previously proposed. These algorithms significantly reduce the time complexity under a huge number of possible carpooling combinations. Finally, simulation results exhibit excellent performance results of this VANET-based carpooling system over traditional ones, with the help of VBA* and proposed CSVI algorithms.

#1917 Optical Transceiver with Deficit Round Robin and RS232 Interface for Synchronous Optical Networking

Guo-Ming Sung (TW), Wen-Duen Chou (TW), Tzu-Hsuan Chiu (TW)

This paper presents an optical transceiver, whose packet process is completed with deficit round robin (DRR) and RS232 interface, for optical synchronous optical networking (SONET) which can service on both asymmetric digital subscriber line (ADSL) and optical packet switching (OPS). To resolve the clock jitter, not only the cycle decision but also the reset function are used to synchronize the clock waveform. In the proposed DRR, it performs the packet process with low delay and low loss. Moreover, the RS232 interface, which is integrated with the field-programmable gate array (FPGA) board, is adopted due to its easy implementation. The processing data will be queued with DRR and be sent to electrical/optical (E/O) converter from the RS232 port on FPGA board (Transmitter). Passing through the optical fiber, the packet from transmitter is sent to the O/E converter and then received at the RS232 port on another FPGA board. The received electrical packet will be displayed on the seven-segment display of FPGA board to verify the transceiver function for SONET. Note that the proposed architecture is designed with Verilog hardware describe language (Verilog HDL). According to the measured results, the data transfer rate is 115,200 bps with the FPGA operating frequency of 50 MHz and the fiber distance of 5 km.

#1940 SmartCam to see through darkness

Jian Ren Wang (TW)

The paper proposes a brand new structure for enhancing nighttime image, including the parts of glow removal, nighttime image enhancement and color calibration. Under the prerequisite that nighttime image is commonly affected by intense artificial light (e.g. streetlamp, car light, traffic lights), which violates the existing image processing technique, it is necessary to remove the glow produced by artificial light, and correct the area affected by artificial light. The paper combines negative film technique with dark channel prior (DCP) algorithm to enhance nighttime image, and employs guided image filtering to make transmission more refined, achieving better restoration effect and making speed faster than the conventional soft matting algorithm by several times. Finally, the paper conducts color calibration of the enhanced nighttime image, and calibrates the distorted colors. This algorithm can be used to enhance the nighttime image taken by closed-circuit television (CCTV) or car video recorder, and especially achieves excellent effect when applied in low-light environment.

#2012 Research on Affinity Propagation Algorithm Based on Common Neighborhood

Yu Ling Hong (CN), Qi Shan Zhang (CN)

Nowadays many researches have focused on the Affinity Propagation (AP) algorithm for community detection as the advantages of near-linear complexity and no prerequisite for any object function or cluster number. In view of different influence in common neighbors, we propose an improved Affinity Propagation algorithms based on adjacency matrix, considering self-similarity and similarity among nodes which have common neighbors but disconnected. Two AP algorithms based on Local Naïve Bayes and Super-mean Random Walk are proposed. The experiments on both the artificial datasets and the real-world datasets demonstrate that the quality of communities discovered by the improved algorithms provide an effective solution with a better stability.

#2029 Performance of Frequency Resource Assignment Schemes for Cognitive Radio Based Cooperative Communication Systems

Yung-Fa Huang (TW), Tan-Hsu Tan (TW), Shing-Hong Liu (TW), Rung-Ching Chen (TW)

Cognitive radio (CR) allows unauthorized users to access authorized band without interfering the authorized user, thereby improving the bandwidth efficiency. In addition, cooperative communications with relay stations (RSs) can be used to improve throughput performance of 4G downlink network. In this study a cognitive radio assisted cooperation (CRAC), which combines advantages of CR and cooperative communications with RSs, is considered for resources allocation in the downlink orthogonal frequency division multiple access (OFDMA) networks. Two adaptive resource allocation algorithms are presented and experimental results demonstrate that the proposed algorithms can not only enhance throughput, but also improve fairness and utility of users assuming available channels are known by base station.

Soft Computing (I)

Organizers: Yan Pei, Ajith Abraham, Mario Koppen, Hideyuki Takagi
October 12 (Wednesday), 11:00-12:30, Sofitel Budapest Chain Bridge, Bellevue 1
Session Chairs: Yan Pei, Ajith Abraham

#1082 Principal Component Selection of Machine Learning Algorithms Based on Orthogonal Transformation by Using Interactive Evolutionary Computation

Yan Pei (JP)

We propose a method to solve the selection problem of principal components of machine learning algorithms based on orthogonal transformation by using interactive evolutionary computation. One of the addressed subjects for machine learning algorithms based on orthogonal transformation is how to decide the number of principal components, and which of the principal components should be used to reconstruct the original data. In this work, we use the interactive differential evolution algorithm to study these subjects by using real humans' subjective evaluation in an optimization process. An image compression problem using principal component analysis is introduced to study the proposed method. From the evaluation, we do not only solve the selection problem of principal components for machine learning algorithms based on orthogonal transformation, but also can analyse the human aesthetical characteristics on visual perception and feature selection from the designed method and experimental evaluation. We also discuss and analyse potential research subjects and some open topics, which are invited to further investigate.

#1112 Improving Gene Expression Programming using Diversity Preservation Tournament and Its Application in Grid Cell Modeling

Lin Wang (CN)

In gene expression programming, diversity can be reduced during evolution, sometimes resulting in premature convergence because of non-coding regions, leading to substantial reproduction of repeated individuals. In order to increase the diversity of the population and to avoid premature convergence, we propose a new diversity preservation tournament operator, adopting a tree-based similarity measurement and global probability weights. Furthermore, the proposed tournament operator is embedded into a hybrid evolution architecture to search for a parsimonious model for the firing pattern of grid cells, neurons in the mammalian brain involved in navigation. Experimental results demonstrate that the proposed diversity preservation tournament improves the performance of gene expression programming for evolving a model for grid-cell data.

#1229 Sliding Mode Control for State Delayed Systems subject to Persistent Disturbance

Lin Wang (CN)

This paper considers the sliding mode control (SMC) for a class of state delayed systems subject to persistent disturbances. First, a disturbance compensator is proposed to eliminate the influence from persistent disturbances, and the stability of control system is discussed. Then, the control problem is transformed into sliding mode control problem for state delayed system without expression of disturbances. The reduced-order sliding mode surface function is proposed based on the Lyapunov-Functional and the designed switching function. Furthermore, sliding mode control law is obtained. Finally, the simulation results demonstrate that the proposed control law can guarantee the stability of state delayed systems.

#1348 DBM vs ELM: A Study on Effective Training of Compact MLP

Masato Hashimoto (JP), Yuya Kaneda (JP), Qiangfu Zhao (JP), Yong Liu (JP)

We compare the performance of multilayer perceptrons (MLPs) obtained using back propagation (BP), decision boundary making (DBM) algorithm and extreme learning machine (ELM), and investigate better method for developing aware agents (A-agent) that are suitable for implementation in portable/wearable computing devices (P/WCD). The DBM has been proposed by us for inducing compact and high performance learning models that are suitable for implementation in P/WCD. The basic idea of the DBM is to generate data to fit the decision boundary (DB) of a high performance model, and then induce a compact model based on the generated data. In our study, support vector machine (SVM) is used as the high performance model, and a single hidden layer MLP is used as the compact model for the DBM algorithm. ELM is paid attention as new learning method for neural networks in recent years. It is known that hidden layer is not to be tuned and available fast training compared to traditional gradient-based learning methods. Experimental results show that the performance of DBM is the highest in three training methods when the number of hidden neurons is small for all databases used in the experiment. This means that the accuracy of DBM converged to high score, when the number of hidden neuron is small. Therefore, we found that DBM is the best algorithm for developing compact and high performance A-agents.

#1377 Electricity Load Demand Time Series Forecasting with Empirical Mode Decomposition based Random Vector Functional Link Network

XueHeng Qiu (SG), Ponnuthurai Nagaratnam Suganthan (SG), Gehan Anil Joseph Amaratunga (GB)

Short-term electricity load demand forecasting is a critical process in the management of modern power system. An ensemble method composed of Empirical Mode Decomposition (EMD) and Random Vector Functional Line network (RVFL) is presented in this paper. Due to the randomly generated weights between input and hidden layers and the close form solution for parameter tuning, RVFL network is a universal approximator with the advantages of fast training. By introducing ensemble algorithm EMD into RVFL network, the performance can be significantly improved. Five electricity load demand datasets from Australian Energy Market Operator (AEMO) were used to evaluate the performance of the proposed method. The attractiveness of the proposed EMD based RVFL network can be demonstrated by the comparison with six benchmark methods.

Soft Computing (II)

Organizers: Yan Pei, Ajith Abraham, Mario Koppen, Hideyuki Takagi
October 12 (Wednesday), 14:00-15:30, Sofitel Budapest Chain Bridge, Bellevue 1
Session Chairs: Yan Pei, Mario Koppen

#1564 Improvement of MF-ARTMAP Classification Accuracy Using Simulated Annealing

Jaroslav Ondo (SK), Peter Sincak (SK), Pitoyo Hartono (JP)

This paper deals with an MF ARTMAP neural network. We study its behavior while training with different data sets and using different parameters. It gives us better knowledge of its strong and weak points. Subsequently, we focus on alleviation of weak points and improvement of strong points like the utilization of a one-shot learning, an incremental ability of the network without forgetting the already obtained knowledge or post-processing of information stored in the form of the transparent internal structure of identified clusters and classification classes. We have shown the incrementality of this neural network. As for the weak part of the MF ARTMAP algorithm, we try to increase the generalization ability by adopting Simulated Annealing method to find the best shape of membership functions with the best possible ratio between generalization of the neural network and its classification performance. Using simulated annealing algorithm, we optimize network's parameters namely the membership function's shapes of fuzzy clusters in the feature space. Subsequently, we compare classification accuracy of MF ARTMAP with and without parameters optimization, as well. Moreover, we compare against the classification precision of the Multi-Layer Perceptron (MLP) using benchmark data sets, with the aim to get a relevant image of the overall MF ARTMAP efficiency beside the well-known and frequently-used algorithm, like the MLP.

#1707 How to Transform Partial Order Between Degrees into Numerical Values

Vladik Kreinovich (US), Olga Kosheleva (US), Joe Lorkowski (US), Martha Osegueda (US)

Fuzzy techniques are a successful way to handle expert knowledge, enabling us to capture different degrees of expert's certainty in their statements. To use fuzzy techniques, we need to describe expert's degree of certainty in numerical terms. Some experts can provide such numbers, but others can only describe their degrees by using natural-language words like “very”, “somewhat”, “to some extent”', etc. In general, all we know about these word-valued degrees is that there is a natural partial order between these degrees: e.g., “very small” is clearly smaller than “somewhat small”. In this paper, we propose a natural way to transform such a partial order between degrees into numerical values.

#1714 Fuzzy-Inspired Hierarchical Version of the von Neumann-Morgenstern Solutions as a Natural Way to Resolve Collaboration-Related Conflicts

Vladik Kreinovich (US), Olga Kosheleva (US), Martha Osegueda (US)

In situations when several participants collaborate with each other, it is desirable to come up with a fair way to divide the resulting gain between the participants. Such a fair way was proposed by John von Neumann and Oscar Morgenstern, fathers of the modern game theory. However, in some situations, the von Neumann-Morgenstern solution does not exist. To cover such situations, we propose to use a fuzzy-inspired hierarchical version of the von Neumann-Morgenstern (NM) solution. We prove that, in contrast to the original NM solution, the hierarchical version always exists.

#1727 Advanced Fuzzy Possibilistic C-means Clustering Based on Granular Computing

Long Thanh Ngo (VN), Hung Quoc Truong (VN), Witold Pedrycz (CA)

With the rapid development of uncertain and large-scale datasets, Fuzzy Possibilistic C-means Clustering (FPCM) and Granular Computing (GrC) were introduced together with the aim to solve the feature selection and outlier detection problems. Utilizing the advantages of the FPCM and GrC, an Advanced Fuzzy Possibilistic C-means Clustering based on Granular Computing (GrFPCM) was proposed to select features as a preprocessing step for clustering problems and granular space is used to handle the uncertainty. Experimental results reported for various datasets in comparison with other approaches exhibit the advantages of the proposed method.

#1877 The Imaginary Particle Swarm Optimizer for Dynamic Maximum Power Point Tracking

Toshimichi Saito (JP), Ryusuke Akeno (JP), Kousuke Tanakajima (JP)

This paper presents the imaginary particle swarm optimizer with reset function (iPSOR) for maximum power point tracking in photovoltaic array under partial shading condition. The cost function corresponds to the voltage-versus-power characteristic of the photovoltaic array. Depending on insolation and temperature, the cost function and its MPP vary in a complicated way. In order to track the dynamic MPP, the iPSOR includes several strategies: imaginary particle swarm consisting of sampled voltages for real-time operation, a flexible reset method of the past history for adaptation to dynamic environment, and alternation between reference and non-reference to neighbor particles for escape from a trap. Performing numerical experiments for basic artificial problems, the efficiency of the iPSOR is confirmed.

Soft Computing (III)

Organizers: Yan Pei, Ajith Abraham, Mario Koppen, Hideyuki Takagi
October 12 (Wednesday), 16:00-17:30, Sofitel Budapest Chain Bridge, Bellevue 1
Session Chairs: Yan Pei, Hideyuki Takagi

#1991 EigenAnt assisted IACOR for continuous global optimization

Prof Jayadeva (IN), Sumit Soman (IN), Udit Kumar (IN)

This paper describes a variant of the Incremental Ant Colony Optimization algorithm for continuous optimization (IACOR). The original IACOR approach estimates the Probability Density Function (PDF) using Gaussians constructed around candidate solutions to generate new solutions. We use Support Vector Regression (SVR) to fit a regressor to the candidate solutions. The minima of the fitted regressor are found using a variant of EigenAnt. This approach is based on the observation that minima tend to be clustered in real problems, and estimating the landscape of minima is more efficient than estimating the landscape of the original function. We present results on two fronts. We demonstrate the effect of the use of SVR and modified EigenAnt. Further, we also demonstrate the performance of our approach on the Soft Computing (SOCO) benchmark functions for global optimization, and obtain appreciable results.

#2411 Multi-objective Neuro-evolution: Should the Main Reproduction Mechanism be Crossover or Mutation?

Adham Salih (IL), Amiram Moshaiov (IL)

Given the fundamental difference between the selection and reproduction mechanisms of MO-CMA-ES and NSGA-II, it should be asked which kind of these mechanisms is better for the multi-objective evolution of neuro-controllers. This question, which has been recently raised and studied, is further investigated here. The numerical investigation is based on two multi-objective navigation problems, in conjunction with two types of networks. In all the studied cases it was found that MO-CMA-ES is better than NSGA-II. The reason for the superiority is explored. First, it is shown that the competing convention problem cannot serve as an explanation to the observed phenomenon. A method is suggested to investigate the convergence of the networks. Based on the proposed methodology, it is found that for the studied cases MO-CMA-ES has a much better convergence properties. The differences between the two algorithms, and the uniqueness of the considered neuro-evolution problems, lead to the following hypothesis. It is postulated that MO-CMA-ES is superior as a result of its ability to fine-tune the solutions by changing particular genes, each at a time.

#1469 Particle Swarm Optimization applied to Relational Data Clustering

Renê Pereira de Gusmão (BR), Francisco de Assis Tenório de Carvalho (BR)

This work introduces a hard clustering algorithm based on Particle Swarm Optimization metaheuristic that is able to partition objects considering their relational descriptions given by a single dissimilarity matrix. The PSO is a metaheuristic based on population which is well known for its simplicity, good performance and it was already designed as clustering algorithm for vector data. The proposed PSO algorithm uses a modified version of the HCMdd algorithm as local search. The HCMdd algorithm is a variant of the well known hard K-medoids clustering algorithm for relational data, that is designed to provide a partition and a representative for each cluster. The performance and the usefullness of the proposed algorithm, in comparison with HCMdd, RHCM and Spectral clustering algorithms, these last two are also able to work with relational data, are illustrated with suitable normalized data sets from the UCI Machine Learning Repository.

Special Sessions

#2292 Image-based Nutrition Composition Analysis with a Local Orientation Descriptor

Ju-Chin Chen (TW), Kawuu W. Lin (TW)

A local orientation descriptor (LOD) for nutrition analysis by quantity estimation is proposed. By observing nutrition properties, a texture-based LOD is designed to extract discriminant information, frequency and length among food items. Prior to classification, food detection is a challenging problem due to significant variety of backgrounds and containers. Thus, three food region detectors are designed in this study. A detector that employs a modified salient object detection algorithm using prior background knowledge provides promising segmentation results for non-uniform backgrounds. Integrating gradient information to construct graph weights yields more precise segmentation results. In addition, nutrition quantity is estimated using coins as reference objects. Three types of features, normalized colour, density, and symmetry properties are extracted for coin classification. Experimental results show that the proposed LOD outperforms existing object recognition features.

#1587 A Novel Particle Swarm Optimization Algorithm for Non-Separable and Ill-Conditioned Problems

Yosuke Hariya (JP), Takuya Shindo (JP), Kenya Jin'no (JP)

Particle swarm optimization (PSO) is a stochastic population-based algorithm that is designed for real-parameter optimization problems. PSO is a simple and powerful algorithm. However, the performance of PSO is degraded in the case of non-separable and ill-conditioned problems. In this article, we discuss the relation between the Hessian matrix of a function and the covariance matrix of the search distribution. The covariance matrix adaptation mechanism is required to solve non-separable and ill-conditioned problems. Therefore, in order to solve such problems, we propose a simple covariance matrix adaptation mechanism that uses the difference vector of the personal best positions. In addition, we propose a selection rule to improve the local search ability. Finally, we clarify the effectiveness of the proposed method in solving non-separable and ill-conditioned problems by using test functions.

Human Centered Transportation Systems (I)

Organizers: Koji Murai, Takashi Imamura, Tadatsugi Okazaki
October 10 (Monday), 15:30-17:00, InterContinental Budapest, Duna Salon IV
Session Chairs: Koji Murai , Tadatsugi Okazaki

#1200 Study on Relation between Operator and Trainee's Mental Workload for Ship Maneuvering Simulator Exercise Using Heart Rate Variability

Koji Murai (JP), Ippei Sugimoto (JP), Kenichi Kitamura (JP), Jie Wang (CN), Yibing Wang (CN)

A ship maneuvering simulator (simulator) is used for the purpose of advancing a maneuvering skill for a navigator and a sea pilot (pilot). We have evaluated their mental workload using physiological indices; however, it doesn't evaluate mental workload of a system engineer of the simulator (operator). We challenge to evaluate the operator's mental workload leads to a new addition for the conventional evaluation of mental workload of trainees, navigational officer and pilot. Heart rate variability (HRV) is one of useful physiological index; in this study we use R-R Interval data and LF/HF (Low/High Frequency) value of HRV data, we evaluate the operator's mental workload, and compared with mental workload of ship's bridge (bridge) teammates: navigator (captain) and helmsman. Finally we verify the effectiveness of simulator and its scenario for training.

#1231 Evaluation of Mixed Culture Bridge Teammates' Mental Workload Using Heart Rate Variability: Simulator-based Ship Handling

Kenichi Kitamura (JP), Koji Murai (JP), Masao Furusho (JP), Yibing Wang (CN), Jie Wang (CN), Yoshiaki Kunieda (JP)

Our goal is to evaluate quantitatively mental workload of a ship's bridge (bridge) teammate: navigator (captain), helmsman, and pilot. The greatest cause of much stress they feel is their treating cargo, infinite sum of money. Their roles in navigating to avoid a disaster at sea are so much large. The actualization to evaluate quantitatively mental workload is not just useful to relieve them of their much mental workload, but also to hand down a navigational skill to a new navigator from a veteran navigator; if we recognize the sea area where a veteran navigator feels mental workload, we understand the veteran navigator's navigating intend and a new navigator acquire and use the navigating skill like a veteran navigator. We use R-R Interval, one of physiological indices, to evaluate mental workload and we utilize the ship maneuvering simulator (simulator) to confirm the effectiveness of R-R Interval. In addition, we evaluate the mental workload of multinational bridge team.

#1240 Development of actual ship experiment system for developing automatic pier docking system

Tadatsugi Okazaki (JP), Nagisa Sano (JP), Shinya Sasaki (JP)

The needs to develop an automatic pier docking system has arisen due to a shortage of seafarers. An automatic pier docking system was proposed in a previous study; however, the system was highly limited in its applicability. In order to develop a practical system, applicable to a wide range of conditions and environments, it was necessary to evaluate the mental workload of captains while using this new system. This study proposed a system that could be safely used to test an automatic pier docking system using a real ship. With the proposed system, an experiment involving the automatic pier docking system was safely executed and the captain's mental workload was effectively measured.

#1400 Operation Support System for Water Transit Service

Kyohei Takahata (JP), Etsuro Shimizu (JP), Motoki Yamaguchi (JP), Masashi Yamagishi (JP), Ayako Umeda (JP), Tsuyoshi Oode (JP)

Recently, the transit service such as the automobiles and the railways are evolving. However, the development of the water transit service is not popular compared to the automobiles and railways system. Therefore, we developed the operation support system for water transit service capable of remote operation, monitor and autonomous navigation. It can be expected the reduction of maritime accidents and the improvement of environment of the crew. It is necessary to transmit data such as video data between the base and the vessels to remote operate and monitor. Therefore, the sufficient bitrate is needed. In order to meet the requirements, the long-range Wi-Fi antenna is used in the system. In this paper, the operation support system for water transit service is developed and examined at Tokyo bay.

#1049 Model construction and authentication algorithm of virtual keystroke dynamics for smart phone users

Hongbo Zhang (CN), Zhao Peihai (CN), Wang Mimi (CN)

This paper focuses on account stolen case of smart phone users. In order to enhance the credibility of user authentication, an authentication method based on virtual keystroke dynamics behavior of touch screen is proposed in this paper. The proposed method extracts time dependent characteristics and pressure related characteristics of users' virtual keystroke dynamics behavior, builds combined authentication model by RBF networks, checks whether the virtual keystroke dynamics behavior of current user matches that of expected user to authenticate user's identity. The experiment shows that the proposed method has the expected result.

Human Centered Transportation Systems (II)

Organizers: Koji Murai, Takashi Imamura, Tadatsugi Okazaki
October 12 (Wednesday), 17:30-19:00, Sofitel Budapest Chain Bridge, Academy 3
Session Chairs: Koji Murai, Takashi Imamura

#1545 Embedding Explicit Representation of Cyber-Physical Elements in Task Models

Philippe Palanque (FR), Racim Fahssi (FR), Célia Martinie (FR)

User interfaces for the command and control of transportation and navigation systems, such as aircraft cockpits, usually integrate several types of interaction elements: physical, hardware or software. Within these cyber-physical environments, operators have to complete their tasks manipulating these different types of elements. However, task description notations do not take into account physical and hardware aspects beyond manipulation of input devices such as mouse and keyboard. This paper identifies generic aspects of cyber-physical interactive systems and proposes extensions to operators' tasks description techniques, to capture them. We argue that representing cyber-physical elements explicitly and systematically in task models contribute to the design and development of usable and reliable transportation systems. These extensions are integrated within the tool-supported notation called HAMSTERS and are illustrated on a case study from the avionics domain.

#1611 Operational assistance system for obstacle collision avoidance and load sway suppression in overhead traveling crane

Yuki Hara (JP), Yoshiyuki Noda (JP)

This paper discusses the development of an operational assistance system in an overhead traveling crane. In the crane operation, the skill with obstacle collision avoidance, suppression of the load sway, and transferring to the target position in a short time is required. However, it is difficult to acquire the skill in the practical field. Therefore, the operational assistance system for avoiding the obstacles collision and suppressing the load sway is proposed in this paper. The proposed system is realized by the system integration of the environment recognition system and joystick system with reaction force display. And, the load sway can be suppressed by the filtering approach. The effectiveness of the proposed system is verified by the experiments with the laboratory-type overhead traveling crane.

#2268 Providing safe and affordable transportation service for female passengers: A case study on college girls in rural Bangladesh

Nuren Abedin (JP), Jecinta Wairimu Kamau (JP), Hironobu Kitaoka (JP), Hiroshi Okajima (JP), Masaharu Okada (JP), Akira Fukuda (JP), Ashir Ahmed (BD)

We carried out a small experiment to observe the transportation situation for adolescent female students in rural Bangladesh. A senior high school (in Bangladesh, they call it a college) student spends 90-120 minutes to travel 11km on an average by using a local transport. Local transport (Tomtom) stops are not always close to their home. They walk. The Tomtom does not have a regular timetable. In worst case, the students wait 30 minutes until the Tomtom driver finds sufficient numbers of passenger. Female students find it uncomfortable to share congested space with male passengers. They cannot raise their voice when they face sexual harassment inside the car or when they walk. The guardians of the female students find it safer to stop their education and arrange a marriage. We proposed a regular college bus service with an adaptive time schedule that follows the routine of the students. In order to make the service sustainable, we designed a model of multi service vehicle so that it can earn extra income during its idle time. We concluded that the operational cost can be covered. We identified new requirements for multiservice vehicle to satisfy the needs of a rural community.

#2383 Navigation in Human-Robot and Robot-Robot Interaction using Optimization Methods

Rainer Heinrich Palm (DE), Abdelbaki Bouguerra (SE), Muhammad Abdullah (PK), Achim J. Lilienthal (SE)

Human-robot interaction and robot-robot interaction and cooperation in shared spatial areas is a challenging field of research regarding safety, stability and performance. In this paper the collision avoidance between human and robot by extrapolation of human intentions and a suitable optimization of tracking velocities is discussed. Furthermore for robot-robot interactions in a shared area traffic rules and artificial force potential fields and their optimization by market-based approach are applied for obstacle avoidance. For testing and verification, the navigation strategy is implemented and tested in simulation of more realistic vehicles. Extensive simulation experiments are performed to examine the improvement of the traditional potential field (PF) method by the MBO strategy.

#1104 How many drivers does it take to spot an OpenSpot?

Imre Lendak (CS), Karoly Farkas (HU)

The primary goal of this paper is to investigate what could have made successful Google's OpenSpot, a crowdsensing based parking assistance application canceled in 2012. For this analysis we have developed UPark, a simulation environment capable of simulating large numbers of vehicles, which look for optimal parking spots in busy urban environments and whose drivers might inform others when they take or free a parking spot (e.g. via a mobile crowdsensing based application which allows the drivers to share the exact time and GPS position of a parking event). We introduce also the UPark simulation environment which has the potentials to be used for investigating other crowdsensing scenarios, e.g. 'sensing' the perceived safety level or crowdedness of urban spaces, or public transport related events.

Interactive and Wearable Computing and Devices

Organizers: Giancarlo Fortino, Peter X. Liu
October 10 (Monday), 15:30-17:00, InterContinental Budapest, Ballroom I
Session Chairs: Giancarlo Fortino, Peter X. Liu

#1174 CanoeSense: Monitoring Canoe Sprint Motion using Wearable Body Sensor Networks

Zhe Long Wang (CN), Jiaxin Wang (CN), Hong Yu Zhao (CN), Ning Yang (CN), Giancarlo Fortino (IT)

This paper presents a monitoring system (CanoeSense) for canoe motion based on wearable Body Sensor Networks (BSNs). An effective motion segmentation method was applied to competitive sport, which can segment human motion phases automatically based on raw time series data that was acquired through wearable Inertial Measurement Units (IMUs). Orientation estimation algorithm was adopted to measure the attitude information of athletes' stroke motion of the canoe. By fusing the data of motion phases and attitude changes, the monitoring data may provide coach with a new performance monitoring method for improving coordination motions of two partners or adjusting the training plan in time. The experimental results showed that our system is able to simultaneously monitor motion phases and attitude changes of two athletes during training on the water.

#2336 A Comparison of Wearable and Stationary Sensors for Stress Detection

Simon Erik Ollander (FR), Christelle Godin (FR), Aurélie Campagne (FR), Sylvie Charbonnier (FR)

To test the stress detection performance of a wearable sensor system, the signals related to heart activity and electrodermal activity of the Empatica E4 wristband have been compared to stationary electrocardiogram and finger skin conductivity electrodes of high sampling rates during the classical laboratory stress protocol Trier Social Stress Test. The comparison has been done on both signal level and in terms of features for stress detection on a total of seven subjects. The main results point out that the Empatica E4 wristband had a significant loss in terms of detected interbeat intervals, but that time-domain features such as the mean heart rate and standard deviation of the heart rate were still well estimated, with good stress discrimination power. Furthermore, the skin conductivity signals measured at different locations (wrist versus finger) show no visual resemblance and it appears that the signal from the Empatica E4 wristband yielded higher stress discrimination power than the signal measured at the fingers.

#1268 A Sensor to Acquire the Relative Movement between Residual Limb and Prosthetic Socket

Veronika Noll (DE), Paul Weber (DE), Stephanie Scortecci (BR), Philipp Beckerle (DE), Stephan Rinderknecht (DE)

The presented paper introduces a new approach to measuring relative movement between two surfaces: in particular between the residual limb and fitted prosthetic socket in an amputee during gait. Considering requirements motivated by the specific measurement task, a system design for the recognition of residual limb movement within the socket system in dynamic gait situations is proposed. To evaluate the feasibility of the measurement task with this sensor concept, a standalone functional model is established and introduced regarding hardware and software components. This paper further presents preliminary experimental evaluation of this functional model. Results considering precision and accuracy of the functional model are displayed. Dependencies to movement velocity, overcome distance and traveling direction are assessed. The realized prototype of the sensor concept shows errors regarding accuracy within the range of 2 to 6 %. Precision depends on movement direction as well as path lengths. Overall, the proposed sensor needs to be assessed in more detail concerning different situations, but seems suitable for acquiring the relative movement between residual limb and prosthetic socket during amputee gait.

#2100 Collaborative Classification for Daily Activity Recognition with a Smartwatch

Hyunchoong Kim (KR), Jonghoon Shin (KR), Soohwan Kim (KR), Yohan Ko (KR), Kyoungwoo Lee (KR), Hojung Cha (KR), Seong-Il Hahm (KR), TaeJun Kwon (KR)

Research of daily activity recognition has been extensively conducted in the field of ubiquitous computing. However, previous daily activity recognition schemes are either obtrusive or inaccurate since they use just special-purpose devices. In this paper, we propose the collaborative classification for recognizing daily activities with a smartwatch. We exploit a single off-the-shelf smartwatch to distinguish 5 different daily activities such as eating, vacuuming, sleeping, showering, and TV watching. More precisely, we conduct experiments for collecting sensor data from accelerometer and acoustic sensor which are embedded in a smartwatch. However, the simple combination of the raw acceleration and acoustic data does not deliver accurate recognition accuracy. In order to achieve high accuracy, we propose a collaborative classification algorithm which integrates sensor data and ground-truth label for improving recognition accuracy by constructing a mapping table. We evaluate accuracies using single-sensor based approach, multi-sensor based approach, and our collaborative classification approach. The results from activity recognition for about 20 hours data collected by subjects show reliable accuracies for all 5 activities, and the overall accuracy of our collaborative approach is about 91.5%. Experimental results reveal that our approach improves the recall rate of each activity by up to 21.5% as compared to that of the simply combined multi-sensor based approach.

#1117 Object-alignment performance in a head-mounted display versus a monitor

Pavlo Bazilinskyy (NL), Natália Kovácsová (NL), Amir Al Jawahiri (NL), Pieter Kapel (NL), Joppe Mulckhuyse (NL), Sjors Wagenaar (NL), Joost de Winter (NL)

Head-mounted displays (HMDs) offer immersion and binocular disparity. This study investigated whether an HMD yields better object-alignment performance than a conventional monitor in virtual environments that are rich in pictorial depth cues. To determine the effects of immersion and disparity separately, three hardware setups were compared: 1) a conventional computer monitor, yielding low immersion, 2) an HMD with binocular-vision settings (HMD stereo), and 3) an HMD with the same image presented to both eyes (HMD mono). Two virtual environments were used: a street environment in which two cars had to be aligned (target distance of about 15 m) and an office environment in which two books had to be aligned (target distance of about 0.7 m, at which binocular disparity was expected to be important). Twenty males (mean age = 21.2, SD age = 1.6) each completed 10 object-alignment trials for each of the six conditions. The results revealed no statistically significant differences in object- alignment performance between the three hardware setups. A self-report questionnaire showed that participants felt more involved in the virtual environment and experienced more oculomotor discomfort with the HMD than with the monitor.

Collaborative Wireless Sensor Networks and Internet of Things

Organizers: Giancarlo Fortino, Wenfeng Li, Antonio Liotta, Weiming Shen
October 10 (Monday), 17:00-18:30, InterContinental Budapest, Duna Salon IV
Session Chairs: Giancarlo Fortino, Antonio Liotta

#1997 Edge enabled development of Smart Cyber-Physical Environments

Andrea Vinci (IT), Franco Cicirelli (IT), Giancarlo Fortino (IT), Antonio Guerrieri (IT), Giandomenico Spezzano (IT)

Smart Cyber-Physical Environments are augmented physical environments whose behaviours are enhanced through the use of ICT technologies. The goal is to offer new services and functionalities devoted to meet people's needs and preferences, and to better exploit existing services and infrastructures. The use of IoT technologies, paired with the edge computing, fosters the development of Smart Environment applications having the important features of reliability, scalability and extensibility. This paper proposes an approach for the design and the implementation of Smart Cyber Physical Environment applications having the aforementioned features. The approach relies on the use of isapiens which is an IoT platform enabling edge computing through the exploitation of the agent metaphor. Such platform provides effective abstractions which are able to hide heterogeneity of both the adopted hardware devices and communication protocols. The approach is validated through a case study involving the realization of a Smart Office prototype for profiling and monitoring daily working activities and performing actuations in the environment on the basis of the obtained information.

#2020 Mitigating Sensor Differences for Phone-based Human Activity Recognition

Xizhe Yin (CA), Gary Shen (CA), Xianbin Wang (CA), Weiming Shen (CA)

This paper presents our recent work on the analyses of smart phone sensor data collected for the human activity detection, with the objective to develop more accurate activity recognition systems independent of smart phone models. We identify the multi-device scenario and present the impairments of different smartphone embedded sensor models on HAR application. Outlier removal, interpolation, and filter in preprocessing stage are proposed as mitigating techniques. Based on datasets collected from four distinct smartphones, the proposed mitigating methods show positive effects on 10-fold cross validation, device-to-device validation, and leave-one-out validation. Improved performance for smartphone based human activity recognition is observed.

#2123 Big IoT data mining for real-time energy disaggregation in buildings

Decebal Constantin Mocanu (NL), Elena Mocanu (NL), Phuong H. Nguyen (NL), Madeleine Gibescu (NL), Antonio Liotta (NL)

In the smart grid context, the identification and prediction of building energy flexibility is a challenging open question, thus paving the way for new optimized behaviors from the demand side. At the same time, the latest smart meters developments allow us to monitor in real-time the power consumption level of the home appliances, aiming at a very accurate energy disaggregation. However, due to practical constraints is infeasible in the near future to attach smart meter devices on all home appliances, which is the problem addressed herein. We propose a hybrid approach, which combines sparse smart meters with machine learning methods. Using a subset of buildings equipped with subset of smart meters we can create a database on which we train two deep learning models, i.e. Factored Four-Way Conditional Restricted Boltzmann Machines (FFW-CRBMs) and Disjunctive FFW-CRBM. We show how our method may be used to accurately predict and identify the energy flexibility of buildings unequipped with smart meters, starting from their aggregated energy values. The proposed approach was validated on a real database, namely the Reference Energy Disaggregation Dataset. The results show that for the flexibility prediction problem solved here, Disjunctive FFW-CRBM outperforms the FFW-CRBMs approach, where for classification task their capabilities are comparable.

#2373 Design and Implementation of a Gateway for Pervasive Smart Environments

Diana Cecilia Yacchirema (ES), Carlos E Palau (ES)

Wireless sensor and actuator networks play an important role in the Internet of Things (IoT) as they are key for the creation of Pervasive Smart Environments. These networks are developed through the interconnection of various heterogeneous devices. Due to the heterogeneity of the devices in terms of the communication protocols and the technologies used, the interconnection between them is still difficult. Particularly, interconnection and interoperability in IoT are two of the great challenges that needs to be faced in order to implement pervasive smart environments. We present the design and implementation of a Smart IoT Gateway which allows technical and syntactic interoperability in IoT using standard open protocols and standard data representation formats. We evaluated and demonstrated the effectiveness of the Smart IoT Gateway in terms of interoperability through its application to a use case in the industry sector.

#1996 An Embedding Approach for Context-Aware Collaborative Recommendation and Visualization

King Keung Wu (HK), Pengfei Liu (HK), Helen Meng (HK), Yeung Yam (HK)

Recommender system has been widely used in e-commerce systems nowadays. Current methodologies focus on predicting users' preferences from their previous ratings. Although the prediction is largely helpful, it gives limited insight to managers of e-commerce systems on how to utilize the interactions between users and items for designing new business and marketing strategies. Besides, big data collected by e-commerce systems raise another challenge in recommendation --- how to incorporate large amount of additional information such as the contexts where the rating or buying event takes place. In this paper, we propose a novel method to simultaneously tackle the two challenges above based on the concept of embedding, by deriving a general distance-dependent rating model that characterizes the relationship between user and item with respective to the embedding space. The generalized model allows us to incorporate contextual information into the recommender system for rating prediction and item recommendation. We show that our embedding model is comparable to state-of-the-art context-aware recommendation algorithms in terms of accuracy, while allowing visualization as an analytics tool which gives intuitive insights to the recommendation in an understandable way. In addition, our algorithm also allows efficient recommendation by leveraging the neighborhood structure of the embedding space. We demonstrate the advantages of our method with experiments and results show that context-aware embedding is a promising approach for context-aware recommender systems.

Shared Control (I)

Organizers: Makoto Itoh, Tricia L. Gibo, Erwin R. Boer
October 11 (Tuesday), 09:30-11:00, Sofitel Budapest Chain Bridge, Academy 3
Session Chairs: Makoto Itoh, Tricia Gibo

#1062 A Trouble Shared Is a Trouble Halved – Usability Measures for Human-Robot Collaboration

Jonas Schmidtler (DE), Moritz Körber (DE), Klaus Bengler (DE)

Changing industrial, social, and legal situations cause a rethinking of novel production systems. One possible approach is to assist the human workers' power. By application of collaborating robots, weaknesses can be compensated by the strengths of the interacting partner using haptic shared control. To ensure acceptance and well-being on the human side, which can be seen as a condition for high performance, usability of the collaborative systems has to be maximized. This study aims to evaluate usability measures for haptic Human-Robot Collaboration in horizontal manipulation tasks (HMT). Results show significant differences and strong effects for accuracy (standard deviation lateral position, SDLP) and efficiency (time to task completion, TTC) measures in a Human Dyad experiment using a Human-Human Collaboration (HHC) method.

#1154 Driving with Shared Control: How Support System Performance Impacts Safety

Husam Muslim Alzamili (JP), Makoto Itoh (JP), Marie-Pierre Pacaux-Lemoine (FR)

Driving with shared control systems has been shown to be efficient in reducing collisions during a lane change. However, the ability of the current shared control systems is limited and their absolute reliability is not assured. The goal of this study is to determine how changes in system performance affect human-machine cooperation and safety. An experiment using a driving simulator was designed to compare two types of support systems, (1) haptic shared control that provides control guidance to resists hazardous lane changes; and (2) mixed-input control that autonomously controls vehicle directions to prevent lane change collisions. Both systems were examined under three conditions: (i) 100% reliability, (ii) full reliability but limited system ability, and (iii) system failure. While both systems were judged trustworthy and accepted by the drivers when fully reliable, the mixed-input was more efficient at maintaining safety. In the second condition, drivers overestimating the capabilities of the system led to more collisions for both systems. The results illustrate that how machine failure impacts surprises and distrust in automation is highly dependent on driver's ability to regain the control. Overall, the haptic guidance was more efficient and accepted more by the drivers.

#1183 A Shared Control in Risk Predictive Braking Manoeuvre for Preventing Collision with Pedestrian

Yuichi Saito (JP), Pongsathorn Raksincharoensak (JP)

Autonomous emergency braking systems have been already introduced to the markets, and have good driver acceptance in terms of the functions of such assistance system. However, such assistance system reaches its limit when there are unexpected moving obstacles appearing suddenly from poor visibility area, such as a space behind a parked vehicle. This paper describes a shared control in risk predictive braking manoeuvre for preventing collision with a pedestrian, and constructs a protection-typed support with an active gas pedal and extension-typed support with a brake pedal. The assistance system activates in a hidden risk situation that an occluded pedestrian suddenly might intend to cross a road. Under a driving simulator experiment, we investigated its functionality and effectiveness of the proposed assistance system, and we confirmed that the proposed assistance system was potentially effective for guiding the drivers to trace the desired safe velocity.

#1283 Towards adaptability of levels of automation with Human-Machine cooperation approach

Lydia Habib (FR), Marie-Pierre Pacaux-Lemoine (FR), Patrick Millot (FR)

The current study focuses on how the levels of automation and the number of simultaneous functions that complete the task demands affect the human operator performance. The research objective is to assess the effects of different levels of automation of vehicles (teleoperated VS. autonomous) and the complexity of the task on human operator performance. An experiment is realized using the simulation environment "Mixed Initiative Experimental" (MIX) which is designed for research and training with unmanned systems. The MIX platform aims to respond to the need for warfighters support and training in the domain of robotic military equipment and unmanned systems in general. The complexity of the task is simulated by increasing the number of autonomous vehicles that a human operator has to supervise or to teleoperate.

#1600 Evaluation of Haptic Support System for Training Purposes in a Tracking Task

Giulia D'Intino (DE), Mario Olivari (DE), Stefano Geluardi (DE), Joost Venrooij (DE), Mario Innocenti (IT), Heinrich Buelthoff (DE), Lorenzo Pollini (IT)

Haptic guidance has previously been employed to improve human performance in control tasks. This paper presents an experiment to evaluate whether haptic feedback can be used to help humans learn a compensatory tracking task. In the experiment, participants were divided into two groups: the haptic group and the no-aid group. The haptic group performed a first training phase with haptic feedback and a second evaluation phase without haptic feedback. The no-aid group performed the whole experiment without haptic feedback. Results indicated that haptic group achieved better performance than the no aid group during the training phase. Furthermore, performance of haptic group did not worsen in the evaluation phase when the haptic feedback was turned off. On the other hand, the no-aid group needed more experimental trials to achieve similar performance to the haptic group. These findings indicate that haptic feedback helped participants learn the task quicker.

Shared Control (II)

Organizers: Makoto Itoh, Tricia L. Gibo, Erwin R. Boer
October 11 (Tuesday), 11:00-12:30, Sofitel Budapest Chain Bridge, Academy 3
Session Chairs: Erwin R. Boer, Makoto Itoh

#1715 Driver's trust in automated driving when sharing of spatial awareness

Kohei Sonoda (JP), Takahiro Wada (JP)

Vibrotactile display has been investigated to support driver's monitoring of traffic situation when auto driving. We assumed a vibrotactile display contributes to driver trust in automation since driver can know the spatial awareness of an automated system to predict or understand the action selection for driving. The display provided the spatial information of close traffic objects with haptic stimulus. We considered driving scenes of passing a motorbike when behind vehicles are approaching. A driving simulator study was conducted to investigate effects of the spatial information and driving behavior of automated system on driver trust. The results showed that the trust was affected by the information and behavior of the system.

#1757 Authority Transfer Method from Automated to Manual Driving via Haptic Shared Control

Takahiro Wada (JP), Kohei Sonoda (JP), Takuya Okasaka (JP), Takahiro Saito (JP)

As defined by the Society of Automotive Engineers (SAE), drivers are required to resume control from an automated driving system (ADS) in automated Level 2 and 3 driving when requested by the automated system. For example, the driver must resume manual driving control when the functional limitations of the ADS are approaching or have reached. In addition, he or she may also resume manual driving control whenever he/she realizes the functional limits of the system are approaching, or when an ADS malfunction is imminent. In such cases, it is necessary to smoothly transfer driving control to the driver, even when immediate steering actions are needed. Accordingly, this research proposes a method for smoothly transferring authority of steering control from the ADS to the driver in situations where drivers are required to perform quick steering actions. The method is based on a haptic shared control technique that can adjust the strength of the steering control by the ADS. We applied our method to a small electric vehicle and conducted experiments. It was demonstrated that the driver's intention to take over the control could be detected quickly only from the driver's steering operation. It was also suggested that aggressive steering behavior was suppressed with the proposed gain tuning technique, even in cases where the driver was required to engage in engage in immediate steering actions after resuming control.

#1932 Using Learning from Demonstration to Generate Real-time Guidance for Haptic Shared Control

Carlos Perez-del-Pulgar (ES), Jan Smisek (NL), Victor Munoz (ES), Andre Schiele (NL)

This paper introduces a new Learning from Demonstration (LfD)-based method that makes usage of robot effector forces and torques recorded during expert demonstrations, to generate force-based haptic guidance reference trajectories on-line, that are intended to be used during haptic shared control for additional operator 'guidance'. Derived haptic guidance trajectories are superimposed to master-device inputs and feedback forces within a bilateral control experiment, to assist an operator by the guidance during peg-in-hole insertion. We show that 96 peg-in-hole expert demonstrations were sufficient to obtain a good model of the task, which was used on-line to generate haptic guidance trajectories in real-time with a 1kHz sampling rate.

#1983 A Multiple-Input Single-Output Model for Human Force Perception in Pedaling

Yoshiyuki Tanaka (JP), Shuhei Tanabe (JP)

Research on the human-centric design of driving interface devices, such as a pedal and a steering wheel, has been conducted to improve the operational comfort as well as the driving safety in developing an intelligent driver assistance system. However, the evidences on human factors in driving has been still insufficient to attain such research goals. In this paper, an electric-driven pedal interface system was developed to analyze human force perception properties at the foot in pedaling. A set of measurement tests was carried out to examine the relationship between force perception and musculoskeletal conditions according to the combination of leg configurations and rages of reaction forces. The results demonstrated that human force perception in pedaling was affected by both the range of force stimuli and the ankle angle, especially for smaller force range. Such perception properties obtained was then modeled as a simple multiple-input single-output system successfully. Furthermore force tracking tests were conducted to examine the usefulness of the perception model in improving the maneuverability of a pedal interface system.

#2130 Shared automation of lane change for avoiding forward obstacle

Makoto Itoh (JP), Takuya Aizawa (JP)

Based on current technologies, automated driving systems needs the human driver to monitor the environment and the machine. One way to enhance the driver to watch the environment is to make him/her put his/her hands on the steering wheel. Under the condition that the human collaborates with the automation, it is important for the automation to be designed that the automation is trustworthy. One of the issues to be addressed is a lane change for avoiding a forward obstacle. In this paper, we discuss the timing of starting lane change maneuver. Three types of the timing, i.e., Earliest, Mean, and Latest, were distinguished based on a preliminary data collection. The results showed that the three types would be acceptable, but Mean would be the best among the three types.

Conflict Resolution (I)

Organizers: Liping Fang, Keith W. Hipel
October 12 (Wednesday), 16:00-17:30, InterContinental Budapest, Ballroom III
Session Chairs: Liping Fang, Keith W. Hipel

#1081 An efficiency-adjusted fair mechanism for house allocation problem with existing tenants

Chengyue Li (JP), Takehiro Inohara (JP)

We study a house allocation problem where there are both existing tenants and new applicants. The NH4 mechanism is a real-world allocation mechanism which satisfies individual rationality, fairness and strategy-proofness. But it fails Pareto efficiency. We propose an efficiency-adjusted NH4 mechanism that allows each student to consent a certain priority violation that has no effect on her own assignment. Under this mechanism, such consent can help recover efficiency loss which is caused by resolving squatting conflicts between two students. Moreover, we show which students' consents will be used.

#1092 Misperception in Nationalization of the Suez Canal

Yasir M Aljefri (CA), Keith W. Hipel (CA), Liping Fang (CA), Abul Bashar (CA)

The 1956 nationalization of the Suez Canal dispute, between Egypt and an alliance between the United States (US) and Britain, is modeled and analyzed within the paradigm of a first-level hypergame in graph form. The results reveal that Britain and US encountered a strategic surprise in the dispute on account of their failure to predict Egypt's action in nationalizing the Suez Canal. The equilibrium states of the dispute are analyzed to provide insights into the types of the misperceptions that caused the conflict, the possible decision makers' reactions after observing the equilibrium states, and the sustainability of the first-level hypergame equilibria. The analysis reveals substantial motivation for the United States and Britain to intensify the dispute to recapture the Suez Canal and to improve their situation.

#1473 Belief Preference in Graph Model for Conflict Resolution with Two Decision-Makers

Hanlin You (CN), Mengjun Li (CN), Jiang Jiang (CN), Bingfeng Ge (CN), Xueting Zhang (CN), Jianguo Xu (CN)

In order to deal with the subjectivity, epistemic uncertainty and incompleteness of input data, a novel methodology is proposed for interactive decision making between two players based on the graph model for conflict resolution (GMCR) with belief preference. First, a new GMCR model is calibrated, in which belief preferences are generated via evaluating the utilities of feasible states. Second, new defini-tions of unilateral improvements and four stability concepts are presented for conflict analysis. Finally, an interactive decision case on a weapon system of systems (WSoS) archi-tecting is studied to demonstrate the feasibility of the pro-posed methodology.

#1479 Automated Extraction of a Game Model using Natural Language Processing: National Strategies of the Asian Infrastructure Investment Bank

Marin Nagase (JP), Yu Maemura (JP), Masahide Horita (JP)

This article presents a method for representing highly strategic events using natural language processing. In 2013, China proposed the creation of the Asian Infrastructure Investment Bank (AIIB) as the country continues to capitalize on its economic growth and makes moves to gain influence in regional development. International society is facing a big shift in power balances, where the existing sphere of influence wielded by financial institutions led by the US and Europe are challenged by new orders being established by the developing countries. The method proposed in this article automates the analysis of written material so that the strategies taken by people or organizations involved can be modelled. The method uses clue expressions and supervised machine learning to identify and extract sentences containing strategic relations from a corpus. The accuracy of extraction, defined as the sentences including strategic relations in the sentences that included clue expressions, was 60%. Coverage was calculated as the ratio of sentences correctly extracted in the sentences containing strategic relations within the sentences including clue expressions, and was 67%. In addition, a method for modelling the strategies extracted is proposed and the relations of strategies contained within news articles are represented in a strategic map. Strategic maps of a complex initiative such as the AIIB has revealed the links between various events that intuitively may be considered irrelevant, such as the AIIB and the annexation of Crimea. Furthermore, the change in game structure before and after UK participation in the AIIB became visible as the consequences of UK participation onto other players' preferences has been revealed.

#1565 Trade and Disaster Risk Sharing in Open Economy Model

Hiroaki Ishiwata (JP), Muneta Yokomatsu (JP)

This paper presents an open economy model qualitatively to investigate the risk sharing effect of a crop sharing system to stabilize food security under drought. Two crop sharing systems are considered in this model: "proportionally divided system" and "forward contract system." The model reveals the possibility that the proportionally divided system is effective when high drought risks exist and high trade barriers prevent a country from importing crops, and that the forward contract system mitigates drought risk when forward contract is set at prices lower than the prices in the normal condition. Further, this study shows that the proportionally divided system can improve social welfare in the condition of high drought risks and high trade barriers, while a hold-up problem can be caused by the lack of producer incentive to invest in the production of crops.

Conflict Resolution (II)

Organizers: Liping Fang, Keith W. Hipel

October 12 (Wednesday), 17:30-19:0, InterContinental Budapest, Ballroom III

Session Chairs: Keith W. Hipel, Liping Fang

#1690 Analyzing the Financing Dilemma of Brownfield Remediation in China by using GMCR

Qingye Han (CN)

This paper constructs a GMCR (Graph Model for Conflict Resolution) model to analyze the financing dilemma existing in the brownfield remediation projects in China. In addition to the stability analysis, status quo and inverse analyses are conducted to obtain further managerial insights. The findings of this research are threefold. First, the local government should not redevelop the brownfield without remediation; otherwise, the situation will raise great public concerns, which may lead to severe conflicts among various stakeholders. Second, the cooperation between the local government and enterprises (developers and/or investors) is the most favorable state to successfully conduct the remediation. Third, in order to achieve the desired outcomes, an intervention party who can influence the decision makers' preference has to be intervened in the unsolved situations.

#2010 Evaluation on the Innovative Capacity of Provincial High-tech Industries in China based on Integrated Theil and TOPSIS

Yingying Jia (CN), Peng Guo (CN)

A novel evaluation model, incorporating Theil entropy into TOPSIS, is employed for investigating Chinese high-tech innovation capacity at provincial level. More specifically, the innovation capacity evaluation in high-tech industries is viewed as a Multi-Criteria Decision Analysis (MCDA) problem. The weights of the indicators are determined by the Theil entropy analysis, and the regions are ranked by using TOPSIS. The findings reveal that 31 provinces, autonomous regions and municipalities are divided into six clusters and there exist huge diversities in China's provincial high-tech industries, which which is consistent with reality. The results demonstrate the suitability and feasibility of the proposed evaluation model and provide an evidence-based approach for region decision-makers to promote the innovative capacity of high-tech industries.

#2053 Composition and Stability Concepts in the Graph Model for Conflict Resolution

Masahito Kitamura (JP)

A new concept of composition is proposed in the framework of the Graph Model for Conflict Resolution. Two graph models whose sets of decision makers are identical are composed into one graph model. The composition is interpreted as a situation in which the same decision makers are involved in two independent conflicts at the same time. Relationships between stabilities of states in a composed graph model and those in the two component graph models are investigated for the case of two decision makers. A composition of the Prisoners' Dilemma and the Modified Chicken is constructed as a simple example and stabilities of states are examined.

#2263 Empirical Analysis of the Reference Point Effect in Residential Choices under the Risk of Slope Disasters

Hiroyuki Sakakibara (JP)

In this study, the hypothesis on the decision making on the residential choice with slope disaster risk was tested. First, two types of decisions, moving-in and moving-out decisions, were defined. Then, the hypothesis that people in moving-in decision are more risk averse than those in moving-out decision, was set. In order to test the hypothesis, the web survey was conducted and the difference of the equivalent rents was confirmed. Then, the hypothesis was verified. The results of the survey were interpreted by prospect theory.

#2074 Multi Agent-Learner based Online Feature Selection System

Fatma Ben Said (TN), Adel M. Alimi (TN)

Online Feature Selection (OFS) is an important technique in pattern recognition and machine learning. Our challenge is how to enhance the classification performance in real contexts where the large-scale training data arrive sequentially with a big number of features. The major problem is how to choose the best accurate and efficient state-of-the art OFS method that can select the relevant features or if we do a combination between these methods can we improve the classification performance? In this paper, we propose a framework of OFS using the characteristics of multi-agent systems (MAS) to overcome this challenge. We propose firstly a new OFS model; Agent-Learner based OFS (ALOFS) which represents each agent in our MAS. ALOFS is a generalization of first-order and second-order online learning methods based feature selection. Secondly, we propose the Multi Agent-Learner based OFS (MALOFS) system which uses two levels of selection. The first level aims to select the more confident learners and the second level has as object to select the relevant features using a proposed negotiation method (MNOFS). MALOFS is applicable to different domains successfully and achieves highly accuracy with some real world applications.

Intelligent Learning in Control Systems (I)

Organizers: Ching-Chih Tsai, Kao-Shing Hwang, Han-Xiong Li
October 11 (Tuesday), 09:30-11:00, InterContinental Budapest, Duna Salon II
Session Chairs: Ching-Chih Tsai, Kao-Shing Hwang

#1118 Implementation of Odometry with EKF for Localization of Hector SLAM Method

Kao-Shing Hwang (TW), Wei-Cheng Jiang (TW)

For large-scale indoor laser scan mapping, a challenging problem is scan information lack of distinguishable landmarks, thus cause the improper mapping result especially in corridor environment. Collision may happen during the autonomous robot navigation. This paper presents a scan matching algorithm with odometer prediction using Extended Kalman Filter (EKF) and an optimal path planning with regression subgoal. The scan matching process will be able to out of local minima, and has an effective correction in the odometry information. By iterating odometer correction in each step, the matching result will be much better than one only believe in scan or odometry. Both simulated and large-scale indoor experimental data under the same conditions are used to verify the effectiveness of the proposed techniques.

#1143 Intelligent Sliding-Mode Formation Control for Uncertain Networked Heterogeneous Mecanum-Wheeled Omnidirectional Platforms

Ching-Chih Tsai (TW), Hsiao-Lang Wu (TW), Feng-Chun Tai (TW)

This paper presents an intelligent sliding mode formation control using recurrent fuzzy wavelet neural networks (RFWNN) for a group of uncertain, networked heterogeneous Mecanum-wheeled omnidirectional platforms (MWOPs). The dynamic behavior of each uncertain MWOP is modelled by a reduced three-input-three-output second-order state equation and the multi-MWOP system is modeled by a directed graph. By using the Lyapunov stability theory and online learning the system uncertainties via RFWNN, an intelligent adaptive, sliding mode control approach is presented to carry out formation control in presence of uncertainties. Two simulations are conducted to show the effectiveness and merit of the proposed method with existing collision-free and obstacle-avoidance approaches.

#1356 Maximum Power Point Tracking of Photovoltaic Generation Systems under Partial Shaded Conditions

Gwo-Ruey Yu (TW)

This paper proposes an improved quantum-behavior particle swarm optimization (IQPSO)-based maximum power point tracking (MPPT) for photovoltaic generation systems (PGS) under partial shaded conditions. The power stage of the MPPT system is a series buck-boost converter which can be operated on buck mode or boost mode. The proposed IQPSO algorithm can avoid the premature problem of the conventional QPSO algorithm such that the searching ability into maximum power point is promoted. The advantages of the method include raising the tracking efficiency, reducing the tracking time, tuning only one parameter. Simulation results demonstrate the performance of the proposed IQPSO is better than that of QPSO, firefly algorithm (FA) and PSO.

#1412 A Bayesian Network Based Method for Activity Prediction in a Smart Home System

Zong-Hong Wu (TW), Alan Liu (TW), Pei-Chuan Zhou (TW), Yen Feng Su (TW)

A smart home system can provide better services to assist users if it knows what user activities will occur beforehand. Early research in activity prediction has indicated that the result of prediction is unique, but the accuracy remains unsatisfactory if only one result is considered. To solve this problem, this paper proposes a method of leveraging multiple models. In this work, we use a Bayesian network to build a model to predict which activity will happen, and then the predicted results go through a property filtering to get the final result. Due to the possibility that residents in a smart home may have different activity patterns, we have built a Bayesian network model to learn conditional probability of resident activities from the dataset of CASAS project. At last, we compare the results and show that our method has improved coverage and accuracy in activity prediction. This proposed method belongs to an ongoing project involving learning and control in a smart home system.

#1696 3-D Model Reconstruction from C-arm Images

Huei-Yung Lin (TW)

In orthopedic surgery, three-dimensional models are usually reconstructed through CT or MRI images. In urgent operations, the most common way for 3-D model reconstruction is to extract C-arm images by C-arm fluoroscopic imaging. However, it is harmful to human bodies because of the ionizing radiation. In this work, we present a model deformation approach for 3D reconstruction from medical imaging. Our approach utilizes the visual hull algorithm to reconstruct a rough 3-D model from C-arm images, and then deforms it according a reference model. During the deformation stage, some adjustments are made for the models and the coherent point drift algorithm is carried out to match the 3-D points of two models. Experimental results demonstrate the feasibility of our technique for 3-D model reconstruction from C-arm imaging.

Intelligent Learning in Control Systems (II)

Organizers: Ching-Chih Tsai, Kao-Shing Hwang, Han-Xiong Li
October 11 (Tuesday), 11:00-12:30, InterContinental Budapest, Duna Salon II
Session Chairs: Kao-Shing Hwang, Ching-Chih Tsai

#1902 PSO and Neural Network based Intelligent Posture Calibration Method for Robot Arm

Ping-Huan Kuo (TW), Guan-Hong Liu (TW), Ya-Fang Ho (TW), Tzuu-Hseng S. Li (TW)

Inverse kinematics is a general method for defining the joint angles of the robot arm. This method provides an efficient way to control the robot arm for several tasks. However, the server motors or the mechanism design of the robot arm may not always be ideal. If the motor consumption is existed, the error of the final position of the robot arm will be increased. In order to solve this problem, this paper proposes an intelligent method for the posture calibration of the robot arm. In this paper, the particle swarm optimization (PSO) algorithm and the proposed neural network model are integrated to calibrate the kinematics of the robot arm. The experimental results show that the control error can be reduced by applying the proposed method. The feasibility and practicality of the proposed method are also validated in the experiments.

#1809 Hierarchical Data-Driven Model-Free Iterative Learning Control Using Primitives

Mircea Bogdan Radac (RO), Radu Emil Precup (RO)

This paper suggests a novel model-free primitive-based hierarchical approach to trajectory tracking, which endows the feedback control systems with learning and planning capabilities. The reference inputs (r.i.s) are first optimized at the low level in a Model-Free Iterative Learning Control framework to achieve controlled output trajectory tracking, without using a model of the environment. The learning takes place in a Linear Time Invariant (LTI) setting. The learned r.i.-controlled output pairs are called primitive pairs. Each new complex trajectory to be tracked is then decomposed at the high level in terms of the learned output primitives regarded as basis functions. The optimal r.i. ensuring output tracking of the new trajectory is obtained by merging the leaned r.i. primitives using the superposition principle specific to LTI. Therefore, the optimal r.i. is computed offline and avoids learning to track new trajectories from repeated executions of the tracking task. The efficiency of this approach is illustrated on a positioning control system for an aerodynamic system.

#1966 Trend Classification Based Weather Forecast

Yang-Chung Chang (TW), Shun-Feng Su (TW), Ming-Chang Chen (TW), I-Hsum Lee (TW)

This paper reports our study on a novel weather forecast approach based on trend classification. This approach is to predict temperature based on past temperature histories. Trend classification is to provide a hierarchical clustering structure to make pattern match more meaningful so that to make temperature prediction based on those pattern can work. In the proposed trend classification, an overlapping idea is considered to enrich the data correspondence. After trend classification, a clustering approach is employed to define patterns for match. From the experimental result, the average error for the maximal temperature predicted by our approach is at least 0.5°C smaller than that predicted in the news, and the average error of the minimal temperature is at least 0.8°C smaller than that predicted in the news. In other words, the prediction is compatible with the traditional prediction made by the Bureau of Meteorology.

#2445 Two Meta-heuristics to Solve a Coordinated Air Transportation and Production Scheduling Problem with Time Windows for the Due Date

Reza Tavakkoli-Moghaddam (IR), M. Mousavi (IR), M. Hajiaghaei-Keshteli (IR), M. Ranjbar-Bourani (IR)

Traditional production management approaches have paid less attention to integrate supply chain functions. Two main functions in supply chain management (i.e., production planning and distribution) are mutually dependent and important in today's real world applications. More of the time, they should be used simultaneously in an integrated manner to minimize costs in the whole chain. In this paper, a coordinated air transportation and production scheduling problem is studied to minimize the total cost of a supply chain. Additionally, time windows for the due date are considered; however, the due date for delivery time has been considered in the literature. Since this problem is NP-hard, two well-known meta-heuristics (i.e., genetic algorithm and simulated annealing) are used. Some new procedures and operators are developed in these algorithms. To evaluate the performance of the algorithms, different problem sizes are used and the results are compared. Finally, the impacts of increasing the problem size are studied.

#1163 Tracking of A Random Target by Circular Pattern of Mobile Agents With A Leader

Chandreyee Bhowmick (IN), Laxmidhar Behera (GB)

This paper is concerned with the problem of tracking a random target by a circular pattern of mobile agents using leader-follower approach. There is a single leader in the group which is located at the centre of the circle. Other agents, i.e., the followers control their motions to locate themselves evenly on the arc of the circle. The problem considered here is two fold - formation of a circular pattern with a static leader and tracking of a randomly moving target by this pattern. A novel distributed control law has been designed based on artificial potential function approach to achieve the formation and maintenance of the circle with the leader being static. The follower agents are allowed to communicate with the leader and only one neighboring follower. For the tracking problem, the leader estimates state of the target using Kalman filter. The leader is then made to track the target as the estimated target position works as the tracking destination. The control law of the followers is modified by adding a navigation term to make them move along with the leader while maintaining the circular pattern. Both the algorithms - circular formation and tracking - have been shown to be Lyapunov stable. Effectiveness of the proposed scheme is demonstrated through extensive simulation.

Logistics Informatics and Knowledge Acquisition in Intelligent Systems

Organizers: Runtong Zhang, Menggang Li, Martin Dresner, Zhenji Zhang
October 12 (Wednesday), 17:30-19:00, Sofitel Budapest Chain Bridge, Bellevue 1
Session Chairs: Menggang Li, Martin Dresner

#2104 An Efficient and Effective Method to Find Uninteresting Items for Accurate Collaborative Filtering

Hyung-Ook Kim (KR), Jiwoon Ha (KR), Sang-Wook Kim (KR)

Collaborative filtering methods suffer from a data sparsity problem, which indicates that the accuracy of recommendation decreases when the user-item matrix used in recommendation is sparse. To alleviate the data sparsity problem, researches on data imputation have been done. In particular, the zero-injection method, which finds uninteresting items and imputes zero values to those items for collaborative filtering, achieves significant improvement in terms of recommendation accuracy. However, the existing zero-injection method employs the One-Class Collaborative Filtering (OCCF) method that requires a lot of time. In this paper, we propose a fast method that finds uninteresting items rapidly with preserving high recommendation accuracy. Our experimental results show that our method is faster than the existing zero-injection method and also show that the recommendation accuracy using our method is slightly higher than or similar to that of the existing zero-injection method.

#2245 Collaborative Image Triage with Humans and Computer Vision

Addison W Bohannon (US), Nicholas R Waytowich (US), Vernon Lawhern (US), Brian Sadler (US), Brent Lance (US)

As the technology for acquiring and storing images becomes more prevalent, we are faced with a growing need to sort and label these images. At this time, computer vision algorithms cannot parse abstract concepts from images like a human. As a result, there may be performance gains possible from the integration of human analysts with computer vision agents. We present an image triage system which facilitates the collaboration of heterogeneous agents through a novel unsupervised meta-learning technique. The system iteratively allocates images for binary classification among heterogeneous agents according to the Generalized Assignment Problem (GAP) and combines the classification results using the Spectral Meta-Learner (SML). In simulation, we demonstrate that the proposed system achieves significant speed-up over a naive parallel assignment strategy without sacrificing accuracy.

#1899 Numerical Analysis of the Transportation Efficiency in a Network Considering Route Choice

Masaru Kaji (JP), Takehiro Inohara (JP)

In this study, we discuss the efficiency of a transportation network depending on the density. When drivers and pedestrians move to their destination, they travel using various roads. In this process, if there are many cars or pedestrians on a road, congestion may occur, and it is possible that the traveling time increases because of this congestion. In particular, it is occasionally assumed that drivers and pedestrians may choose another route and detour, even if the traveling length is longer. Here, we assume a directed cycle graph considering shortcut and detour routes and study the transportation efficiency of the graph. Thus, we analyze the locations at which congestion occurs using the graph along with the situations in which congestion occurs. Furthermore, we show the vulnerability in the network structure due to the randomness in the density in the graph.

#1453 A Competitive QUasi-Affine TRansformation Evolutionary (C-QUATRE) Algorithm for Global Optimization

Zhenyu Meng (CN), Jeng-Shyang Pan (TW)

In this paper, we proposed a Competitive QUasi-Affine TRansformation Evolutionary (C-QUATRE) algorithm. This algorithm is an advancement of a preciously proposed QUATRE algorithm. The QUATRE algorithm is arguably a very powerful stochastic optimization algorithm, and it will appear in CEC2016 conference proceedings with the paper title QUasi-Affine TRansformation Evolutionary (QUATRE) Algorithm: A Parameter-reduced Differential Evolution Algorithm for Optimization Problem. It conquers some weaknesses of Differential Evolution (DE) algorithm and it has excellent performance even on multi-modal optimization problem. Here in the paper, we advance a C-QUATRE algorithm which uses a pairwise competition mechanism to enhance the performance of the former proposed QUATRE algorithm. The C-QUATRE algorithm is verified both on CEC2013 test suite for real-parameter optimization and BBOB2009 framework for black-box optimization, and experiment results show that the pairwise competition mechanism is very useful for the enhancement of the QUATRE performance over all these benchmarks.

Medical Mechatronics (I)

Organizers: Ming-Yih Lee, Yi-Hung Liu, Chung-Hsien Kuo
October 10 (Monday), 13:30-15:00, InterContinental Budapest, Panorama V
Session Chairs: Chung-Hsien Kuo, Yi-Hung Liu

#1408 Joint Angle Estimation using the Distribution of the Muscle Bulge on the Forearm Skin Surface of an Upper Limb Amputee

Akira Kato (JP), Yuya Matsumoto (JP), Yo Kobayashi (JP), Masakatsu G. Fujie (JP), Shigeki Sugano (JP)

A novel joint angle estimation method is proposed using a new bio-signal for an amputee subject. We used the muscle bulge movement on the forearm skin surface as a new bio-signal for estimating the extent of motion in a previous study. We found that it is feasible to estimate the intended wrist joint angle using the distribution of the muscle bulge for intact subjects. Thus, in the present paper, we validate the feasibility of our method for an amputee. In applying our method to an amputee subject, we improved our distance sensor device so that it can accommodate the position of the muscle, which is variable for an amputee subject. In addition, we improved the algorithm that estimates the wrist joint angle using linear multiple regression for calculating the relationship between the intended wrist joint angle and the distribution of the muscle bulge. As a result, we found that the distribution of the muscle bulge changes for the amputee as for intact subjects. The movement of the position of the muscle bulge on the forearm skin corresponded to the extent of the intended wrist joint angle. According to the result of the estimation of the wrist joint angle, the root-mean-square error of the estimated angle with respect to the measured angle for the amputee was slightly larger than the error for intact subjects. Nevertheless, the root-mean-square error for the amputee was smaller than that when employing the previous method for intact subjects. Finally, it is feasible to use the muscle bulge movement on the forearm skin to estimate the intended wrist joint angle for the upper limb amputee.

#1518 Integration of Visual Feedback System and Motor Current Based Gait Rehabilitation Robot for Motor Recovery

Quanquan Liu (JP), Bo Zhang (JP), Yi-Hung Liu (TW), Yu-Tsung Hsiao (TW), Mu Der Jeng (TW), Masakatsu G. Fujie (JP)

This paper presents a visual feedback available robotic gait training system for motor recovery of hemiplegic stroke survivors. The system is composed of a treadmill consisting of two split belts, a pelvic support manipulator assisting patient’s pelvic movement, and a visual interface feedbacking patient’s gait phase. The split-belt treadmill allow patient to walk in different velocities between sound side and affected side legs, and detect patient’s gait phase by current value of DC motor. The pelvic support manipulator provides three active actuations to assist patient’s leg swinging during walk training. The virtual walking scenario gives visual feedback for patient while providing patient’s gait phase calculated from motor current of the treadmill. One subject with simulated stroke participated in this study. Experiment results indicate gait phase of the virtual model can well track that of patient’s walking, verify the feasibility of the proposed system to improve gait recovery during rehabilitation.

#1594 The Use of Deep Learning and Mean Shift to Learn Global and Local Processing in Human Visual Perception

Wei-Wen Hsu (US), Min Zhang (US), Chung-Hao Chen (US), Wen-Chao Yang (TW)

The purpose of this research is to provide a puzzle-based framework to understand human’s perception in decision making from global and local information. Since the Deep Convolutional Neural Networks (DCNN) has shown the state of the art performance in image classification and object detection, DCNN can output scores to reflect the level of global information, which is highly similar to human’s recognition for partial objects in images, i.e. puzzle pieces. Besides, the local information is also taken into consideration in decision making when playing puzzle, therefore, the puzzle-based instrument is proposed in this paper to study how local and global information can be integrated in decision making.

#1807 Decoupled PID Control with Gain Adaptation for a Cycling Dynamic Knee Rig

Amelie Chevalier (BE), Brecht De Vlieger (BE), Matthias Verstraete (BE), Clara M. Ionescu (BE), Robin De Keyser (BE)

This paper presents the deployment and validation of a control structure for a dynamic knee rig used to gain insight into the kinematics and kinetics of the human knee joint. The dynamic knee rig is able to implement a bicycle motion onto the knee joint using five different actuators. Two actuators control the position of the ankle, one actuator mimics the quadriceps force and two more actuators impose the hamstring forces. Identification of the subsystems of the rig is performed using the ARX method. The obtained mathematical models are used to tune the controller parameters of the proportional-integral-derivative (PID) controllers which control each subsystem. Apart from PID controllers, the control structure also contains feedforward action, decouplers and gain adaptation mechanism. The controllers are tested using a mechanical hinge as knee joint. The results indicate a good trajectory tracking performance of the controllers.

#1810 Adaptive Sliding Mode Control of a Lower-limb Exoskeleton Rehabilitation Robot

Kai-An Yu (TW), Chen-Yun Kuo (TW), Miao-Ju Hsu (TW), Su Chan-Wei (TW), Mu Der Jeng (TW), Chung-Hsien Kuo (TW)

With the increasing demands of rehabilitation facilities and the advances of robotic technologies, lower-limb exoskeleton rehabilitation robots have been proposed to improve the quality and effectiveness of rehabilitation, as well as to reduce the effort and load of physiotherapists. In this paper, not only the mechanical design but also the control approaches of a lower-limb exoskeleton rehabilitation robot are discussed. The control system was developed to work with a body-weight support system and a power treadmill to perform subject specific locomotor training trajectories. Practically, conventional proportional-derivative (PD) servo control approach was applied to the joint motors; however, it cannot adaptively deal with the subject's weight variations. To overcome this problem, an adaptive sliding mode control (ASMC) was realized to track specific locomotor training trajectories with the considerations of different subjects' weights. According to the simulation and experiment results, the adaptive sliding mode controller represented better trajectory tracking performance than conventional PD controllers. Moreover, the ASMC is capable of dealing with different subjects' conditions without extra adjusting operational control parameters.

Medical Mechatronics (II)

Organizers: Ming-Yih Lee, Yi-Hung Liu, Chung-Hsien Kuo
October 10 (Monday), 15:30-17:00, InterContinental Budapest, Panorama V
Session Chairs: Ming-Yih Lee, Yi-Hung Liu

#2030 An Accelerometer-based Festinating Gait Detection Algorithm and Its Application to Parkinson? Disease Development

Wen-Yen Lin (TW), Wen-Zheng Chou (TW), Wen-Shao Wu (TW), Ming-Yih Lee (TW)

Festinating gait is one of the most commonly seen motor symptoms of Parkinson's Disease patients. In this research, an accelerometer-based sensing system implemented on a vest is used to detect the behavior of festinating gait. The detection algorithm is based on the analysis of gait symmetry from the data measured by accelerometers. Specific indices were proposed to evaluate the severity of festinating gait behavior. Along with detection of the upper body lean forward angle while walking, the system could be used as a long-term trend monitoring tool for the development of festinating gait. This application could help users to know the development of the progressive behavior of festinating gait and hence to get proper treatment on PD earlier.

#1695 Relation between Magnitude of Applied Torque during Pre-Swing Phase and Toe Clearance Change to Prevent Trip of Elderly People

Tamon Miyake (JP), Yo Kobayashi (JP), Masakatsu G. Fujie (JP), Shigeki Sugano (JP)

Elderly people are at risk of falling because of their low toe clearance. Gait training to improves toe clearance could be instrumental in avoiding tripping. We propose using a gait-training robot that applies torque during the pre-swing phase to achieve this goal. It is still possible to revert to their original trajectory after the training, however, depending on the magnitude of the applied torque. We investigated the relation between the magnitude of the applied torque and the change in toe clearance before and after application of torque. We developed a robot and carried out an experiment in which a motor pulls a string embedded on the robotic frame worn by the participants, thereby applying torque during the pre-swing phase. The experimental task included walking on a treadmill for 50 s. We applied torque to the knee during the pre-swing phase for 20 s. The phases before and after applying torque were 15-s normal walking phases with no interference from the robot. We compared toe clearance during the phases before and after applying torque. We found that the toe clearance increased after applying a torque of 8 Nm. We were thus able to verify the influence of torque on toe clearance.

#1053 A Medication Adherence Monitoring System for People with Dementia

Vasily Moshnyaga (JP), Masaki Koyanagi (JP), Fumiyuki Hirayama (JP), Akihisa Takahama (JP), Koji Hashimoto (JP)

Due to forgetfulness, people with dementia need assistive technologies for managing medications. In this paper we present a Kinect-based smart system for unobtrusive medication adherence monitoring of people with people with memory-degrading conditions. Unlike existing pill dispensers, our system not only reminds a patient on time of medicine intake and provides the corresponding medication dose, but also vocally guides the patient through the steps of medication intake, controlling correctness and completeness of his actions and alerting the caregiver if problems occur. The experimental evaluation of prototype system shows that it effectively monitors medication adherence and is very easy to use.

#1652 Cognitive Workload in Conventional Direct Control vs. Pattern Recognition Control of an Upper-limb Prosthesis

Wenjuan Zhang (US), Melissa White (US), Maryam Zahabi (US), Anna Winslow (US), Fan Zhang (US), He Huang (US), David B. Kaber (US)

The purpose of this study was to compare the cognitive workload of able-bodied individuals when using a myoelectric prosthetic under direct control (DC) or electromyography pattern recognition (PR) control. Different from existing clinical evaluations involving dual-task performance, pupillography measured with an eye-tracking system was used to quantitatively assess user cognitive workload in using a 2 degree-of-freedom prosthesis for a clothespin task. Test results revealed the PR control to produce superior task performance and to require lower cognitive load than demanded of participants under the DC condition. This study provided evidence of both performance and workload advantages of PR control over DC control. PR control was more intuitive to the prosthesis user and, therefore, required less cognitive effort. Furthermore, the study identified a new effective measure of cognitive workload in upper limb prosthesis use via pupillography.

Intelligent Media and New-Generation Software

Organizer: Masahito Kurihara
October 12 (Wednesday), 17:30-19:00, Sofitel Budapest Chain Bridge, Bellevue 2
Session Chairs: Masahito Kurihara

#1151 A Study on an Emotion Estimation of Narratives Using Cognitive Appraisals of the Reader

Naruaki Toma (JP), Yuhei Akamine (JP), Yamada Koji (JP), Satoshi Endo (JP)

Our emotion estimation refers to estimation of a reader's sentiments and feelings after they read a narrative (i.e., post-reading emotion types). The emotion types manifest in a reader's feelings combine to form diverse and various patterns. To elicit this phenomenon, we here attempt to estimate readers' emotional patterns based on their cognitive appraisals of the work. This paper describes our cognitive appraisal methodology, variation in readers' emotion types due to differences in their cognitive appraisals, and report and discuss the results of emotion estimation experiments in which a reader performs a cognitive appraisal of the text of a narrative.

#1222 The Effect of Education and Learning Using Note-Taking Application

Masanobu Numazawa (JP), Masato Noto (JP)

In recent years, in each stage of education from elementary to high school in Japan, the focus has been on teaching/learning programming. However, it cannot be said that all students are able to learn programming technology. Difficult problems exist in teaching programming because of differences in student achievement levels. These differences are found at the elementary and middle school levels of course, but are even more obvious at the high school level where courses begin to separate into humanities, science, and other fields. In existing note-taking practices, many effective learning methods have been shown in which teachers can explain note-taking methods effectively so that learners can learn how to take notes that they can easily read and understand. In our previous research, we reported our development of a teaching support system that enables students to redesign contents the teacher provides, whether on whiteboards or in projected slides. It enables students to freely revise the teacher's notes so that they can easily read and understand them. In this paper we show how the teaching and learning support system with a note-taking application we developed, as well as notes taken on paper, can be used to examine the effectiveness of note-taking in the teaching and learning of programming. Specifically, we describe experiments we carried out in which we compared cases where notes were not taken during actual lectures with cases where notes taken on paper were used.

#1260 Discovering Inductive Theorems Using Rewriting Induction

Haruhiko Sato (JP), Masahito Kurihara (JP)

Theory exploration has been investigated as the lemma generation methods which play important role in automation of theorem provers. In order to enlarge the scope of provable theorems in the exploration, in this paper we propose an approach of applying the rewriting induction technique in exploration of inductive theorems. Especially, we propose some heuristics for proof search in the rewriting induction. In the experimentation using two examples, the proposed heuristics improve the efficiency without sacrificing the number of successes in the proof search.

#1436 Distance Based Multiple Swarms Formation Method in Particle Swarm Optimization

Junpei Tsuji (JP), Masato Noto (JP)

Particle swarm optimization (PSO) is a solution to the functional optimization problem. PSO has been used in various fields because it has a simple algorithm and is characterized by being versatile with rapid convergence. However, because of its rapid convergence, it may fall into a local optimum especially when the problem has a large number of local solutions. In this paper, we propose a new type of PSO that forms swarms according to distances between particles, with the aim of addressing this local optima issue. Forming swarms in this way makes it possible for each particle to search the region of its own periphery in detail. The results of performance evaluation experiments using computer simulation verified that this method is less likely to get trapped in a local solution compared with conventional PSO.

#2273 System for Game Enhancement using Scene Recognition in Emulated Consoles

Christopher Thibeault (US), Jean-Yves Hervé (US)

This paper investigates the modification of an existing game console emulator to utilize scene recognition to perform audio-visual enhancement of vintage video games. Such games featured low-resolution graphics with limited colors and low-quality electronic music. Information contained about the virtual hardware state information is exploited to provide high-resolution, full-color graphics and a recorded soundtrack, complete with atmospheric effects, in real-time using the original game logic. The system developed as part of this research uses a modified version of the FCEUX emulator for the Nintendo Entertainment System. The system is capable of loading a commercially-released game, marking scenes for later recognition, mapping scenes to audio-visual events, and recognizing those scenes to enable those events. The result is an immersive game experience that far exceeds what was possible in the original game hardware.

In memory of William A. Gruver – Special Session on Distributed Adaptive Systems

Organizers: Haibin Zhu, William A. Gruver, Weiming Shen
October 12 (Wednesday), 09:30-11:00, Sofitel Budapest Chain Bridge, Academy 4
Session Chairs: Haibin Zhu, Weiming Shen

#1265 A Visualization Tool for Adaptive Collaboration

Haibin Zhu (CA)

Adaptive Collaboration (AC) has been proven and verified to be a promising methodology to conduct collaboration. AC follows an iterative and dynamic process that includes phases of role negotiation, agent evaluation, role assignment, role playing, and role transfer. However, AC is complex, and the benefits of AC are not easily observed. In particular, the benefits must be obtained through complicated computations and should be further presented appropriately, e.g., visualization. This paper proposes an approach to visualizing the benefits of AC in group performance. Such visualization can illustrate how dynamic role assignment performs better than static role assignment. Our research is verified through implementations, a case study, and a usability study.

#1562 Evolutionary Strategies for Novelty-Based Online Neuroevolution in Swarm Robotics

Marco Galassi (IT), Nicola Capodieci (IT), Giacomo Cabri (IT), Letizia Leonardi (IT)

Neuroevolution in robot controllers through objective-based genetic and evolutionary algorithms is a well-known methodology for studying the dynamics of evolution in swarms of simple robots. A robot within a swarm is able to evolve the simple neural network embedded as its controller by also taking into account how other robots are performing the task at hand. In online scenarios, this is obtained through inter-robot communications of the best performing genomes (i.e. representation of the weights of their embedded neural network). While many experiments from previous work have shown the soundness of this approach, we aim to extend this methodology using a novelty-based metric, so to be able to analyze different genome exchange strategies within a simulated swarm of robots in deceptive tasks or scenarios in which it is difficult to model a proper objective function to drive evolution. In particular, we want to study how different information sharing approaches affect the evolution. To do so we developed and tested three different ways to exchange genomes and information between robots using novelty driven evolution and we compared them using a recent variation of the mEDEA (minimal Environment- driven Distributed Evolutionary Algorithm) algorithm. As the deceptiveness and the complexity of the task increases, our proposed novelty-driven strategies display better performance in foraging scenarios.

#1832 An Evaluation Method for Self-Adaptive Systems

Farahani Ali (IT), Giacomo Cabri (IT), Nazemi Eslam (IR), Rafizadeh Alireza (IR)

Nowadays, change is an important aspect of the world. Complexity and change in requirements and environments bring us to Autonomic Systems as a solution. Like any other kind of software system, better implementation of a system needs a proper evaluation method for system implementation. To evaluate a Self-Adaptive system, appropriate quality factors are needed for evaluation. This research tries to use non-adaptive system's evaluation methods to evaluate Self-Adaptive ones. The qualitative factors for self-adaptive systems have been extracted from a literature review (as Self-Adaptive System Qualitative Factors or for abbreviation SAQFs). Hence, there is no explicit or even implicit way for measuring most of the SAQFs, This research has tried to measure them through some measurable Qualitative Criterion. These Qualitative Criteria (we call them QCs) consist of some self-adaptive systems attributes and also some non-adaptive systems' qualitative factors. A map between these SAQFs and software system's QCs (which are more measurable) have been introduced. For each QC, sufficient metrics for measuring could be dug up based on the problem context. For better knowing about the influence of qualitative factors on each other, a prerequisite and post-requisite graph from relations among SAQFs have been introduced. This relational graph shows the importance and impact of each factors measurement on measuring the systems from self-adaptive viewpoint. For evaluating the method, we have proposed a questionnaire to experts about the model the correctness of these impacts and influences have been verified. In addition, a case study on a system in changing environment evaluated with proposed method and the applicability of the method have been reviewed.

#1920 Group Role Assignment Based on Multi-Criteria in Collaboration System

Xianjun Zhu (CN), Xianzhong Zhou (CN), Mo Zhang (CN), Haibin Zhu (CA), Xiumei He (CN)

In the real-world, agent has many criteria that is an important factor affect the result of the group role assignment (GRA). To obtain a satisfied assignment, we need to select an appropriate method of multi-criteria. This paper points out the key issues in formally specifies the related concepts, formalizes the problem of GRA based on multiply criteria (GRA-MC), selects three algorithms of multi-criteria decision, i.e., simple additive weighting (SAW), multiplication exponent weighting (MEW) and weighted distance (WD), briefs the procedure of GRA-MC, simulates a case study and discusses the result of GRA-MC.

#2216 Adaptive Workload Distribution for Local and Remote Clouds

Lan Wang (GB), Olivier Brun (FR), Erol Gelenbe (GB)

Cloud systems include both locally based servers at user premises and remote servers and multiple Clouds that can be reached over the Internet. This paper describes a smart distributed system that combines local and remote Cloud facilities. It operates with a task allocation system that takes decisions to allocate tasks dynamically to the service that offers the best overall Quality of Service and a routing overlay which optimizes network delay for data transfer between clouds. Experimental results are conducted at the global intercontinental level, both to collect data for decision making and to illustrate the effectiveness of our approach.

Distributed Adaptive Systems and Biometric Systems

Organizers: Haibin Zhu, William A. Gruver, Weiming Shen
October 12 (Wednesday), 14:00-15:30, Sofitel Budapest Chain Bridge, Bellevue 2
Session Chairs: Weiming Shen, Haibin Zhu

#2470 Simulating Tolerance: A Collective Behavior Observed in Dynamic Social Networks

Yu Zhang (US)

Research into social network systems has observed a phenomenon, named tolerance, through simulations. Tolerance is defined as agent's willingness to maintain an unrewarding connection. We have presented a mathematical model of tolerance to predict the n-tolerance of an agent. We use a real world dataset in the experiments and adjust variables and procedure to achieve desirable results. This work has shown that tolerance is not just a side-effect of the decision rule chosen for the system, nor is it a purely sociological theory, but an observable trait of dynamic social networks in real-world situations.

#1484 Applications of the Viable System Model in Automotive and Battery Storage Systems

Markus Herzog (DE), Andreas Wilhelm Ebentheuer (DE), Michael Winter (DE), Julian Taube (DE), Joachim Froeschl (DE), Hans-Georg Herzog (DE)

The renewable electric power generation in low voltage distribution grids is continuously increasing, which can lead to overload of power transformers. Battery storages can help reducing the load of the transformer and increase the percentage of self sufficiency of distribution grids. In this paper applications of the Viable System Model proposed by Stafford Beer in different fields of research are presented. Finally an approach for a scalable battery storage system based on this cybernetic method is introduced. The system shows a high efficiency even in partial load operation, fault tolerance and availability in error cases, maintainability and a high flexibility regarding the used storage technology.

#1853 Part-Based Representation and Classification for Face Recognition

Marcus de Assis Angeloni (BR), Helio Pedrini (BR)

In recent years, we can observe an increasing use of biometric technology in our daily lives. Face recognition has several advantages over other biometric modalities, since that it is natural, nonintrusive, and it is a task that humans perform routinely and effortlessly. Following a recent trend in this research field, this paper focuses on a part-based face recognition, exploring and evaluating specific descriptions / classifications for each facial part. Experimental results obtained in three public datasets (AR Face, MUCT and XM2VTS), assessing 15 approaches in each facial part and two score fusion strategies, show that features and classifiers specific for facial part can improve the accuracy of biometric systems, achieving error rates close to zero in some cases, including scenarios where the false acceptance cases are critical.

#2103 Smartphone Enabled Person Authentication Based on Ear Biometrics and Arm Gesture

Andrea Francesco Abate (IT), Michele Nappi (IT), Stefano Ricciardi (IT)

Smartphones are arguably candidates to become the platform of choice for ubiquitous biometric-based identity verification, thanks to their embedded sensors, reasonably good computing power and widespread diffusion. While applications of the most established biometrics like face, fingerprint and even iris have already been proposed on mobile devices, other less exploited identifiers could also be worth investigating. To this regard, in this paper a novel multi-modal approach to person authentication based on ear biometrics and gesture analysis is proposed. The idea is to coupling the discriminant power of ear, captured during the act of responding to a phone call, with the user's arm dynamics affecting the smartphone motion pattern due to behavioral and anatomical characteristics involved in this gesture. According to experiments conducted on a specifically built multi-modal database comprising a hundred subjects, we confirm that the responding gesture has significant discriminating power and combined to ear features provides additional robustness and accuracy in mobile authentication scenarios.

#2328 GRiD: Gathering Rich Data from PubMed using One-class SVM

Junbum Cha (KR), Jeongwoo Kim (KR), Sanghyun Park (KR)

The Medical Subject Headings (MeSH) term search is typical data-gathering method in biomedical text mining. However, it has two problems: the allocation delay of the MeSH term and missing valuable literature sources. Since MeSH term allocation is performed by a human being, the allocation process has delay. In addition, even if a literature source was allocated with a MeSH term, there is a still the problem that valuable literature sources are missed during the data-gathering process. There are literature sources that are not indexed to the MeSH term of a keyword, even though it contains valuable information related to the MeSH term. The MeSH term search misses these valuable literature sources. In order to resolve these problems, we propose a novel method to gather rich data using a one-class support vector machine (SVM) and relevance rule. The term frequency--inverse document frequency (TF-IDF) and paragraph vector are examined as text vectorization methods with various parameters and relevance factors. We apply our method to lung cancer, prostate cancer, breast cancer, and Alzheimer’s disease. As a result, up to 26\% of keyword data and 35\% of target data are gathered with high quality (a C-score of at least 0.948).

Discrete Event and Hybrid Systems

Organizers: Maria Pia Fanti, MuDer Jeng, MengChu Zhou
October 11 (Tuesday), 09:30-11:00, Sofitel Budapest Chain Bridge, Bellevue 2
Session Chairs: Maria Pia Fanti, MengChu Zhou

#1109 Analysis and Control of Wafer Delays in a Dual-armed Cluster Tools for a K-Cyclic Schedule

Dong-Hyun Roh (KR), Tae-Eog Lee (KR)

We examine wafer delays, particularly the worst-case delay, of a dual-armed cluster tool for a K-cyclic schedule. We propose two useful concepts related to robot operations for the analyses, which are the time difference σ and the robot delay R. By using these concepts, we formulate a mixed-integer linear programming for computing the worst-case wafer delay. An upper bound for the worst-case wafer delay and experimental results are suggested. We also suggest an improved wafer delay regulation method by exploiting workload balancing. We introduce the effects of workload balancing and the strategies for achieving workload balancing. Explanations related to the configuration of the tool also are suggested.

#1717 Place Invariant Simplification in Optimal Supervisor Synthesis for FMS

Bo Huang (CN), Mengchu Zhou (US), Yi-Sheng Huang (TW)

The theory of regions is an important method to derive an optimal and liveness-enforcing supervisor for a flexible manufacturingsystems based on Petri nets. It first partitions the reachability graph into a live zone (LZ) and a deadlock zone (DZ). Then, activity places are used to construct place invariants (PIs) to prevent the system from entering DZ and permit all markings in LZ. This work studies the reduction of the number of places to be considered in the optimal PI designs. First, the concepts of critical transitions and critical activity places are defined, and an algorithm is provided to compute the sets of critical and uncritical activity places. Then, the proof of that only critical activity places need to be considered in such optimal PI designs is established.

#1871 Modeling Cyber Attacks by Stochastic Games and Timed Petri Nets

Maria Pia Fanti (IT), Massimiliano Nolich (IT), Stella Simic (IT), Walter Ukovich (IT)

This paper presents a model of Satellite Base Station (SBS) networks subject to malicious attacks and defense actions. The SBS structure and the attack-defense actions are modelled as a two-player stochastic game and a Nash Equilibrium is computed to obtain the stationary strategy guaranteeing the best behaviour. On the basis of this result, the SBS dynamics are modelled as a Discrete Event System in a Timed Petri Net framework that allows obtaining the evolution of the SBS under the Nash Equilibrium and the stochastic game rules. A case study describing the cyber security of an SBS is outlined and the details of the model are illustrated.

#1304 A Petri Net Based Methodology for Modelling, Analysis, Demand Forecast and Optimal Planning of Batch Production Systems

Konstantinos Vrontakis (GR), Andreas Kampianakis (GR), George Tsinarakis (GR)

A methodology for optimal production planning of an industry, processing multiple raw material types, is presented. Petri net modeling of production procedures, combined with stochastic forecast of upcoming demand, produce necessary input for a Mixed Integer Linear Problem (MILP) that calculates optimal production timeline according to various constraints. The methodology is developed for batch production systems with resource sharing between different types of final products, and is applied to a real case study system.

#1157 A hybrid knowledge-based framework for author name disambiguation

Jarosław Protasiewicz (PL), Sławomir Dadas (PL)

In this study, we propose a hybrid knowledge-based framework for author name disambiguation. The developed approach helps incrementally identify authors of documents in data acquired from various sources. The nature of the problem calls for an orchestrated use of several methods; thus, the framework is composed of two levels. The first level contains a rule-based disambiguation algorithm. The second tier covers an agglomerative hierarchical clustering procedure that incorporates heuristics rules as well as classifiers to estimate similarity between clusters. The classifiers are trained on data coming from the first level; whereas, the rules are based on experts' knowledge, data analysis, and literature. The framework has been verified through various experiments concerning both rule-based and hierarchical clustering algorithms, different similarity measures, and stop criteria. The rule-based approach runs faster and is more precise than the clustering procedure. However, it can assign only known individuals; whereas, the clustering algorithm can identify even unknown yet authors. We demonstrate that the framework might be useful for incremental identification of authors in self-growing databases.

Grey System Theory and Application (I)

Organizers: Sifeng Liu, Naiming Xie, Yingjie Yang
October 12 (Wednesday), 14:00-15:30, InterContinental Budapest, Panorama V
Session Chairs: Sifeng Liu, Yingjie Yang

#1034 A new decision model to solve the clustering dilemma

Sifeng Liu (GB), Yingjie Yang (GB), Zhi-Geng Fang (CN)

As the case that the conclusion by compare between the maximum components and of decision coefficient vector and conflicts with the conclusion by compare between and integratedly, the clustering dilemma occurred. Here we show a novel method to solve the existing clustering dilemma. We define both the weight vector of grey synthetic measure and the decision coefficient vector with grey synthetic measure at first. Then a novel two-stage decision model with the weight vector of grey synthetic measure and the decision coefficient vector with grey synthetic measure is put forward, and several functional weight vector grey synthetic measure are given. This method can effectively solve the clustering dilemma of rule of maximum value and produce consistent results. At last, a practical evaluation and decision problem of the projects for subjects constructing of a university have been studied by the novel two stages decision model with grey synthetic measure.

#1067 The model TMGM(1,N) based on the development trend of multiple driving variables and its application

Long Wei (CN), Yao-Guo Dang (CN)

In order to overcome the shortcomings of the conventional model GM(1,N), a new optimized model which is based on the development trends of multiple driving variables, termed TMGM(1,N), is proposed in this study. The new model has improved the theory from the following aspects. First, a new forecast model of the development trend of the driving variables is established which can make better use of the information of the driving variables. Meanwhile, the time response formula of the TMGM(1,N) are based on the convolution integral which can better simulate the driving variables' function on the system sequence which can improve the accuracy of the prediction. Finally, the forecast of China's grain yield is adopted for demonstration. The results indicate that the new model has higher accuracy of the output than model GM(1,N)and model TGM(1,N).

#1203 The Application of Grey-Incidence Decision Making In the Analysis of Brownfield Redevelopment Project

Mikiale Gebreslase Gebremariam (CN), Yuming Zhu (CN)

Grey-incidence decision making approach is proposed to deal with the implementation of brownfield redevelopment project in the remediated sites. The inspiration behind this approach is valuable, because it is suitable to use regardless of the sample size. Whether it is big or small, or whether the data fulfills a particular conventional distribution or not. Above and beyond that, what makes it convenient to use is, the amount of computation embraced is bite-sized and can be carried out classically without the difficulty between quantitative and qualitative conclusions. Thus, the government wants to clean up a brownfield sites and after remediating the contaminated sites the government has to select the best development proposal from three planning options, such as: Industrial park planning, Recreation center planning, and Real estate planning. To do so, the attributed weights are calculated step-by-step with the help of the software so called Grey System Theory Modeling Software 3.0 (GTMS 3.0). In this way the absolute degree of grey incidence is generated from the classic reference sequence and effect vector. Following this, quasi-classic effect vector and quasi-classic circumstance are obtained. Finally, the result leads us to make a decision in terms of producing the most ideal choice of development planning among the available alternatives of the development planning.

#1269 Universities-industry collaboration (UIC) partner selection based on Grey Fuzzy Evaluation

Xiaoyu Song (CN), Yuming Zhu (CN), Fen Lv (CN)

A comprehensive evaluation model of enterprise's partner selection on UIC is established by use of Analytical hierarchical process (AHP) and Grey Fuzzy Evaluation method. The weight of each index will be determined by AHP, therefore the reasonable conversion from qualitative to quantitative will be acquired through the application of grey fuzzy comprehensive assessment method, which enable to make the evaluation model scientific and reasonable. From the case on UIC partner selections involved in this paper, the evaluation model is tested to prove it is effective and applicable for firms to choose UIC partner.

#1563 Rough approximation model based on grey dominance relation

Ming-Li Hu (CN)

Some scholars have already proposed a lot of dominance relation and its corresponding rough model under incomplete information system in order to deal with the problem of preference decision which has incomplete information. In the incomplete information system no matter use any dominance relation to construct a rough set model the result is uncertain. In order to reduce the misclassification caused by uncertainty, this paper put forward the concept of grey dominance relation and its rough model. Firstly the analyses of the sectors which cause the uncertainty of classification are presented in this paper. Secondly the concepts of difference coefficient and grey dominance relation are definite. Besides, rough approximation model based on grey dominance relation is constructed. Finally, through the example new model proves to have better classification performance.

Grey System Theory and Application (II)

Organizers: Sifeng Liu, Naiming Xie, Yingjie Yang
October 12 (Wednesday), 16:00-17:30, InterContinental Budapest, Panorama V
Session Chairs: Naiming Xie, Sifeng Liu

#1783 A novel grey nearness incidence model for visual inspection on composite materials subjected to low-velocity impact damage

Yue Yin (CN), Yao-Guo Dang (CN)

In order to solve the problems about visual damage inspection on composite materials, a novel grey nearness incidence model is proposed, based on the limited experimental data of visual damage inspection. The application range of the proposed model is expanded from the uniformly spaced sequence to the non-uniformly spaced sequence, aiming at identifying the key factors that affect the visual inspection experimental results. With the help of proposed model, the best inspection condition is gained in the analysis by sorting the incidence between different affecting factors and experimental results. Moreover, reasonable suggestions are provided for the practically visual inspection, which indicate that the inspection environment of indoor fluorescent light is better than that of outdoor light, while the white surface coating is better than other colors.

#1881 A Study on the Assessment of Power System Security Risk based on Grey Clustering and Maximum Entropy Theory

Peng Peng (CN), Chuanmin Mi (CN), Si-Feng Liu (CN), Jing Tao (CN)

The requirement of electric power has been increasing greatly, and the scale of the power system is becoming larger and larger, all of which make the complex characteristics of power system more and more obvious. It is extremely urgent to have a scientific and reasonable evaluation of power system security risk. By analyzing the recent series of large-area-blackout incidents, it can be concluded that the traditional methods for security assessment, including the deterministic stability analysis and probabilistic assessment method, have some shortages. This paper put forward a neoteric thought that power system security risk can be evaluated based on the method of grey clustering analysis, and then this paper use maximum entropy theory to calculate the weight. Finally, the conclusion indicated that this method used to evaluate the power system security risk is strongly practical.

#1480 An Improved Prediction Model for Interval Grey Number

Liyun Wu (CN)

In this paper, the parameter would be introduced to forecast grey number sequence that was based on the paper with known whitenization weight function published by Bo Zeng. We use variable weight instead of no-preference generation. So the most appropriate parameter to build the DGM (1,1) would be chose by GA. Then an improved grey prediction model for forecasting interval grey number is proposed. An application analysis is presented to illustrate the effectiveness and practicability of the proposed model. Simulation examples show the average relative error of the proposed model has been significantly improved.

#2457 An Evolutionary Optimization based Interval Type-2 Fuzzy Classification System for Human Behaviour Recognition and Summarisation

Bo Yao (GB), Hani Hagras (GB), Jason Lepley (GB), Robert Peall (GB), Michael Butler (GB)

Automatic recognition of behaviours and events from visual data is an emerging topic in video surveillance. These methods promise the ability to derive contextual awareness for a scene and may further enable the ability to predict the intentions of the subject. This paper describes a novel system for analysing human behaviours in the context of a video surveillance application. This may be used to distinguish between normal and anomalous behaviours. We propose a novel framework for the application of behaviour recognition and summarisation using interval type-2 fuzzy logic classification systems (IT2FLS). We employ the evolutionary-based technique Big Bang Big Crunch (BB-BC) to automatically optimise parameters of membership functions (MFs) and rules in the IT2FLSs. Our analysis shows that the BB-BC IT2FLS is able to robustly recognise behaviours and furthermore outperforms both its' conventional IT2FLS (which doesnot employ fuzzy classification techniques) and Type-1 FLSs (T1FLSs) counterparts in addition to non-fuzzy recognition methods.

#2129 Spatial Collaborative Representation for Image Categorization

Dammak Mouna (TN), Chokri Ben Amar (TN)

A novel proposed approach, collaborative representation-based classification, has been developed for face recognition and recently used in image classification task. It shows its very simplicity and effectiveness. Despite its advantage, it neglects the spatial structure among the images representations. Inspired by the success of this technique and motivated by the power of spatial information in improving the image representation, we suggest in this paper a novel collaborative approach named spatial collaborative representation based classification. Hence, after applying the feature encoding and pooling method, we exploit the global manifold structure of image by applying the spatial pyramid representation. After that, two successive steps are required in order to obtain the label category for each image. In the first step we apply the standard collaborative method for each histogram generated at each pyramid level. The second stage aims to combine efficiently the image reconstruction results in the interest of decide the category label.

Grey System Theory and Application (III)

Organizers: Sifeng Liu, Naiming Xie, Yingjie Yang
October 12 (Wednesday), 17:30-19:00, InterContinental Budapest, Panorama V
Session Chairs: Yingjie Yang, Sifeng Liu

#2406 R-Fuzzy Sets and Grey System Theory

Arjab Singh Khuman (GB), Yingjie Yang (GB), Robert John (GB), Sifeng Liu (GB)

This paper investigates the use of grey theory to enhance the concept of an R-fuzzy set, with regards to the precision of the encapsulating set of returned significance values. The use of lower and upper approximations from rough set theory, allow for an R-fuzzy approach to encapsulate uncertain fuzzy membership values; both collectively generic and individually specific. The authors have previously created a significance measure, which when combined with an R-fuzzy set provides one with a refined approach for expressing complex uncertainty. This pairing of an R-fuzzy set and the significance measure, replicates in part, the high detail of uncertainty representation from a type-2 fuzzy approach, with the relative ease and objectiveness of a type-1 fuzzy approach. As a result, this new research method allows for a practical means for domains where ideally a generalised type-2 fuzzy set is more favourable, but ultimately unfeasible due to the subjectiveness of type-2 fuzzy membership values. This paper focuses on providing a more effective means for the creation of the set which encapsulates the returned degrees of significance. Using grey techniques, rather than the arbitrary configuration of the original work, the result is a high precision set for encapsulation, with the minimal configuration of parameter values. A worked example is used to demonstrate the effectiveness of using grey theory in conjunction with R-fuzzy sets and the significance measure.

#1108 A Study on the Equilibrium of Regional Industrial Spatial Distribution based on Grey Prediction Model

Hui Shu (CN), Wenping Wang (CN), Xiong Pingping (CN)

This paper discusses the industrial space layout optimization under different TFP evolutionary paths simulated by grey prediction models. We construct a simulation and analysis model about the progress of regional industrial layout adjustment in project level. On the basis of the model, we analyze the economic-ecology balance of the regional industrial space layout. The results show that the short-term evolution trends of the TFP of Chinese industries are more along the path of traditional GM (1, 1) model. The economic and ecological balance of regional industrial space layout is in the reasonable range under this path, while the regional economic-ecology balance is greatly improved under the TFP evolution path provided by the grey Versulst model.

#1036 Surface Vibration Displacement Prediction based on a Non-equidistant Grey Model

Wensong Jiang (CN), Zhong-Yu Wang (CN), Hongyang Li (CN)

To predict the vibration displacement distributed on a vibrating surface, an r order Non-equidistant Grey Model (r-NGM) is proposed in this paper. This model is built by accumulating the initial discrete non-equidistant vibration displacement set with the r order Accumulated Generating Operation (r-AGO). The r-NGM is applied to a vibrating surface of a shaker to displacement prediction. The experimental result indicates that the predictive accuracy of r-NGM is positive to growth rate when r ranges from [0.1, 0.5], and negative when r ranges from (0.5, 1.0]. The minimum error range is [-0.010, 0.006] for 0.5-NGM. As well, the maximum error range is [-0.111, 0.111] for traditional grey model, which is over ten times higher than the former one. It demonstrates that the 0.5-NGM is superior to the traditional GM(1, 1) model when it applies to predict the surface vibration displacement.

#1443 Study on Spatial Correlation Mechanism of Industries between Different Major Functional Areas Based on Grey Target Theory

Wenping Wang (CN)

It is an important measure for China to implement the strategy of major functional area (MFA) to promote the optimization and upgrading of the industry and the development of regional integration. In order to study spatial correlation structure between optimization development zone and key development zone, the paper chooses Beijing-Tianjin-Hebei Metropolitan Region (BTHMR) and Ha-Chang City Group (HCCG) as examples. Based on cross regional input-output table and Social Network Analysis (SNA), regional industrial spatial correlation network model is established. By analyzing the characteristics of network structure and the function of block, industrial spatial correlation structure between optimization development zone and key development zone is studied. Furthermore, with the grey target contribution analysis, the major causes of the formation of the industrial spatial correlation structure are discussed from the characteristics of the industry in the spatial correlation network.

#1475 Fuzzy Zoning: A Lagrangean Relaxation Approach

Siamak Naderi Varandi (TR), Kemal Kılıç (TR)

This research arises from the need of equality in real life problems. Clustering algorithms are being used in many applications where equality is an interest, such as districting (either zonal or political) and industry (distribution companies). One of the well known clustering algorithms is Fuzzy clustering. We add an equality constraint to the existing model. We call the new optimization problem ”Zoning” problem. One of the application where equality can play a critical role is Wireless Sensor Network. A Lagrangean relaxation based approach is developed to solve Zoning problem. The proposed algorithm is simulated and the results show robust performance regarding the equality of the clusters.

Matrix Analysis and Feature Learning for Multimedia Understanding (I)

Organizers: Xinmei Tian, Jun Yu, Weifeng Liu, Yicong Zhou
October 10 (Monday), 17:00-18:30, Sofitel Budapest Chain Bridge, Academy 4
Session Chairs: Xinmei Tian, Jun Yu

#1115 Data-driven Facial Animation via Hypergraph Learning

Jun Yu (CN), Xi Li (CN), Fei Gao (CN), Jian Zhang (CN)

Data-driven facial animation has attracted much attention in recent years. Existing facial animation methods may not preserve the topology structure, and cannot achieve a natural face. This paper proposes a new data-driven facial animation method based on hypergraph learning. It drives a neutral face to a certain expression face. This paper assumes that neutral face has similar topology with the expression face, we compute the alignment laplacian matrix using hypergraph learning. To get a natural face, we add a constraint item which is consisted of a set of motion data. Experiment results demonstrate that our method can achieve a natural expression face. And the results show the superiority over the state-of-art.

#1292 Distributed Graph Regularized Non-negative Matrix Factorization with Greedy Coordinate Descent

Ziheng Gao (CN), Naiyang Guan (CN), Xuhui Huang (CN), Xuefeng Peng (CN), Zhigang Luo (CN), Yuhua Tang (CN)

Graph regularized non-negative matrix factorization (GNMF) decomposes a high-dimensional non-negative data matrix into two low-dimensional matrices with the non-negativity property kept and the geometric structure preserved. Due to its effectiveness, GNMF has been widely used in many fields such as computer vision and data mining. However, GNMF cannot process large-scale datasets on distributed system because the gradient of the graph regularization term costs huge amount of communication overheads among computing nodes. In this paper, we proposed a distributed GNMF (DGNMF) algorithm to overcome this deficiency. Particularly, DGNMF reformulates the graph regularization term to avoid multiplying graph Laplacian by factor matrix through introducing an auxiliary variable and incorporating an equality constraint over it. We optimize DGNMF by using greedy coordinate descent method in the frame of augmented Lagrange method and implement this algorithm on a distributed system. Since DGNMF requires quite few communication overheads among computing nodes, it can be applied to large scale dataset. The preliminary results illustrate efficiency, scalability, and effectiveness of DGNMF.

#1401 Photo Aesthetic Quality Assessment via Label Distribution Learning

Jun Yu (CN), Xiaowei Zhang (CN), Fei Gao (CN), Min Tan (CN), Di Huang (CN)

Automatic prediction of photo aesthetic quality is useful for many practical purposes. Current computational approaches typically solved this problem by assigning a categorical label (“good” or “bad”) to a photo. However, due to the subjectivity and complexity of human’s aesthetic judgments, only a categorical label is insufficient to represent human’s perceived aesthetic quality of a photo. This paper focuses on an interesting problem: is it possible to predict the crowed opinions about the aesthetic quality of a photo? The crowed opinion here is expressed by the distribution of scores given by a number of subjects. For each given photo, a deep convolutional neural network (DCNN) is utilized to calculate its feature representation. Afterwards, the crowed opinion prediction problem is formulated as one of label distribution learning (LDL). Experiments show that the proposed method is highly effective and outperforms state-of-the-art algorithms.

#1560 Multi-Organ Plant Identification With Multi-Column Deep Convolutional Neural Networks

Anfeng He (CN), Xinmei Tian (CN)

Automatically identifying plants from images is a hot research topic due to its importance in production and science popularization. It tries to identify the name of a plant with a known taxon from a given image automatically. Most of existing researches in automatically plant identification focus on identifying plants with single-organ, such as flower, leaf, or fruits. Plant identification using single-organ is not reliable enough because different plants many have similar organs. To solve this problem, this paper is devoted to automatically identify plants by combining multiple organs of plants. Specifically, we propose a multi-column deep convolutional neural networks (MCDCNN) model to combine multi-organs for plant identification efficiently. Extensive experiments demonstrate the effectiveness of our model and the plant identification performance is greatly improved.

#2468 Class Specific Dictionary Learning based Kernel Collaborative Representation for Fine-grained Image Classification

Xiaojie Feng (CN), Yanjiang Wang (CN), Baodi Liu (CN), Weifeng Liu (CN)

Recently, dictionary learning based sparse representation algorithm has been widely adopted and achieved satisfying performance in image classification. However, sparse representation based classification (SRC) as well as collaborative representation based classification (CRC) always result in high residual error due to their basic assumption that considers training samples as dictionary directly for each category. PAnd conventional class specific dictionary learning algorithm usually operates in the Euclidean space and fails to capture nonlinear information. To deal with these problems, we propose a classification algorithm which is called class specific dictionary learning based kernel collaborative representation (CSDL-KCRC) to enhance the classification accuracy. Extensive experimental results operated on three fine-grained image datasets, such as Oxford 102-Flowers dataset, Caltech-UCSD Birds-200-2011 (CUB-200-2011) dataset and Stanford Dogs dataset, demonstrate the effectiveness of CSDL-KCRC in image classification.

Matrix Analysis and Feature Learning for Multimedia Understanding (II)

Organizers: Xinmei Tian, Jun Yu, Weifeng Liu, Yicong Zhou
October 11 (Tuesday), 14:00-15:30, InterContinental Budapest, Ballroom III
Session Chairs: Weifeng Liu, Yicong Zhou

#2135 Configurable Privacy Management for Secure Video Surveillance in Energy-constrained Systems

Junhyung Moon (KR), Hwisoo So (KR), Kyoungwoo Lee (KR)

Nowadays, lots of people concern about the privacy violation in the video surveillance systems widely utilized in order to protect people and their properties. Various protection techniques have been proposed to protect the privacy-sensitive information in the video surveillance and they properly provide the protection. Unfortunately, the video compression rate and the energy consumption have not been thoroughly investigated in the video surveillance system providing the privacy protection. However, the advance from the wired system to the wireless system which has the limited resources makes the video compression rate and the energy consumption as important as the degree of the perceptual protection and the recognition accuracy in the recovered video. In this paper, we propose the configurable privacy management technique in order to enhance both the compression rate and the energy efficiency of the privacy-protected video surveillance system. Satisfying the highest 10% degree of the perceptual protection in our experiments, the proposed method reduces the compressed bitstream size and the energy consumption by up to 66.0% and 27.3% each as compared to no protection, that is, the compression only while achieving the fine recognition accuracy by 82.1% in the recovered video.

#1693 A Three Level Adaptive Video Streaming Framework Over LTE

Satish Kumar (IN), Santhosh Sriram (IN), Arnab Sarkar (IN), Arijit Sur (IN)

The ever increasing demand for high bandwidth, low latency multimedia applications on mobile devices is set to pose a considerable challenge on the bandwidth allocation and multiplexing mechanisms in LTE and future wireless networks. This paper proposes a low overhead Scalable Video Coding (SVC) based dynamic adaptive streaming framework (called TLS-AV) which attempt to maintain a minimum satisfactory Quality of Experience (QoE) for all end users even during transient network overloads. Two fast and efficient radio resource allocation heuristics namely, the TLS-AV Water-Filling Heuristic (TWH) and TLS-AV Balanced Water-Filling Heuristic (TBWH) have been implemented over the proposed framework. Experimental results reveal that both the developed heuristics are able to restrict packet loss rate below ~10% while simultaneously achieving high video qualities and fairness among the transmitted qualities of video flows, on average.

#1579 Personalizing Information Retrieval: a New Model for User Preferences Elicitation

Rim Fakhfakh (TN), Ghada Feki (TN), Anis Ben Ammar (TN), Chokri Ben Amar (TN)

The innovative brand “The internet of Me” is a recent research area that highlight the prevalence of personalization across the internet and focuses on the user habits and actions tracked from his interaction with the web content. This paradigm presents an efficient way to define the user experience, preferences useful in e-commerce, marketing, social and search purpose. In this paper we are interested in the integration of the advances of user profile in information retrieval systems by predicting the user preferences from his user interaction with social content. These data are exploited and modeled to be used for tailoring the query interpretation for the user and delivering more relevant and accurate results for the user. As for as the experiments, our proposed approach of user profile modeling shows promising results applied for the personalization of a defined set of ambiguous queries retained by thirty users having different profiling characteristics.

#1942 Camera-based document image spotting system for complex linguistic maps

Mickael Coustaty (FR)

This paper proposes a camera-based document retrieval systems using various local features as well as indexing methods in order to locate a region from dialectology data. Dialectology addresses the study of the linguistic features of languages having a strong oral tradition like local dialects. In order to transcribe ancient maps of Linguistic Atlas of France into geolinguistic data, and to automatically map iso-glosses in interpreted maps, this work aims at identifying the region spot by a camera or a user. This method relies on a new feature, named as Scale and Rotation Invariant Features (SRIF), which is computed based on geometrical constraints between pairs of nearest points around a keypoint. Our systems are applied on dataset including 400 heterogeneous-content complex linguistic map images (9800 X 11768 pixels resolution) and the experimental results show that SRIF outperforms the state-of-the-art in terms of retrieval time with 91.9% retrieval accuracy.

#1369 Optimized Per-Joint Compression of Hand Motion Data

Antonio Furtado (CA), Xinyao Sun (CA), Anup Basu (CA), Irene Cheng (CA)

Motion data is quickly expanding its application scope, following the recent advancements in smart sensing technology. In particular, it has been shown to be helpful for objective measurement and assessment of surgical dexterity among users at different levels of training. The goal is to allow trainees to evaluate their performance based on a reference set of hand movements. Similar to other multimedia data types, recording motion can produce a substantial amount of data, some of which are redundant for the application. Compression methods aim to optimize storage and transmission of motion capture (MoCap) data by taking advantage of temporal and spatial correlation. Hand motion data is a special sub-type of MoCap and is the focus of many applications, where hand movement evaluation is important. In this paper, we propose a lossy but visually indifferent, compression method that exploits redundancy found in hand motion data. Since individual joint movements have different impacts on the motion sequence, our technique is designed to minimize the overall distortion by providing a perjoint compression. We are able to demonstrate that our approach offers a quantitative gain for different compression ratios, while preserving visual quality.

Computational Awareness (I)

Organizers: Wuhui Chen, Zhenni Li, Qiangfu Zhao, Goutam Chakraborty, Tadahiko Murata, Robert Kozma
October 11 (Tuesday), 09:30-11:00, Sofitel Budapest Chain Bridge, Bellevue 1
Session Chairs: Tadahiko Murata, Goutam Chakraborty

#1216 Time series processing at the age of big data: any change of paradigm?

Cedric Bornand (CH)

Acquiring data is quite easy, at least until it is exploited, when the results usually show the limits due to acquisition errors. At a time where big data sounds the solution to many problems, it is important to signify that it is not because you have a lot of data available that its quality may be less important. Data must be reliable, it must be a precise representation of the reality one wants to observe. In this article we will point out the solutions we used in our last realisations to deal with data evaluation, starting from simple time-series, such as a heartbeat monitoring signal, to more complex ones with several heterogeneous signals, such as hyperspectral images or environmental measurements. All imply careful time acquisition as well as precise value estimations. For each situation that will be presented, we will identify the difficulties and find how to overcome them or, at least, diminish their impact. In any case, having a maximum of information in the signal must be a goal and will be crucial to obtain a good discrimination between signal and noise. The goal here is not to present a new algorithm, an improvement somewhere, or an extraordinary object. The goal is to put together little things that are often unconsidered, and bring difficulties and chaos when pushing a new realisation to its end.

#1349 Brain Source Separation for Motor Imagery Classification Using Tensor Decomposition

Liu Yang (CN), Zuyuan Yang (CN)

A tensor-based scheme is proposed in this paper for mental activity recognition by analyzing the single trial electroencephalogram data in brain-computer interfaces. A novel model, which is based on blind source separation but more delicate than it, is introduced to extract the discriminative features from the scalp-recorded single trial EEG activities in different mental states. The performance of the proposed scheme is demonstrated by numerical simulations, and performance comparisons are made with a common spatial pattern method and an independent component analysis method.

#1358 Guide Data Generation for On-Line Learning of DBM-Initialized MLP

Yuya Kaneda (JP), Qiangfu Zhao (JP), Yong Liu (JP)

In this paper, we propose a method for generating guide data, and investigate its efficiency and efficacy for on- line learning with guide data. On-line learning in this research updates a learning model initialized by the decision boundary making algorithm proposed by us in our earlier study. The problem is that, if the guide data are not properly generated, on-line learning may require high computational cost in terms of time, and the learning process may not converge to good result. To solve this problem, we propose to use k-means to cluster all candidates of guide data, and use one datum from each cluster as the guide datum. We conducted experiments on several public databases, using different settings, and confirmed the performance of the proposed method. Specifically, if k=5, we can obtain good models with low computational cost through on-line learning.

#1362 Privacy Preserving Infrared Sensor Array Based Indoor Location Awareness

Yuta Kobiyama (JP), Qiangfu Zhao (JP), Omomo Kazuki (JP)

In recent years, researches on smart environments (SEs) especially smart homes for senior care have attracted great attention. One important issue in constructing such kind of SEs is privacy, because the target environment (e.g. a home or a room) is not public space, and devices like video cameras cannot be used. For individual or personal spaces, the SE should not be too smart to invade the resident's privacy. The objective of this study is to establish a technology for constructing privacy preserving SEs. This technology will be a core for supporting our daily lives. Our solution is to use an array of some homogeneous sensors (e.g. infrared sensor) to detect various daily activities with an accuracy just good for supporting the residents. In this paper, we investigate the possibility of location awareness using an array containing 10 infrared sensors. Experimental results show that the array can provide enough information for recognizing the locations, and various classifiers can be used to recognize the locations with a relatively high accuracy.

#1632 Measuring computational awareness in contextual neural networks

Maciej Huk (PL)

Modeling awareness is an important topic in the computer science as it is closely related to preparing systems that know what is needed (e.g. data accumulated or ignored, effector activated) to achieve a given goal. Preparing tools to build and compare dedicated or general aware computational systems can lead to step-by-step hierarchical construction of intelligent solutions. Within this text we show the relation between awareness, selective attention and contextual systems. Using this as a base we propose basic measures of awareness and present example numerical results obtained for selected contextual neural networks and dedicated, multi-problem benchmark sets. The results allow to quantify awareness in terms of context and selective attention and to propose such solution for use in the general case.

Computational Awareness (II)

Organizers: Wuhui Chen, Zhenni Li, Qiangfu Zhao, Goutam Chakraborty, Tadahiko Murata, Robert Kozma
October 11 (Tuesday), 11:00-12:30, Sofitel Budapest Chain Bridge, Bellevue 1
Session Chairs: Incheon Paik, Zhenni Li

#2018 Analysis of Data Distribution to Classify Data Based on Taxonomy Hierarchy

Incheon Paik (JP), Wuhui Chen (JP)

Nowadays, owing to the growth of quantity of data, the data mining techniques have been required on web exceedingly for extracting information from the data. Classification of text in data mining is very important and has been a hot issue on the topic. Especially, ontological taxonomy classification is important for more intelligent information reasoning. As it relates to data distribution of classes directly, we investigate relation between the data distribution and classification performance in this research. This paper shows the clue to improve taxonomy classification accuracy from a new viewpoint.

#2019 An efficient algorithm for incoherent analysis dictionary learning based on proximal operator

Zhenni Li (JP)

In analysis dictionary learning, the learned dictionary may contain similar atoms, leading to a degenerate dictionary. To address this problem, we propose a novel incoherent analysis dictionary learning algorithm with the $\ell 1$-norm for sparsity and simultaneously with the coherence penalty. The whole problem is convex but nonsmooth due to the sparsity regularizer and the coherence penalty. Hence, the proximal operator is introduced to conquer the nonsmoothness in the sparsity regularizer and in the coherence penalty. The alternating minimization is sequentially solved for each row of the analysis dictionary and for each row of the analysis matrix in the same manner. According to our analysis and simulation study, the main advantages of the proposed algorithm are its greater efficiency in learning and its higher convergence rate than state-of-the-art algorithms.

#2037 Modified SA-based Household Reconstruction from Statistics for Agent-Based Social Simulations

Tadahiko Murata (JP), Takuya Harada (JP), Daiki Masui (JP)

In this paper, we modify a household reconstruction method using simulated annealing (SA) for micro-simulations (MS) or agent-based simulations (ABS). MS and ABS are recently employed for social simulations. For enabling MS or ABS, each household composition such as ages, occupations, or other properties of each member of a household should be prepared before simulations. However real household compositions are not available to researchers due to privacy or security reasons. Therefore, we need to reconstruct household compositions from available statistics for MS or ABS. However, it should be noted that the reconstructed population is just an artificial population that is suitable to the employed statistics. That means, the generated population cannot always be a real population that gives the statistics. We modify the SA-based household reconstruction method in three points: a generation procedure of initial solution, a transition procedure in SA, and an evaluation procedure using more statistics. Through simulation results, we show how errors between the artificial population and real statistics are reduced by the proposed modifications.

#2045 Automatic Detection of Driver's Awareness with Cognitive Task from Driving Behavior

Basabi Chakraborty (JP)

Awareness or alertness while driving is extremely important for road safety. It is known that cognitive load due to multitasking affects driving alertness. In this work, possibilities of automatic detection of driver's distraction due to various cognitive tasks from driving behavior has been studied with simulation experiments in a driving simulator. Experiments are done with different types of driving situations (normal driving, driving with secondary cognitive tasks) in different road scenarios. Various time series data (such as steering wheel angle, brake stroke, accelerator stroke, car speed etc.) from sensors attached to car simulator have been analyzed with data mining algorithms. It has been found that driving behavior changes with statistical significance for varying cognitive tasks and also the change of driving behavior of individual person is reflected in different parameters of driving behavior.

#2069 Incorporating Awareness in Expert Systems - Learning from Expert's Selective Attention and Perception

Goutam Chakraborty (JP)

We collect environmental information through our sensory organs, perceive them suitably to execute the task in hand. Examples of such tasks are abundant, like driving, operating machines, playing games, hunting, or mushroom picking on mountains. While executing such tasks, there is a marked difference in efficiency and accuracy between an expert and a novice. An expert is attentive to only what is important, still makes fewer errors. She is tacitly aware when or where to focus attention. The operation is efficient because an expert has less information to process, and do not attend to what is irrelevant. An expert correctly perceives from sensory information when to be alert, and therefore she is efficient. At times, the expert is able to explicitly describe her knowledge in a set of rules, but not always. It is not uncommon that the expert herself is unaware how the right decision is taken, and can not express his expertise in explicit rules. This is tacit knowledge acquired through long experience, and lack of which makes a novice ponder to accomplish the task correctly. What is perceived by an expert is different from that of a novice, though the available information through vision, audio and other senses are the same. We can design efficient machines, if the expert's selective attention and perception could be learned and incorporated in machine learning. The motivation of this work is to propose a framework to design machines which will be able to learn the tacit knowledge of an expert. When something important is perceived (like an alarming situation warranting immediate action), it is reflected in bio-signals like increased pulse rate or decrease in GSR. These bio-signals are used as cues to collect labeled data for supervised learning of the tacit knowledge. The system will be efficient by avoiding irrelevant information.

Computational Awareness (III)

Organizers: Wuhui Chen, Zhenni Li, Qiangfu Zhao, Goutam Chakraborty, Tadahiko Murata, Robert Kozma
October 11 (Tuesday), 14:00-15:30, Sofitel Budapest Chain Bridge, Bellevue 1
Session Chairs: Robert Kozma, Tadahiko Murata

#2260 Modeling Learning and Strategy Formation as Phase Transitions in Cortical Networks

Robert Kozma (US), Yury Sokolov (US), Marko Puljic (US), Miklos Ruszinko (HU)

Learning in the mammalian brain is commonly modeled through changing synaptic connections in cortical networks. Dynamical brain models indicate that learning leads to the formation of limit cycle oscillations across cortical areas and that the oscillatory regimes re-emerge when the learnt input is presented to the system. In this work, learning is modeled using a graph-theoretical model, which captures salient characteristics of the learning process. We introduce a random graph that combines a torus with lattice edges and additional random edges, which have power law length distribution. On this graph, we consider bootstrap percolation with excitatory and inhibitory vertices. Theoretical and numerical studies indicate the presence of various dynamical regimes on these graphs. Here, the transitions between fixed-point and limit cycle attractors are analyzed. We link this transition to changes in cortical networks during category learning, which have been observed in animal experiments using electro-cortiograph (ECoG) arrays over sensory cortices. We discuss how learning leads to categorization and strategy formation, and how the theoretical modeling results can be used for designing learning and adaptation in computationally aware intelligent machines.

#1733 Music Emotion Recognition using Chord Progressions

Yong-Hun Cho (KR), Hyunki Lim (KR), Dae-Won Kim (KR), In-Kwon Lee (KR)

The chord progression is a fundamental building block in music which sketches the overall mood of a song. Many composers compose music by first deciding chord progressions as a structure and then adding melody and details. Despite its importance, it is rarely used as an emotional feature in music emotion recognition. Few previous works considered chords or intervals as features but the progression or transition of chords were ignored. In this work, we explore the effect of chord progressions in music emotion recognition. We collected music database and extracted features to form an emotion recognition model. The chord progression is then detected from each song, and its effectiveness is showed using cross-validation. The results show that chord progressions have influence in music emotion, especially valence.

#1734 Automated Music Video Generation Using Emotion Synchronization

Ki-Ho Shin (KR), Hye-Rin Kim (KR), In-Kwon Lee (KR)

In this paper, we present an automated music video generation framework that utilizes emotion synchronization between video and music. After a user uploads a video or music, the framework segments the video and music, and then predicts the emotion of each of the segments. The preprocessing result is stored on the server's database. The user can select a set of videos and music from the database, and the framework will generate a music video. The system finds the most closely associated video segment with the music segment by comparing certain low level features and the emotion differences. We compare our work to a similar music video generation method by performing a user preference study, and show that our method generates a preferable result.

#1576 Applying connectivism? Does the connectivity of concepts make a difference for learning and assessment?

Christian Weber (HU), Réka Vas (HU)

The society is in a state where learning has no limits and starts to overlap with technological developments. The recent advent of a connectivistic learning theory promises to shed light on how we learn in environments of interconnected knowledge and how the connectivity of concepts can guide the learning and conceptualization. This paper will have a look at a domain ontology-based approach to learning and assessment and investigate if the connectivity of the stored concepts, measured by a selected set of centrality measures, can provide a prediction of the assessment performance. The analysis will be conducted on a real world application with 247 students in the field of business informatics.

#2396 A Pareto Optimal Solution Visualization Method using SOM-NG with Learning Parameter Optimization

Yusuke Kobayashi (JP), Takashi Okamoto (JP), Seiichi Koakutsu (JP)

The visualization of the Pareto optimal solution set is one of important issues of the decision-making process on the multi-objective optimization problem. The Pareto optimal solution visualization method using the self-organizing maps (SOM) is one of promising visualization methods. This method has two shortcomings in the Pareto optimal solution representation capability. One is that the maps have incorrect points that represent non-Pareto optimal solutions. The other is that the coverage of the maps for the edge region of the Pareto optimal solution set is not good. This study proposes a Pareto optimal solution visualization method using SOM-NG. In SOM, winner nodes affect neighbor nodes on the map space irrespective of similarity on the input data space. This causes the above-mentioned shortcomings. SOM-NG can form maps with considering similarity on the input space; hence, the shortcomings are expected to be overcome. In addition, in the proposed method, the learning parameter optimization is introduced. The effectiveness of the proposed method is confirmed on the incorrectness and the coverage of maps through numerical experiments.

Cybermatics for Cyber-enabled Worlds (I)

Organizers: Jianhua Ma, Laurence T. Yang, Julien Bourgeois, Huansheng Ning
October 10 (Monday), 13:30-15:00, Sofitel Budapest Chain Bridge, Bellevue 3
Session Chairs: Jianhua Ma, Huansheng Ning

#1071 A Kinect-Based System for Promoting Healthier Living at Home

Wenbing Zhao (US), Roanna Lun (US)

In this paper, we present a novel system designed to promote healthy living at home. The system integrates Microsoft Kinect and wearable devices such as smart watches and fitness bands to enable selective tracking of user activities at the home setting. The objective of the system is to continuously monitor each user and detect bad postures that could increase the risk of back injuries, and prolonged sedentary bouts that are not conducive for a healthy lifestyle. The wearable device to be worn by each user also delivers realtime feedback to the user on detection of bad postures or inactivities. Furthermore, activities data are logged for each individual at a home server and can be assessed via mobile devices or regular Web browsers.

#1184 A State-Prediction-based Control Strategy for UAVs in Cyber-Physical Systems

Tie Qiu (CN)

Multiple Unmanned Aerial Vehicles(UAVs) are crucial for Cyber-Physical Systems(CPS). No collisions should be ensured between each other when executing a complex task. This paper proposes a state-prediction-based trajectory control strategy for UAVs. We first introduce the concept of space-time protection volume" under the constraint of the number of needed vehicles and the scope of the task space. The prediction model of hierarchical flight and collision probability is established. Based on the safety threshold, the flight strategy is given under the different condition through calculating the collision probability. Besides, in the communication condition of formation flight of UAVs, we further put forward the compensation method based on Kalman state estimation according to the communication noise caused by the bias of the information state. The simulation results show that our proposed scheme enhances the anti-noise ability of UAVs and effectively reduces the collision probability."

#1185 Workflow Fragments of Layer Hierarchy Detection and Recommendation

Zehui Cheng (CN), Zhangbing Zhou (CN)

Recently, workflow fragments gains increasing momentum for reuse and re-purpose in Cyber-Physical Systems. To the end, this article proposes to detect and recommend workflow fragments gratifying e-Scientist requirement. Specifically, most common workflow fragments in the form of layer hierarchy are extracted from scientific workflows, which are collected in the myExperiment repository. Annotations for those workflow fragments are developed to support the discovery of workflow fragments. Consequently, an approach for workflow fragments rank and recommendation is presented considering the semantics and structure of workflow fragments.

#1343 Growth Scheduling and Processing in Cyber-I Modeling

Jianhua Ma (TW)

With the progressive development of information and communication technologies, we are now facing a new world called hyper world that is composed by the cyber world and the physical world with various digital explosions including data, connectivity, service and intelligence. Therefore, Cyber-I has been proposed, which is a real individual’s counterpart in cyberspace, and is to create a unique, digital, comprehensive description for every individual person. As similar to our human, a Cyber-I once born should be able to grow. Therefore, a Cyber-I’s model must be a dynamic one, and can be built successively by utilizing an increasing amount of personal data with adaptive methods. Namely, a growable Cyber-I model is necessary to achieve the adaptation for successive approximations to its corresponding real individual (Real-I). This paper presents our research and development of an adaptable system, called Cyber-I growth modeling system (CGMS). This research is mainly to (1) schedule a Cyber-I’s growth according to data and time, (2) manage the quantity of raw data that is involved in a specific growth process, (3) generate the Cyber-I model data with appropriate growth forms, and (4) record the information of a Cyber-I model’s growth process into a log file in personal database.

#1427 STLF: Spatial-Temporal-Logical knowledge representation and object mapping Framework

Sahraoui Dhelim (CN), Huansheng Ning (CN), Tao Zhu (CN)

Space and time are crucial characteristics of the physical objects. Considering only the spatial dimension will leadto an ambiguity when objects are mapped from the physical world to cyber world, therefore the temporal and logical dimensions also should be addressed in the mapping process. In this context we propose STLF, a spatial-temporal-logical framework that observe the relations that holds among objects in the physical space to properly map them to the cyberspace, and furthermore, we discuss the methods to map the object’s changing properties, we conclude by advocating Perdurance-based mapping.

Cybermatics for Cyber-enabled Worlds (II)

Organizers: Jianhua Ma, Laurence T. Yang, Julien Bourgeois, Huansheng Ning
October 11 (Tuesday), 14:00-15:30, Sofitel Budapest Chain Bridge, Bellevue 3
Session Chairs: Julien Bourgeois, Wenbing Zhao

#1540 Distributed Embedded Deep Learning based Real-time Video Processing

Weishan Zhang (CN), Dehai Zhao (CN)

There arises the needs for fast processing of continuous video data using embedded devices, for example the one needed for UAV aerial photography. In this paper, we proposed a distributed embedded platform built with NVIDIA Jetson TX1 using deep learning techniques for real time video processing, mainly for object detection. We design a Storm based distributed real-time computation platform and ran object detection algorithm based on convolutional neural networks. We have evaluated the performance of our platform by conducting real-time object detection on surveillance video. Compared with the high end GPU processing of NVIDIA TITAN X, our platform achieves the same processing speed but a much lower power consumption when doing the same work. At the same time, our platform had a good scalability and fault tolerance, which is suitable for intelligent mobile devices such as unmanned aerial vehicles or self-driving cars.

#1849 The Design and Implementation of a Kinect-Based Framework for Selective Human Activity Tracking

Wenbing Zhao (US)

In this paper, we present the design and implementation details of a Kinect-based framework for human activity tracking. The framework is intentionally designed to be open so that it can communicate over the network with other systems and mobile/wearable devices. The possibility of integrating with other devices and systems makes it possible to use Kinect for human activity tracking in a way unforeseen before. For example, the integration of our framework with wearable sensors, such as smart watches and fitness bands, enables us to perform selective tracking of the daily activities of a particular user and provide realtime feedback to the user. Furthermore, multiple frameworks could work together to form a federated system to cover a large area and/or a large number of users.

#1867 Programmable matter as a cyber-physical conjugation

Julien Bourgeois (FR), Benoit Piranda (FR), Andre Naz (FR), Hicham Lakhlef (FR), Nicolas Boillot (FR), Hakim Mabed (FR), Dominique Douthaut (FR), Thadeu Tucci (FR)

Programmable matter i.e. matter that can change its physical properties, more likely its shape according to an internal or an external action is a good example of a cybermatics component. As it links a cyberized shape to real matter, it is a straight example of by cyber-physical conjugation. But, this interaction between virtual and real worlds needs two elements. The first one is to find a way to represent the cyberized object using programmable matter and the second is to be able to adapt the matter to the cyberized changes. This article presents the progresses made in these two topics within the Claytronics project.

#1396 Active Bayesian Observer Correcting Overconfidence Effects Due to E-type Confirmatory Bias

Kazunori Fujimoto (JP), Jun Muramatsu (JP)

This paper presents a preliminary analysis of an active Bayesian observer that communicates with humans to correct the overconfidence effects due to their confirmatory biases. Two types of confirmatory biases, called Z- and E-types, are introduced and formalized using a model of noisy channels between signals and perceptions. Persons suffering from Z-type confirmatory bias receive a signal and perceive it incorrectly as a different signal with a certain probability, while those suffering from E-type confirmatory bias fail to receive a signal with a certain probability. A dynamic Bayesian network model is developed to analyze the effects of Z- and E-types in a unified way. The analytical model enables us to give a theoretical insight into some basic properties of the active Bayesian observers.

#2472 The Evolution of Ethnic Cultural Industry Towards a Cyberspace: A Perspective of Generalized Ecosystem

Xuan Zhou (CN), Duo Xu (CN), Weihui Dai (CN), Ye-Sho Chen (US)

Ethnic cultural industry is the important engine of promoting regional economic development. Due to limited consumption ability in the local market, the most potential consumers of ethnic cultural products and services are mainly from economic developed areas. Therefore, how to improve its industrial influence forces and market scale through Internet has been the key development strategy. However, a series of issues such as cross-cultural cognition, refactoring of industrial chain, and evolutionary pattern should be studied systematically in the transformation process. Based on a comprehensive summary of the existing researches, this paper analyzed the structure, ecological chain, and sustainable mechanism of ethnic cultural industry from the perspective of generalized ecosystem, and discussed the above issues in its evolution towards a cyberspace. For the reference, a case study of Naxi ethnic culture industry in western China was offered.

Better Artificial Intelligence Methods for Bigger Data Mining (I)

Organizers: Huseyin Seker, Kit Yan Chan, Mehmet Emin Aydin, Tzung-Pei Hong, Vasile Palade
October 12 (Wednesday), 11:00-12:30, Sofitel Budapest Chain Bridge, Academy 4
Session Chairs: Huseyin Seker, Kit Yan Chan

#1959 A Novel Approach to Generating an Interval Type-2 Fuzzy Neural Network Based on a Well-Behaving Type-1 Fuzzy TSK System

Junlong Gao (CN), Ruyi Yuan (CN), Jianqiang Yi (CN), Hao Ying (US), Chengdong Li (CN)

This paper presents a novel approach to automatically creating an interval type-2 fuzzy neural network (IT2-FNN) from a type-1 fuzzy TSK system (T1-TSK). The IT2-FNN is constructed in such a way that it takes advantage of the well-behaving T1-TSK. Our approach makes designing the IT2-FNN more efficient and the resulting system is expected to perform better than the T1-TSK due to the footprint of uncertainty of the IT2 fuzzy sets, especially when the system is subject to heavy external or internal uncertainties. There are two automated procedures in the IT2-FNN formation: (1) antecedent structure construction, and (2) learning of the parameters in both the antecedent and consequent. The structure construction is based on antecedent structure of the T1-TSK and consists of three steps – IT2 fuzzy set creation, similarity categorization, and mergence. The IT2 fuzzy sets are directly initialized from the fuzzy sets of the T1-TSK. Then, the IT2 fuzzy sets are classified into different groups based on their similarities. Finally, the IT2 fuzzy sets in each group are merged to create a representative IT2 fuzzy set for each group. The parameter learning procedure uses a hybrid learning algorithm to attain the optimal values for all the parameters. The learning algorithm adopts a new adaptive steepest descent algorithm and a linear least-squares method to adjust the antecedent parameters and consequent parameters, respectively. One benchmark modelling problem is utilized to compare our approach with the T1-TSK systems in the literature under various scenarios. The comparison results show our IT2-FNN performs better than the T1-TSK systems, especially when there are strong uncertainties. In summary, the IT2-FNN can not only achieve better performance but its structure is simpler than that of the similar type-2 fuzzy neural networks in the literature.

#1753 Spreading Fuzzy Random Forests with MapReduce

Alessio Bechini (IT), Adriano Donato De Matteis (IT), Francesco Marcelloni (IT), Armando Segatori (IT)

Random forests are currently considered among the most accurate and efficient classifiers. Moreover, recently fuzzy implementations of random forests have been proposed to exploit the ability of fuzzy decision trees to cope with uncertain data. Whenever the size of training sets grows substantially, as it happens in the case of Big Data, ordinary implementations of classifiers become inadequate, and fuzzy random forests make no exception. In this paper, we consider a method, which generates fuzzy partitions of the continuous attributes along the decision tree learning, and we propose a distributed implementation of fuzzy random forests based on this method. The implementation relies on the MapReduce programming model and the Apache Hadoop framework. It is shown that such a model can easily accommodate an effective distribution strategy for the computation, yielding good scalability figures. The novel distributed algorithm makes fuzzy random forests able to deal with extremely large data sets, both in the learning and in the classification phases, thus fostering its applicability in the modern scenario of increasingly frequent data deluges.

#1955 Genetic-Fuzzy Mining with MapReduce

Tzung-Pei Hong (TW), Liu Yu-Yang (TW), Wu Min-Thai (TW), Chun-Hao Chen (TW), Shyue-Liang Wang (TW)

Genetic-fuzzy mining (GFM) was proposed to train fuzzy membership functions, thus enhancing the final solution quality. However, it is quite time-consuming because of frequent database scans for fitness evaluation. In this paper, we propose a parallel algorithm with MapReduce architecture to further speed up the genetic-fuzzy mining process. In the proposed approach, the master processor randomly generates chromosomes for each item. Each chromosome is encoded in the key-value format, where the key is the item name and the value is the chromosome for corresponded item. Reduce is then utilized to execute the genetic operations. At last, experiments are conducted to show the performance of the proposed approach.

#1968 An Instance Selection Framework for Mining Data Streams to Predict Antibody-Feature Function Relationships on RV144 HIV Vaccine Recipients

Ferdi Sarac (GB), Huseyin Seker (GB)

Data streams are rapidly and constantly growing. Analysis of rapidly changing data streams is quite difficult since the amount of data increases in timely manner. Individual patient records provide a vital resource for health research for the benefit of society, such as understanding the association between human immune system and viruses. As the patient records have been constantly growing, data reduction techniques are needed to reduce the complexity of the data, the cost of data storage and to enhance generalization performance. %The purpose of our work is to mine streaming of data from RV144 vaccine recipients in order to predict the effect of antibody features (IgGs) and primary Natural Killing (NK) cells' cytotoxic activities on RV144 vaccine recipients and to disclose the functional relationship between immune system and HIV virus. This study uses the concept of data stream mining to predict the effect of antibody features (IgGs) and primary Natural Killing (NK) cells' cytotoxic activities on RV144 vaccine receipts and to disclose the functional relationship between immune system and HIV virus. In order to adapt the data stream mining techniques, this data is manumitted to mimic a data stream. We propose a novel instance selection framework that identifies relevant and important instances and yields better results than the entire data set. The RV144 vaccine data set contains 100 data samples in which 20 of them are the placebo samples and 80 of them are the vaccine injected samples. Each data sample has twenty antibody features that consist of features related to IgG subclass and antigen specificity. To accomplish our goal the data randomly divided into four chunks which have been utilised for sequential random sampling of the data. In addition, a synthetic data set was created and divided into five chunks similar to RV144 data set. Then each chunk is sequentially added to the database at a time. However, instead of using entire data set to select samples, we utilised one chunk at a time and most relevant and important instances of upcoming samples are selected before new chunk of data has arrived. Therefore, our framework does not only reduce the size of data set but also reduce the cost of storage.

#2126 A Supervised Feature Selection Framework in relation to Prediction of Antibody Feature-Function Activity Relationships in RV144 Vaccines

Ferdi Sarac (GB), Huseyin Seker (GB), Volkan Uslan (TR), Ahmed Bouridane (GB)

Identification of functional characteristics of the virus-antibody interplay in individuals can provide insight to the development of effective vaccines against HIV virus. In order to reveal the functional interactions between human immune system and HIV virus, computational methods such as clustering, classification, feature selection and regression methods can be utilised to construct predictive models. The purpose of this study is to predict the associations between antibody features and effector function activities on RV144 vaccine recipients. The RV144 vaccine data set contains 100 data samples in which 20 of them are the placebo samples and 80 of them are the vaccine injected samples. Each data sample has twenty antibody features that consist of features related to IgG subclass and antigen specificity. In this study, we proposed a novel supervised feature selection framework to identify the discriminating antibody features from RV144 vaccine data set. Then, the Support Vector Regression is utilised to quantitatively predict the association between antibody features (IgGs) and effector function activities. Three different cell-mediated assays are utilised in this study to characterise effector function activities: antibody dependent cellular phagocytosis (ADCP), antibody dependent cellular cytotoxicity (ADCC), and cytokine release. Promising experimental result on these three cell-based assays has validated the effectiveness of our proposed framework. The prediction performance of proposed feature selection framework is compared to previous studies which utilised the RV144 data set for the same purpose.

Better Artificial Intelligence Methods for Bigger Data Mining (II)

Organizers: Huseyin Seker, Kit Yan Chan, Mehmet Emin Aydin, Tzung-Pei Hong, Vasile Palade
October 12 (Wednesday), 14:00-15:30, Sofitel Budapest Chain Bridge, Bellevue 3
Session Chairs: Tzung-Pei Hong, Mehmet Emin Aydin

#2150 Prediction of splice site using AdaBoost with a new sequence encoding approach

Elham Pashaei (TR), Alper Yilmaz (TR), Mustafa Ozen (TR), Nizamettin Aydin (TR)

The Biological sequence data are increasing rapidly, so there is a vital need of effective method for gene detection. Predicting of splice site is an important part of gene finding. Therefore, attempts to improve the prediction accuracy of the computational methods for splice sites detection continue. In this paper we propose a hybrid algorithm for splice sites prediction by combining AdaBoost classifier with a novel nucleotide encoding method, namely FDDM. Our encoding method provides frequency difference between the true sites and false sites (FD) along with distance measure (DM). The proposed method produces an improvement in comparison with the result of current methods such as MM1-SVM, Reduced MM1-SVM, SVM-B, LVMM, DM-SVM, DM2-AdaBoost and MSC+Pos(+APR)-SVM, when applied to the HS3D dataset with repeated 10-fold cross validation. In addition, for demonstrating the stability of the method, we also applied it to NN269 dataset. The obtained results indicate that the new method is practicable and efficient.

#1170 A Proposal of Hierarchical Vertex Clustering Based on the Gosper Curve

Vojtěch Uher (CZ), Petr Gajdoš (CZ), Michal Radecký (CZ), Vaclav Snasel (CZ)

Space-filling curves (SFCs) are straightforward and efficient methods for a sparse space clustering. They are utilized in research areas like classification, computer vision, computer graphics and/or machine learning. Most of the SFCs are based on a regular orthogonal grid. Generally, a hierarchical properties of Quad-trees (2D) or Octrees (n-dimensional) are utilized for a vertex hashing. However, the regular hexagonal grid is applicable for 2D tiling as well. The hexagonal shape is principally not a rep-tile, so the construction of hexagonal SFCs or a query structure is still a complex task. The Gosper curve (Flowsnake) is a self similar fractal that groups the hexagons to a composite called the Gosper island. This paper proposes a novel method constructing a Gosper-like space-filling curve of 2D vertices. The final algorithm is tested on several datasets and the results are discussed.

#1458 Dimensionality Reduction-Based Diagnosis of Bearing Defects in Induction Motors

Maryam Farajzadeh-Zanjani (CA), Roozbeh Razavi-Far (CA), Mehrdad Saif (CA)

Efficient diagnosis of bearing defects in induction motors usually requires extracting informative features from the vibration signal and efficiently reducing the dimensionality of the features. In this paper, the vibration signal is primarily analyzed by the empirical mode decomposition technique to extract informative intrinsic mode functions as a set of features. The dimensionality of the extracted feature set is reduced by means of maximally collapsing metric learning (MCML) to create an informative set of small-sized features for fault classification. MCML is an efficient supervised dimensionality reduction technique which aims to collapse patterns of the similar class to a point in the feature space while separates patterns of other classes to the maximum extent possible. To compare the performance of MCML, other state-of-the-art unsupervised and supervised techniques are used for the dimension reduction of the features. The fault diagnosis unit includes various classifiers which aim to diagnose multiple bearing defects that are ball, inner race and outer race defects of different diameters.

#1631 Topological Analysis of Ancient Glyphs

Gábor Hosszú (HU), Kovacs Ferenc (HU)

This paper presents a machine learning approach to explore the phenetic relations of historical scripts and their glyphs. Its first step is the identification of the observable topological transformations in the development of the glyphs, and with the use of these transformations, the method collects the possible cognate glyphs by minimizing the necessary topological transformations between the glyphs. In these investigations, the phonetic properties of the graphemes were consistently considered. The second step of our method is selecting similarity groups of possible cognate glyphs by minimizing the differences of their topological properties. The third step is multidimensional scaling and different cluster analyses based on the similarity groups of the glyphs of the historical scripts in order to explore the phenetic relationships between these scripts. The resulting phenetic structure of the scripts could be used for paleographical research, especially in deciphering ancient hard-to-read inscriptions.

#1533 Associative Search through Formal Concept Analysis in Criminal Intelligence Analysis

Nadeem Qazi (GB), William Wong (GB), Neesha Kodagoda (GB), Rick Adderley (GB)

Criminal Intelligence Analysis often requires a search different from the semantic and keyword based searching to reveal the associations among semantically and operationally connected objects within a crime knowledge base. In this paper we have introduced associative search as a search along the networks of association between objects like people, places, other organizations, products, events, services, etc. We then propose an associative search model consisting of five 5WH associated concepts of a crime, i.e. WHAT (What has happened), WHO (who has committed the crime), WHEN (When was it happened), WHERE (the geo-spatial information of the crime) HOW (The modus-operandi used in the committing a crime). We have employed Formal Concept Analysis theory to reveal the associations, highlighting Hot Spots, offender's profile and its associated offenders in a criminal activity.

Machine Learning with Big Data

Organizers: Xizhao Wang, Wing Ng, Qiang He
October 12 (Wednesday), 14:00-15:30, InterContinental Budapest, Ballroom III
Session Chairs: Xizhao Wang, Wing Ng, Ping Guo

#1767 Deep Neural Networks with Pseudoinverse Learning Algorithm and its Application to Astronomical Spectral Data

Ke Wang (CN), Ping Guo (CN), A-Li Luo (CN), Xin Xin (CN)

The success of deep learning proves that deep models are able to achieve much better performance than shallow models in representation learning. However, deep neural networks with auto-encoder stacked structure suffer from low learning efficiency since common used training algorithms are variations of iterative algorithms based on the time-consuming gradient descent, especially when the network structure is complicated. To deal with this complicated network structure problem, we employ a “divide and conquer” strategy to design a locally connected network structure to decrease the network complexity. The basic idea of our approach is to force the basic units of the deep architecture, e.g., auto-encoders, to extract local features in an analytical way without iterative optimization and assemble these local features into a unified feature. We apply this method to process astronomical spectral data to illustrate the superiority of our approach over other baseline algorithms. Furthermore, we investigate visual interpretations of high level features and the model to demonstrate what exactly the model learn from the data.

#1865 An Approach to Sample Selection from Big Data for Classification

Yulin He (CN), Sheng Xing (CN), Hong Zhu (MO), Xizhao Wang (CN)

When traditional sample selection methods are used to compress large data sets, the computational complexity turns out to be very high and it is really time consuming. To avoid these shortcomings, we propose a new method to select samples based on non-stable cut points. With the basic characteristic of convex function that its extreme values occur at the endpoints of intervals, the method measures the extent of a sample being endpoints by labeling non-stable cut points. Then we can select the samples with higher endpoint extent, which can avoid calculating the distances between samples. This method aims to compress the data sets and improve the computational efficiency without affecting the classification accuracy. Experiments show that the proposed algorithm performs very well on the compression of data sets with higher imbalance degree. Meanwhile, the method is experimentally confirmed to have strong noise-resistance.

#1644 HMSNN: Hippocampus inspired Memory Spiking Neural Network

Tielin Zhang (CN), Yi Zeng (CN)

Human beings receive stimulations in primary sensory cortex and transfer them to higher brain regions automatically. What happened in this procedure? In this paper, we will focus on one of these regions (hippocampus) and try to simulate its working procedure by building a HMSNN (Hippocampus inspired Memory Spiking Neural Network) model. Dentate Gyrus (DG) and Cornu Ammonis area 3 (CA3) are the main regions of hippocampus and will be simulated by feed forward Spiking Neural Network (SNN) and recurrent Hopfield-like network respectively. From the structural perspective, the computational unit and the connectivity between neurons in HMSNN are all consistent with the anatomical-experimental results in hippocampus. From the functional perspective, the multi-scale memory formation, memory abstraction and memory retention will be shown in HMSNN model. In addition, the HMSNN will be tested on MNIST handwritten digit dataset (with static images) and robot walking-road dataset (with dynamical images). The experimental result shows that: biological brain region inspired HMSNN shows the better classification performance on both datasets than the state-of-art convolutional neural networks (CNNs).

#2288 Approach to Integrate Episodic Memory into Cogency-based Behavior Planner for Robots

Min-Joo Kim (KR), Seung-Hwan Baek (KR), Se-Hyoung Cho (KR), Kim Jong-Hwan (KR)

This paper proposes a novel scheme of integrating episodic memory into semantic memory based task planner. Task planners have taken an important role in AI research along with semantic memory to better perform tasks for robots. Episodic memory memorizes and retrieves temporal sequence of situated behaviors by which temporal relationship between behaviors can be defined. None of any research, however, has implemented it into their work for task planning. By introducing episodic memory into task planner, the temporal causal relationship between situated behaviors, which are stored in semantic memory, is taken into consideration. The integrated architecture proves its effectiveness by notably reducing the number of nodes traversed in finding solutions. Robots can reduce time complexity in solving given problems by retrieving previous memories. Deep Adaptive Resonance Theory (Deep- ART) neural model and cogency-based hierarchical behavior planner are used for the episodic memory and the task planner, respectively. Cogency-based hierarchical behavior planner proves its capability of solving given problems in experiment with humanoid robot Mybot, and Deep-ART is augmented to the planner and tested in simulations. Therefore, the contribution of this approach lies on developing a framework which takes advantage of implementing episodic memory and planner in one place.

#2085 Cogent Confabulation-based Hierarchical Behavior Planner for Task Performance

Se-Hyoung Cho (KR), Seung-Hwan Baek (KR), Deok-Hwa Kim (KR), Yong-Ho Yoo (KR), Sanghyun Cho (KR), Kim Jong-Hwan (KR)

This paper proposes a novel hierarchical behavior planner with a multi-layered confabulation based behavior selection structure for robots to perform tasks. The proposed planner integrates a STRIPS based behavior selection approach and cogent confabulation approach. The STRIPS based behavior selection approach is a goal tree search which induces goaloriented sequences of behaviors, while the cogent confabulation approach is based on conditional probabilities between input symbols and target behaviors, aims to model human thinking mechanism. Our planner is applied with a set of behaviors defined in a multi-layered structure to show that it can plan a hierarchical sequences of behaviors to perform given tasks. This effectiveness and applicability of the proposed scheme is demonstrated by the experiments with the robot Mybot, developed in the Robot Intelligence Technology Lab. at KAIST.

Innovative Computational Intelligence, Learning Representation of Data, and Industrial Applications

Organizers: Takumi Ichimura, Akira Hara

October 11 (Tuesday), 14:00-15:30, InterContinental Budapest, Ballroom II

Session Chairs: Takumi Ichimura, Akira Hara

#1365 Particle Swarm Optimization Using Clustering

Tomohiro Hayashida (JP), Ichiro Nishizaki (JP), Shinya Sekizaki (JP), Shunsuke Koto (JP)

Sun and Li (2014) have proposed TCPSO(Two-swarm Cooperative Particle Swarm Optimization) that the swarms are divided into two groups with different migration rules. TCPSO has higher performance for high-dimensional non-linear optimization problems. This study revises TCPSO to avoid inappropriate convergence of the swarms. The quite feature of the proposed method is that the population have same migration rules. However, through that the swarms are divided into some clusters based on distance measure, k-means clustering method, both diversity and centralization of search process are maintained, and it increases the potential of attainment to the global optimal solution. This study conducts numerical experiments using several types of functions, and the experimental results indicate that the proposed method has higher performance than the TCPSO for large-scale optimization problems.

#1685 Time Series Classification using MACD-Histogram-based SAX and Its Performance Evaluation

Keiichi Tamura (JP), Tatsuhiro Sakai (JP), Takumi Ichimura (JP)

Time series classification is one of the most well-known grand challenges in many different application domains. Time series classification is the task of assigning a discrete class label to an unclassified time series. Three important key points should be considered in the design of time series classifiers: the feature expression for the time series, the definition of the distance function, and the classification strategy. Many researchers of time series have been focusing on Symbolic Aggregate approXimation (SAX), which is a state-of-the-art feature expression for time series. SAX is a high-level symbolic representation for time series that allows for dimensionality reduction. SAX allows symbol-based approaches, which have been studied in depth to be applied in time series classifiers. In this paper, we propose a novel method for time series classification using a SAX-based symbolic representation. The proposed method includes: MACD-Histogram-based SAX and Nearest Neighbor (1-NN) utilizing the extended Levenshtein distance. To evaluate the performance of the proposed method, we implemented it and conducted experiments using the UCR time series classification archive. The experimental results showed that the proposed method outperforms not only other distance-based 1-NNs, but also other state-of-the-art methods.

#1769 Objective Measurement for Satisfaction Values to Sightseeing Spots and Route Recommendation System

Takashi Hasuike (JP), Hideki Katagiri (JP), Hiroshi Tsuda (JP)

This paper proposes a route recommendation system for sightseeing based on a network optimization problem. Sightseeing route planning is not difficult if a tourist initially sets satisfaction values of sightseeing spots numerically. However, it was hard to evaluate the satisfaction values objectively according to the tourist’s feelings. The tourist can subjectively do a qualitative and pairwise comparison of sightseeing plans which tourism companies provide. Our proposed approach is to formulate a mathematical programming problem with constraints based on the tourist’s comparison and to determine the satisfaction values of sightseeing spots objectively. Our proposed approach can deal with the synergy effect among sightseeing spots. In addition, the framework of personal sightseeing route planning system is proposed.

#1973 Deterministic Geometric Semantic Genetic Programming with Optimal Mate Selection

Akira Hara (JP), Jun-ichi Kushida (JP), Tetsuyuki Takahama (JP)

To solve symbolic regression problems, Genetic Programming (GP) is often used for evolving tree structural numerical expressions. Recently, new crossover operators based on semantics of tree structures have attracted many attentions. In the semantics-based crossover, offspring is created from its parental individuals so that the offspring can inherit the characteristics of the parents not structurally but semantically. Geometric Semantic GP (GSGP) is a method in which offspring is produced by a convex combination of two parental individuals. In order to improve the search performance of GSGP, deterministic Geometric Semantic Crossover utilizing the information of the target semantics has been proposed. In conventional GSGP, ratios of convex combinations are determined at random. On the other hand, the deterministic crossover can use optimal ratios for affine combinations of parental individuals so that created offspring can be closest to the target solution. In these methods, parents which crossover operators will be applied to are selected based only on their fitness. In this paper, we propose a new selection method of parents for generating offspring which can approach to a target solution more efficiently. In this method, we select a pair of parents so that a distance between a straight line connecting the parents and a target point can be smallest in semantic space. We confirmed that our method showed better performance than conventional GSGP in several symbolic regression problems.

#1280 Interval Type-2 Intuitionistic Fuzzy Logic System for Non-linear System Prediction

Imo Eyoh (GB), Robert John (GB), Geert De Maere (GB)

This paper presents an approach to prediction based on a new interval type-2 intuitionistic fuzzy logic system (IT2IFLS) of Takagi-Sugeno-Kang (TSK) fuzzy inference. The gradient descent algorithm (GDA) is used to adapt the parameters of the IT2IFLS. The empirical comparison is made on the designed system using two synthetic datasets. Analysis of our results reveal that the presence of additional degrees of freedom in terms of non-membership functions and hesitation indexes in IT2IFLS tend to reduce the root mean square error (RMSE) of the system compared to a type-1 fuzzy logic approach and some interval type-2 fuzzy systems.

Pattern Recognition and Image Processing (I)

Organizers: Yuan Yan Tang, Yulong Wang
October 10 (Monday), 13:30-15:00, InterContinental Budapest, Panorama I
Session Chairs: Yuan Yan Tang, Yulong Wang

#2137 Detecting Korean Characters in Natural Scenes by Alphabet Detection and Agglomerative Character Construction

Jangho Kim (KR), Yong-Joong Kim (KR), Yonghyun Kim (KR), Daijin Kim (KR)

This paper considers the Korean character detection problem. Unlike English where an alphabet constitutes a character, the Korean character is composed of more than two Korean alphabets, where they could be either connected or separated, relying on the Korean character font. Also, the Korean has two character structures which constitute a nested structure. These properties make the Korean character detection problem difficult. In this paper, we divide the Korean character detection problem into two subproblems, Korean alphabet detection and Korean character construction, and redefine the Korean character structures to efficiently detect Korean characters. Based on the new structures, we train four independent Korean alphabet detectors, and perform a sequential alphabet detection process with a specific detection order, to eliminate false alarms caused during detection procedure. Finally, the detected alphabets are grouped into the Korean characters by an agglomerative character construction algorithm. To evaluate our method, we carried out some experiments on a public dataset with several alternatives, and showed that our proposed Korean character detection method has outperformed other methods.

#1305 A New Method for Blood Smear Good Working Area Identification Based on Hough Transform

Salwa Ahmed (CA), Mostafa Mohamed (CA), Abdelrahman Ali (EG), Behrouz H. Far (CA)

Microscopic blood analysis is one of the commonly used clinical tests. Automating blood analysis under microscope requires determination of good working area of the blood smear as a first step. In this paper we proposed a new method for blood smear good working area identification. The method is based on Circular Hough Transform which marks the red blood cells. Image preprocessing was performed to increase the image contrast and correct lighting distribution. The average nearest neighbor method is to measure the distance between each point and its nearest neighbor points. Nearest Neighbor Index ration is utilized as a measure to detect the good working area. The results demonstrate a very high accuracy not less than 90% for all the tested blood smears using the proposed method with specificity more than %88.6.

#2330 Laser Stripe Model for Sub-Pixel Peak Detection in Real-Time 3D Scanning

Ingmar Besic (BA), Zikrija Avdagic (BA)

Estimator algorithms rely on assumed laser stripe image profile to determine its peek with sub-pixel accuracy. They depend on light intensity readings around the peak and are susceptible to noise and saturation. Noise and stripe intensity models are commonly used to synthesize and feed test data to estimator algorithms in order to evaluate their accuracy and robustness. For real-time 3D scanning applications estimator algorithms are expected to prefer less computationally demanding estimation techniques. Simple and accurate models of empirical noise and laser stripe profile could be used to improve testing and algorithms accuracy. Modular test setup for 3D scanning is utilized to project a laser stripe on the target with patterned surface. Laser stripe image is captured and processed to extract noise and surface pattern interference. Laser power modulation is used to generate series of captures with various stripe intensities. Captures are partitioned, analyzed and presented according to target surface properties and color channels. Image noise interfering with sub-pixel peak detection is analyzed and noise model based on empirical data is proposed. Empirical laser stripe images are analyzed and novel simple laser stripe intensity profile model conforming to empirical data is proposed.

#2374 Deep Convolution Neural Network with Stacks of Multi-scale Convolutional Layer Block using Triplet of Faces for Face Recognition in the Wild

Bongnam Kang (KR)

Recently, deep convolutional neural networks have set a new trend in fields of face recognition by improving the state-of-the-art performance. By using deep neural networks, much more sophisticated and high level abstracted features can be learned automatically. In this paper, we propose a method for face recognition using multi-scale convolution layer blocks and triplets of faces in unconstrained environments. We use the ensemble of deep convolution neural networks trained on differently scaled and aligned face images. This extracts low dimensional but high-level abstraction and discriminative features for face recognition. With these features, we employ the jointly Bayesian model and transfer learning which adapts the knowledge trained from the source domain to target domain. Experiment shows that our proposed method achieves 98:33% pair-wise verification accuracy on the LFW dataset.

#1713 Objective Quality Assessment of Image Retargeting Based on Line Distortion

Yichi Zhang (HK), King Ngi Ngan (HK)

With the proliferation of mobile devices, research on image retargeting is becoming ever more important. However, there is little work on image retargeting quality assessment despite its importance. In this work, we focus on evaluating retargeting quality based on line distortion. Generally, image retargeting results in content loss and shape distortion. Line segments, which are fundamental image structures, are hence discarded or distorted in retargeted images. As a result, we formulate a retargeting quality index consisted of three line distortion measures: line loss, line artifact and line rotation. To test its performance, we have validated it on the public dataset RetargetMe. Experimental results demonstrate that our method outperforms many existent ones and line distortion is a good indicator of retargeting quality.

Pattern Recognition and Image Processing (II)

Organizers: Yuan Yan Tang, Yulong Wang
October 10 (Monday), 15:30-17:00, InterContinental Budapest, Panorama I
Session Chairs: Yuan Yan Tang, Yulong Wang

#1099 Effective Subpixel Edge Detection for LED Probes

Chung-Yen Su (TW), Li-An Yu (TW), Nai-Kuei Chen (TW)

The market of light-emitting devices (LED) is growing dramatically over these years. To test the quality of LEDs, lots of LED probes are required. Therefore, it is important to develop an effective method to measure the angle (around 10 degrees) and the radius (15 m ~ 30 m) of a produced LED probe. In this study, we propose a new subpixel edge detection for LED probes. The proposed method mainly consists of a coarse edge detection by Canny operators and a fine edge detection by a reconstructive method. In addition, an Otsu thresholding and a reflecting-point removal are included to reduce noise and increase accuracy. Compared to the previous methods, the proposed method can further reduce angle error up to 19.5% and the radius error up to 24.8%, respectively.

#1556 Improved ADMM based TV minimized Image Deblurring Without Boundary Artifacts

Dániel Hadházi (HU), Áron Horváth (HU), Gábor Horváth (HU)

Edge preserving (e.g. total variation minimized) regularized image deblurring methods are actively researched with many practical applications. Formally this type of deblurring is equivalent to a convex non-smooth optimization problem. In this paper we describe an ADMM optimization based effective algorithm which can be considered as an improved version of a previously published method. Due to the introduced modifications different loss functions can be easily used, positivity constraint is applied and the speed of the convergence of deblurring is also increased. The quality of the deblurring in the cases of using different loss functions is compared qualitatively and quantitatively and the accelerating rate of the convergence is also examined. For these measurements benchmark images were used. Based on our experiments we suggest to consider Huber function as loss function instead of the commonly used quadratic functions.

#1708 Rotation-Invariance Can Further Improve State-of-the-Art Blind Deconvolution Techniques

Vladik Kreinovich (US), Fernando Cervantes (US), Bryan Usevitch (US)

In many real-life situations, we need to reconstruct a blurred image in situations when no information about the blurring is available. This problem is known as the problem of blind deconvolution. There exist techniques for solving this problem, but these techniques are not rotation-invariant. Thus, the result of using this technique may change with rotation. So, if we rotate the image a little bit, the method, in general, leads to a different deconvolution result. Therefore, even when the original reconstruction is optimal, the reconstruction of a rotated image will be different and, thus, not optimal. To improve the quality of image decomposition, it is desirable to modify the current state-of-the art techniques by making them rotation-invariant. In this paper, we show how this can be done, and we show that this indeed improves the quality of blind deconvolution.

#1072 Phase Congruency Based Edge Saliency Detection and Rate Control for Perceptual Image and Video Coding

Sam Kwong (HK), Wei Gao (HK)

Phase Congruency (PC) features are firstly introduced into image and video coding field in this paper. As an effective tool to measure the edge information for image textures, PC change can be used to evaluate the compression loss, i.e. the coding distortions in image and video coding. Firstly, the compression influences on PC maps are given and analyzed. Secondly, the relationship between the consumed bits and the PC distortion are modeled. Lastly, the Mean-Squared-Error (MSE) based and PC distortion based optimized Coding Tree Unit (CTU) level bit allocation solutions are combined as a two step bit allocation and rate control method for intra frames for High Efficiency Video Coding (HEVC). Experimental results demonstrate that, compared with the state-of-the-art JCTVC-K0103 and JCTVC-M0257 methods, for small size videos, the proposed method can achieve significant R-D performance gains, and also works well on PC map preservation, quality smoothness and bit rate accuracy.

#1912 Discriminant Dictionary Learning with Sparse Embedding on Face Recognition

Yefei Chen (CN), Jianbo Su (CN)

Sparse dictionary learning on face recognition focuses on representing a face linearly by a set of atoms from the dictionary. How to learn a dictionary is a key issue to sparse representation. Structured dictionary has been used during the process of dictionary learning in order to improve the performance of classification. However, we consider that dictionary should not only be composed of a discriminant dictionary for identity or class information, but also a common dictionary which may contains disturbances and some common features for all class. Meanwhile, most of the proposed methods learns features and dictionary separatively, which may decrease the classification ability. Because projecting the source domain into a low dimensional space before dictionary learning will fail to catch some vital class-specific information which may be learned from dictionary learning. In this paper, a discriminant dictionary learning method with sparse embedding is proposed. Both discriminant and common dictionary are learned under the constraints on pairwise distance of sparsity coefficients, and the projection matrix is learned jointly. Experiments show that our method achieves better performance than other state-of-art methods on face recognition.

Pattern Recognition and Image Processing (III)

Organizers: Yuan Yan Tang, Yulong Wang
October 11 (Tuesday), 11:00-12:30, InterContinental Budapest, Panorama I
Session Chairs: Yuan Yan Tang, Yulong Wang

#2372 A hybrid simplified swarm optimization for neural network training to forecast stock price

Jianjia Pan (HK)

A improved swarm optimization method based on particle swarm optimization (PSO) and simplified swarm optimization (SSO) is proposed to adjust the weight in artificial neural network. This method is a modification of traditional PSO and SSO, and combines them to a new optimization method (PSOSSO for short). The proposed method overcomes some of the drawbacks of SSO and improves its ability to train the weight of ANN. In the experiments, the PSOSSO is employed to train fuzzy wavelet neural network (FWNN) forecasting model to predict the daily closing prices of Hong Kong Hang Seng Index. The experimental results present that the PSOSSO is more efficient than traditional PSO and SSO methods.

#2332 Extended Salient Fisher Vector Encoding for Person Re-identification

Salma Ksibi (TN), Mahmoud Mejdoub (TN), Chokri Ben Amar (TN)

Recognizing the same person across multiple potentially non-overlapping cameras, known as Person Re-identification, is a fundamental challenging task in Computer Vision.This is due to the important challenges that it proposes, like large view angle, pose, background clutter and occlusion and low resolution. Most of existing approaches rely on brute-force matching between local descriptors and thus suffer from low computational efficiency. Therefore, we present a new perspective for person re-identification based on a histogram encoding scheme. For that, an extended weighted version of the traditional Fisher vector encoding scheme is proposed. This is achieved by incorporating the Salience of the encoded descriptors and their topological location in the encoding process. Experimental results made on three challenging datasets (VIPeR, CUHK03 and Market-1501 dataset), prove the effectiveness of the proposed method.

#1777 An Adaptation Module with Growing and Adjustment RBFNN using a Long-Term Memory

Lobna Haddad (TN), Tarek M. Hamdani (TN), Adel M. Alimi (TN)

In this paper we proposed a writer adaptation system based on an adaptation module that is a plug-in for any writer-independent handwriting recognition systems. The adaptation module is a radial basis function neural network (RBF-NN) that is built using an incremental learning algorithm named GALTM-AM algorithm (Growing-Adjustment with Long-Term Memory). GALTM-AM train a new given data with some LTM data to suppress the interference. Therefore, we design two procedures to manage the LTM data. The first is produce and store. The second is retrieve and learn. This new learning algorithm is evaluated by the adaptation of a writer-independent handwriting recognition system. Moreover, the results using a benchmark database named LaViola prove the efficiency of the proposed GALTM-AM. Performance comparison of GALTM-AM algorithm over the existing approaches is presented.

#1218 Automatic selection of relevant features using Rough Set Theory for real-time situation recognition based on fuzzy SOM-based CBR

Arezoo Sarkheyli (DE), Dirk Soeffker (DE)

This paper investigates feature selection to discard irrelevant features for dimensionality reduction and improving situation recognition process. A situation illustrating the internal structure of a system state and its related environment is based on a large set of characteristics (features). Real-time situation recognition is still a challenge because of dealing with incremental knowledge as well as imprecise, uncertain, and redundant data (features). Investigation of relevant and key situations features could effectively enhance the situation recognition performance in terms of accuracy and computational complexity. In this paper, Case-Based Reasoning (CBR) as a problem solving approach is used for situation recognition. A fuzzy SOM-based approach by integration of Situation-Operator Modeling (SOM) and Fuzzy Logic (FL) is provided for knowledge representation in CBR process. A feature selection is realized using Rough Set Theory (RST) for data mining and uncertainty management in real-time applications. Different feature selection algorithms based on RST are applied to fuzzy SOM-based CBR. An analysis of the performance of all resulting combinations is done in terms of feature reduction and situation recognition. Finally, the proposed CBR approach is realized using experiments based on driving maneuvers conducted by a professional driving simulator. This application shows the effectiveness as well as the accuracy of the introduced approach.

#1155 Super Resolution Image Reconstruction and Imaging Device

Chinatsu Mori (JP), Kenkichi Tanioka (JP), Seiichi Gohshi (JP)

Super resolution (SR) studies started in the 1990s and many papers were issued in the 2000s. Super resolution image reconstruction (SRR) is one of the most common SR methods. SRR reconstructs a high-resolution image (HRI) using multiple low-resolution images (LRIs). However, it requires that certain conditions are met for it to work based on the SRR algorithm. Aliasing in LRIs is one of the essential conditions for SRR. Aliasing occurs when the signal is sampled with specific frequencies not satisfying the Nyquist sampling theorem. In the beginning of this century, analog cameras were replaced with digital cameras. The digital cameras are equipped with digital imaging devices, such as complementary metal oxide semiconductors (CMOS), and charge-coupled devices (CCD), for imaging process. The imaging devices have imaging cells with finite sizes and areas. The cells generate aliasing in accordance with their fill factors. The ability of SRR is deeply related to the performance of imaging devices. In this paper, the relationship is discussed theoretically.

Pattern Recognition and Image Processing (IV)

Organizers: Yuan Yan Tang, Yulong Wang
October 11 (Tuesday), 14:00-15:30, InterContinental Budapest, Panorama I
Session Chairs: Yulong Wang, Alfredo Cuzzocrea

#1146 Road Curve Fitting by Multi-resolution Analysis

Li Sun (MO), Yuan Yan Tang (MO), Tao Wu (CN), Patrick Wang (US)

In this paper, we propose a new method for road curve fitting in urban environment based on multi-resolution analysis. The main technical contributions of the proposed method are the reconstructed approximation on the basis of the wavelet decomposition structure for curve fitting and the de-noising via the wavelet coefficients thresholding. The carried out experimental tests show promising results in a series of continuous driving images, validating our suggested method can fit the road curve effectively and computational efficiently.

#1272 Local One-dimensional Embedding Interpolation for Hyperspectral Image Classification

Yalong Song (CN), Hong Li (CN), Huizhen Li (CN), Yantao Wei (CN)

In the hyperspectral image classification area, a few number of labeled samples is a bottleneck for the improvement of classification accuracy. In order to tackle this problem, multiple one-dimensional embedding interpolation (M1DEI) has been used for hyperspectral image classification and achieved promising results. Despite the success, the complexity of M1DEI prevents its practical application. On the other hand, the percentage of newly added samples is set by experience when enlarging the labeled set. In this paper we develop a method by extending the M1DEI method with local strategy, called multiple local one-dimensional embedding interpolation (ML1DEI). We only map the labeled samples and their local spatial neighbors into the one-dimensional (1D) space. The local strategy can reduce the complexity of M1DEI, since only labeled samples and their neighbors need to be mapped. In addition, the local strategy ensures all these newly labeled samples come from the spatial neighborhood of labeled samples. Then, during the merging stage, we can incorporate all of them with the labeled samples. Moreover, the proposed ML1DEI can incorporate the spatial information and make full use of the unlabeled samples. Compared with other spatial-spectral classification methods, the proposed ML1DEI method obtains promising results. Experimental results on the commonly used hyperspectral data set validate the effectiveness of the proposed method.

#1682 Improving Unbalanced Downsampling via Maximum Spanning Trees for Graph Signals

Xianwei Zheng (MO), Yuan Yan Tang (MO), Jiantao Zhou (MO), Patrick Wang (US)

The state-of-the-art downsampling method for graph signals has been constructed by using maximum spanning trees (MSTs) of the graphs. For the graph signals defined on unweighted densely connected graphs, such as social network data, the sampling rates via MST-based downsampling are not close to ½ leading to a unbalanced downsampling phenomenon on multi-level downsampling. The unbalance hinders the applications of MST-based downsampling on constructing graph signal multiscale transforms, such as graph wavelet decomposition and multiscale pyramid transform. In this paper, we propose a simple but efficient method to improve the performance of the MST-based method on downsampling balance. For every graph signal, we first propose an unbalance possibility to measure the unbalance of the MST-based downsampling. If the unbalance possibility is high, the downsampling will be conducted on an improved MST, which is constructed by rearranging the structure of the MST to reduce the downsampling unbalance. The experiment results on synthesis graph signal show that the proposed improved MST leads to balanced downsampling. That is, the sampling rates produced by the improved MST are closer to ½ in multi-level downsampling than the original MST-based method.

#2040 Face Reconstruction from Skull Based on Least Squares Canonical Dependency Analysis

Fangyu Bai (CN), Cheng Zhengxin (CN), Deng Qingqiong (CN), Tian Yun (CN), Fuqing Duan (CN)

Face reconstruction from skull, called as Craniofacial Reconstruction (CFR), is a useful technique to identify an unknown decomposed corpse if no other evidence is available. Traditional manual methods greatly depend on the experience of sculptors, so that the results are highly subjective, and the whole process is time consuming. Recent years, 3D data acquiring technology becomes consummate, and machine learning techniques raise a tidal wave in academia and industry. Researchers turn to finding computer aided solutions, especially the supervised machine learning technique, for craniofacial reconstruction. Least Squares Canonical Dependency Analysis (LSCDA) is a dimension reduction method, which aims at finding subspaces where the dependency measured by Least Squares Mutual Information (LSMI) of two variables reaches maximum. This paper proposes a new method for craniofacial reconstruction based on LSCDA. First, two statistical shape models for skull and skin are constructed respectively by Principle Component Analysis (PCA). Then the subspaces of maximum dependency of face and skull are extracted in the shape parameter spaces via LSCDA. Finally, according to such dependency, the relationship model between skulls and skins is established by Least Squares Support Vector Regression (LSSVR), which is used to reconstruct the facial appearances for an unknown skull. Experiment results show that the proposed method is effective.

#2301 An Efficient CUDA-based Approximate Two-Dimensional Dynamic Programming Algorithm for Advanced Computer Vision Applications

Alfredo Cuzzocrea (IT), Enzo Mumolo (IT), Daniel Pirrò (IT)

Dynamic programming is a popular optimization technique, developed in the 60's and still widely used today in several fields for its ability to find global optimum. Dynamic Programming Algorithms (DPAs) can be developed in many dimension. However, it is known that if the DPA dimension is greater or equal to two, the algorithm is an NP complete problem. In this paper we present an approximation of the fully two-dimensional DPA (2D-DPA) with polynomial complexity. Then, we describe an implementation of the algorithm on a recent parallel device based on CUDA architecture. We show that our parallel implementation presents a speed-up of about 25 with respect to a sequential implementation on an Intel I7 CPU. In particular, our system allows a speed of about ten 2DDPA executions per second for 85 85 pixels images. In the experimental Section of the paper we report some image warping examples performed with our CUDA-based 2D-DPA and speedup figures.

Pattern Recognition and Image Processing (V)

Organizers: Yuan Yan Tang, Yulong Wang
October 12 (Wednesday), 17:30-19:00, InterContinental Budapest, Panorama III
Session Chairs: Yulong Wang, Yuan Yan Tang

#1003 Describing Body-Pose Feature - Poselet - Activity Relationship Using Pachinko Allocation Model

Thien Huynh-The (KR), Ba-Vui Le (KR), Sungyong Lee (KR)

Understanding video-based activities have remained the challenge regardless of efforts from the image processing and artificial intelligence community. However, the rapid developing of computer vision in 3D area has brought an opportunity for the human pose estimation and so far for the activity recognition. In this research, the authors suggest an impressive approach for understanding daily life activities in the indoor using the skeleton information collected from the Microsoft Kinect device. The approach comprises two significant components as the contribution: the pose-based feature extraction under the spatio-temporal relation and the topic model based learning. For extracting feature, the distance between two articulated points and the angle between horizontal axis and joint vector are measured and normalized on each detected body. A codebook is then constructed using the K-means algorithm to encode the merged set of distance and angle. For modeling activities from sparse features, a hierarchical model developed on the Pachinko Allocation Model is proposed to describe the flexible relationship between features - poselets - activities in the temporal dimension. Finally, the activities are classified by using three different state-of-the-art machine learning techniques: Support Vector Machine, K-Nearest Neighbor, and Random Forest. In the experiment, the proposed approach is benchmarked and compared with existing methods in the overall classification accuracy.

#2306 Image Guided Fuzzy Clustering for Image Segmentation

Li Guo (MO), Long Chen (MO), Chen Philip (CN)

Fuzzy clustering methods are efficient tools for image segmentation. However, most of fuzzy clustering approaches are too sensitive to deal with the misclassification of pixels in image segmentation. In recent years, a variety of enhanced fuzzy clustering approaches have been proposed to obtain smoother results in noised image segmentation, but usually with less accurate edges in these results. To fix this problem, we derive some modified algorithms by using Guided Filter, the filter that can reserve the edge information when smoothing every region in segmentation. This paper provides a new roadmap for the application of Guided Filter and gives a thorough discussion of its applications in classical clustering methods, which are Fuzzy C-Means (FCM) and some other variants of FCM. Verified by the experimental results, we conduct a good use of Guided Filter to improve the performance of fuzzy clustering methods in a simple way.

#1846 American Sign Language Recognition System by Using Surface EMG Signal

Celal Savur (US), Ferat Sahin (US)

Sign Language Recognition (SLR) system is a novel method that allows hard of hearing people to communicate with society. In this study, an American Sign Language (ASL) recognition system was proposed by using the surface Electromyography (sEMG). The objective of this study is to recognize the American Sign Language alphabet letters and allow users to spell words and sentences. For this purpose, sEMG signals are acquired from subject’s right forearm for 27 American Sign Language gestures, 26 English alphabet letters, and one for home position. Time domain, frequency domain (band power), power spectral density (band power), and average power features were used as the feature extraction methods. After feature extraction, Principal Component Analysis (PCA) was applied to obtain uncorrelated features. As a classification method, Support Vector Machine and Ensemble Learning algorithm were used and their performances were compared with tabulated results. In conclusion, the results of this study show that sEMG signal can be used for SLR systems.

#2355 Fuzzy Indexed Color descriptor for Image Retrieval

Asma Eladel (TN), Ridha Ejbali (TN), Mourad Zaied (TN), Chokri Ben Amar (TN)

Color is a significant visual characteristic for both human vision and computer processing. Global color descriptors characterize an image by its color distribution or histogram, and discard information about object location as well as content of different colors. In this paper, we proposed a local color descriptor based on indexed matrix wavelet analysis and fuzzy decision support system (FDSS), which we called ”Fuzzy Indexed Color (FIC)”. First, the indexed map of each image is analyzed using Fast wavelet transform to capture the most relevant color feature content for each color channel R, G and B. Then, a FDSS is proposed for image matching in order to get more flexibility and reliability in making decision. The proposed FIC was evaluated using Google color, ebay data, Soccer and Flower datasets; and the results are very promising.

#1399 A Fast Multi-scale Decomposition based Tone Mapping Algorithm for High Dynamic Range Images

Qiaosong Chen (CN), Xiao Liu (CN)

Traditional digital display devices, due to their hardware limitations, cannot represent the whole range of luminance in High Dynamic Range (HDR) images. In order to solve this incompatible problem, many tone mapping techniques were introduced to reproduce HDR images presently. Unlike one of the traditional work of art in [13], this paper proposes a fast and multi-scale decomposition based tone mapping algorithm using the Improved Local Extrema (ILE) filter depended on the correlation of pixels. The reason of using ILE filter is due to the fact that it is able to decrease the time-consuming without noticeable image quality deterioration. Firstly, the ILE filters of variant scales are utilized to dispose the input HDR image into a series of base images under different scales. Secondly, multi-scale decomposition is utilized to obtain detail images with variable scales from the aforementioned base images. Finally, both of the base and detail images are converted into an initial compressed image to generate a Low Dynamic Range (LDR) image. Experimental results show that the proposed algorithm outperforms previous methods for reconstructing the real scene of HDR images, especially for its fast running time compared with the traditional work using Local Extrema (LE) filter.

Medical Imaging Analytics and Systems Solutions (I)

Organizers: Jinshan Tang, Sos Agiagn, Yicong Zhou
October 12 (Wednesday), 11:00-12:30, Sofitel Budapest Chain Bridge, Academy 3
Session Chairs: Yicong Zhou, Jinshan Tang, Sos Agaign

#1037 A Feature-Preserving Mesh Denoising Filter For 3-D Printers

Zilong Hu (US), Jinshan Tang (US)

A feature-preserving mesh denoising filter is proposed in the paper for 3-D printers. The whole algorithm contains two steps: non-iterative normal filtering and iterative vertex up-dating. The basic idea of normal filtering is to minimize the angles between face normals in meshes in flat region. The proposed filter was tested and compared with other mesh denoising filters on simulated noisy mesh models as well as real mesh models. The performance of filters were evaluat-ed based on the edge features from the filtered meshes. The proposed filter is very simple to accomplish, and it shows good performance in both noise removal and edge preser-vation. We also printed the original noisy mesh and the fil-tered versions using a 3-D printer and visually checked the quality of the filtered meshes obtained by different filters and we found that the meshes filtered by the proposed filter has the best visual quality.

#1175 Comparison of Several Speckle Reduction Techniques for 3D Ultrasound Images

Jinshan Tang (US)

In this paper, we describe three speckle reduction filters and compared their performance in speckle reduction for 3D ultrasound images. Filtering techniques related to those filters include Frost's filter, anisotropic diffusion, Normalized bilateral filtering, and non-local means filter. The qualitative as well quantitative evaluations are used to analyze the performance of four filters.

#1654 A Versitile Edge Preserving Image Enhancement Approach For Medical Images Using Guided Filter

Rahul Rajendran (US), Shishir Paramathma Rao (US), Agaian Sos S. (US), Karen Panetta (US)

Medical imaging systems often require image enhancement to visualize images of the human body and its organs. This would help medical professionals in irregularity or abnormality detection and diagnosis. This paper presents a novel method to enhance medical related images. The proposed algorithm uses techniques, such as, guided filtering, edge enhancement, contrast stretching, and image fusion to enhance low resolution images. Visually, the proposed method produces better or comparable enhanced images than several state-of-the-art method [1-4]. In addition, we also test the performance of the proposed method with the method mentioned in [5].

#1745 Implement of follicle monitoring system based on 3D ultrasound images

Jun Liu (CN)

The monitoring and analysis of the cattle follicle dynamics plays an important role in improving the cattle pregnancy rate theoretically and practically. In this paper, we generated a follicle monitoring system based on 3D ultrasound image. This system integrated the image de-noising algorithm, edge detection algorithm and 3D reconstruction algorithm together by the MFC frame and OpenGL technology. Using this system, we realized the following functions: image de-noising, follicle detection, follicle surface extraction, follicle 3D reconstruction, follicle volume calculation and so on.

#1960 Automatic Segmentation of the Left Atrium from MR Images Via Semantic Information

Xiaolong Zhang (CN), Chunhua Deng (CN)

Magnetic resonance imaging (MRI) can aid in assessing post-ablation scar formation. Automatic segmentation of the left atrium offers great benefits for an accurate statistical assessment of the region. However, how to robustly segment the left atrium is still remaining as a challenging task for its high anatomical variability. In this paper an robust segmentation method that exploits semantic information from different parts is proposed. The semantic correlation is exploited by the K Nearest Neighbor (KNN) and Convolutional Neural Network (CNN) feature, which can be regarded as our main contribution. We propose a graph model to fuse the semantic cues and eliminate accidental factors. Meanwhile, to optimize segmentation results, a super pixel voting method is also proposed by us. The experiments on the public dataset of MRI images demonstrate the validity and accuracy of our semantic segmentation.

Medical Imaging Analytics and Systems Solutions (II)

Organizers: Jinshan Tang, Sos Agiagn, Yicong Zhou
October 12 (Wednesday), 16:00-17:30, Sofitel Budapest Chain Bridge, Academy 3
Session Chairs: Jinshan Tang, Yicong Zhou, Sos Agiagn

#1988 An interactive Image retrieval method

Ye Jiang (CN), Min Jiang (CN), Ye Jiang (CN), Jinshan Tang (US)

In this paper, we propose an interactive image retrieval method based on interactive image segmentation and relevance feedback. For testing the performance of the algorithm, we built an image database by web crawlers, and added a background label to each image by histogram analysis. For image retrieval, an interactive image segmentation scheme based on GrabCut has been applied to get the region of interest (ROI), and then we use an automatic labeling method to get the training samples of relevance feedback, and then incorporate the background labels into the similarity measurement to decrease the influence of clutters. The experimental results show that this method can reduce the influence of image background on image retrieval, and optimize the search results by the feedback of users.

#2404 A Quantitative Histogram-based Approach to Predict Treatment Outcome for Soft Tissue Sarcoma Using Pre- and Post-treatment MRIs

Hamidreza Farhidzadeh (US), Dmitry Goldgof (US), Lawrence Hall (US), Jacob G. Scott (US), Robert Gatenby (US), Robert Gillies (US), Meera Raghavan (US)

The goal of this paper is to show the use of data mining techniques to predict the Soft Tissue Sarcoma (STS) tumor progression. STS are cancers which occur in different parts of the body such as fat, muscle and nerves. The lack of effective treatments and the difficulty in predicting treatment response make them challenging for physicians, and has likely slowed the evolution of new therapeutic agents. To design a prediction model, we propose a novel quantitative histogram based method to analyze the difference in histograms obtained from pre and post-treatment multi-modality magnetic resonance images. Here, we used Radiomics techniques as a non-invasive method for outcome prediction. This study could help physicians identify distinctive patterns within each tumor to find more patient-specific treatments. We demonstrated the new approach on two practical tasks: tumor recurrence prediction (metastasis) and rate of necrosis prediction. Our learned model shows 87.79% prediction accuracy for metastasis with a 0.73 AUC and 82.22% prediction accuracy for necrosis with a 0.65 AUC.

#2034 An EM-based estimation for a two-level traitor tracing scheme

Faten Chaabane (TN), Maha Charfeddine (TN), William Puech (FR), Chokri Ben Amar (TN)

In multimedia distribution platforms, one of the main challenges is to provide an efficient and accurate tracing process despite the lack of information about the colluders' strategy. Indeed, the original Tardos tracing performance is considered as suboptimal because of its agnostic behavior and conservative accusation regardless the collusion strategy. The Expectation Maximization algorithm has shown to be an efficient solution to estimate the collusion channel and thus to tune the Tardos accusation functions. In this paper, we explore the impact of this algorithm in a group-based tracing scheme to deal with the computational costs and the invariance of the Tardos accusation performance. The tracing scheme we propose benefits from a twofold accusation process. Indeed, in a first time, it is based on a two-level tracing strategy which consists in tracing guilty groups in a first level with the Boneh Shaw tracing code and in retrieving at least one colluder in accused groups with Tardos code in the second level. This strategy has reduced efficiently the decoding process of the Tardos code. The main shift we propose in the second level is to apply the Expectation Maximization algorithm to be tightly tied to collusion yielded by colluders and hence to find the more accurate Tardos accusation functions. The performance of the resulting tracing scheme is evaluated according to different criteria and promising results have been achieved when compared to the existing tracing schemes proposed in the literature.

#2259 Using Frame Semantics in Authorship Attribution

Robert Hinh (US), Sangmi Shin (US), Julia M Taylor (US)

Authorship attribution is a stylometric technique that associates text to authors based on the type of writing styles. Researchers have looked for ways to analyze the context of these texts, in some cases with limited results. Most of the approaches view information at the syntactic and physical levels and tend to ignore semantic levels. In this paper, we present a technique that incorporates the use of semantic frames as a method for authorship attribution. We hypothesize that it provides a deeper view into the semantic level of texts, which is an influencing factor in a writer's style. We use a variety of online resources in a pipeline fashion to extract information about frames within the text. The results show that bag of frames approach can use successfully used for stylometry.

#1243 Deep Wavelet Network for Image Classification

Salwa Said (TN), Olfa Jemai (TN), Salima Hassairi (TN), Ridha Ejbali (TN), Mourad Zaied (TN), Chokri Ben Amar (TN)

The success of the deep learning and specifically learning layer by layer led to many impressive results in several contexts that include neural network. This gave us the idea to apply this principle of learning on wavelet network because it is an active research topic at the moment. This paper present our approach for image classification by the combination of two techniques of learning: the wavelet network and the deep learning. We try to classify images in a supervised way following by an unsupervised learning using the principle of autoencoder. Experiments on two databases COIL-100 and MNIST show that our approach gives good results for the two classifiers that we used.

Intelligent Computing and Innovative Applications (I)

Organizers: Shun-Yuan Wang, Chwan-Lu Tseng, Jen-Hsiang Chou
October 11 (Tuesday), 11:00-12:30, InterContinental Budapest, Panorama V
Session Chairs: Jen-Hsiang Chou, Shun-Yuan Wang

#1100 An Adaptive Sliding Self-organizing Fuzzy Controller for Switched Reluctance Motor Drive Systems

Shun Yuan Wang (TW), Chwan-Lu Tseng (TW), Foun-Yuan Liu (TW), Jen-Hsiang Chou (TW), Ying-Chung Hong (TW), Ching-Yin Lee (TW)

This paper presents an adaptive sliding self-organizing fuzzy controller (ASSOFC) designed using fuzzy theory and a self-organizing algorithm. Composed of a conventional fuzzy controller (FC) and self-organizing algorithm, the ASSOFC adopts the sliding surface signal as an input, uses the algorithm to adjust the central position of the output consequent membership function of the FC, and, through fuzzy control, regulates the learning rate and fuzzy rules in real time to improve control performance. The ASSOFC is embedded into the direct torque control system of a switched reluctance motor (SRM) as a speed controller, and the performance and feasibility of the controller was validated. The experimental results indicate that the root mean square error values for the ASSOFC at various speed ranges are lower than those for a conventional FC, indicating that the proposed controller provides a superior speed response for SRMs.

#1164 Applications of Wireless Sensor Network for Monitoring System Based on IOT

Wen-Tsai Sung (TW)

A number of ZigBee based monitoring systems are built on the basis of IOT technology in this work on the perception layer, using temperature/humidity sensors, light sensors and 3-axis accelerometer modules. Wirelessly transmitted to a monitoring center, all the sensed data are collected by a human computer interface. On the application layer in an IOT, simulation experiments are conducted, namely, applications of light sensors to an automated basketball court lighting system, 3-axis accelerometer modules to the monitoring of infant's sleeping posture and accidental fall of the elderly, and temperature/humidity sensors to thermal comfort testing. This research work is validated as an effective way to achieve the aim of power consumption reduction, improve the health care quality and provide a higher comfort level.

#1180 Assessment of Effect of Music Tempo on Heart Rate Recovery using Wearable Device

Chun-Chieh Hsiao (TW), Jian-Ming Liu (TW), Robert Lin (TW), Ren Guey Lee (TW)

Taiwan government has recently promoted "Plan for Building Island of Exercise" which has leaded the trend of exercises and increased the needs of various healthcare and fitness products. Prior researches have also pointed out that listening to music with different tempos while exercising apparently affects heart rate, oxygen consumption, breathing rate and other physiological parameters. Among the physiological parameters, heart rate (HR) best represents the current body status while heart rate recovery (HRR) can also represent the physical fitness condition since HRR can be used to predict death risk. As increasing number of people listen to music when exercising and due to the widespread use of wearable devices, this paper proposes to analyze the relevance between music tempos and heart rate recovery based on the platform of wearable devices. Utilizing wearable devices and our developed Android App, measured data can be transmitted to server to observe the status of the subjects under the "experiment of progressive resistance stationary ergometer exercise" to find out whether music tempos affect heart rate recovery after exercise. The experimental results show that, some of the subjects have better HRR under slow music and some of the participants have better HRR under fast music. Further investigation of the subjects' physical fitness shows that the subjects who have better HRR under slow music are the ones with poorer physical fitness while those who have better HRR under fast music are the ones with better physical fitness. For the subjects with poorer physical fitness, the average HRR under fast music and slow music are 54.17 bpm and 55.5 bpm respectively. However, for the subjects with better physical fitness, the average HRR under fast music and slow music are 58.43 bpm and 54.14 bpm respectively. Consequently, for subjects with poorer physical fitness, the relevance between music tempo and HRR is weaker. On the contrary, for subjects with better physical fitness, effect of music tempo on their HRR tends to be stronger and their HRR is better under fast tempo.

#1181 Multiple Biometric Authentication for Personal Identity using Wearable Device

Chun-Chieh Hsiao (TW), Shei-Wei Wang (TW), Robert Lin (TW), Ren Guey Lee (TW)

In this paper, we propose to integrate fingerprint and ECG authentification implemented on wearable devices for personal identify. The identification rate of fingerprint authentication is 96%, ECG authentication with fixed threshold method and variable threshold method are 92.6% and 95.9% respectively. We have combined fingerprint and ECG authentication as a novel multiple authentication method. Meanwhile, we have reduced the complexity of algorithms and used less ECG wave range in order to implement on wearable devices. The identification rate has been up to 92% to achieve high accuracy and high security goal using wearable devices.

#1187 Predictive Direct Torque Control with Discrete Multiple Vector Voltages and Fuzzy Hysteresis

Guo-Ming Sung (TW), Wei-Yu Wang (TW), Yu-Chi Huang (TW)

This paper presents a predictive direct torque control (PDTC) system with discrete multiple vector voltage (DMVV) and fuzzy hysteresis for a three-phase induction motor. A fuzzy hysteresis controller is proposed to establish a DMVV for estimating both flux and torque errors, which are the membership functions of the fuzzy system. DMVV switching timing ensures that an appropriate voltage vector is sent to the inverter. The difference between conventional switching timing and DMVV is that conventional timing produces a stator voltage vector in a cycle, whereas DMVV produces four stator voltage vectors in a cycle. The proposed DMVV not only reduces the ripples that are generated with sampling errors and delays, but also enhances the stability of the PDTC system. Verilog hardware description language is used to implement the hardware architecture; a field programmable gate array (FPGA) development board is used to verify designed functions. According to the results measured using the FPGA development board, the proposed PDTC with DMVV and fuzzy hysteresis successfully works at an operating frequency of 50 MHz, with a supplied voltage of 1.8 V and a power consumption of 300 mW.

Intelligent Computing and Innovative Applications (II)

Organizers: Shun-Yuan Wang, Chwan-Lu Tseng, Jen-Hsiang Chou
October 11 (Tuesday), 14:00-15:30, InterContinental Budapest, Panorama V
Session Chairs: Chwan-Lu Tseng, Shun-Yuan Wang

#1498 Design of a Novel Exoskeleton Walking Assistance System

Kuang-Yow Lian (TW), Zong-Jun Yang (TW)

This paper presents a framework for gait recognition based on acceleration sensors. In our framework, the acceleration signal is normalized and converted to action models. A complete gait cycle has four phases: Push-off, Swing, Heel-strike and Stance. We use the LCS algorithm to look for the longest common subsequence between the gait action sequences and plurality of sample sequence. After we identify the gait movement, we can control the exoskeleton device based on the foot path, step distance and moving speed.

#2006 Robust Type-2 T-S Fuzzy Multiple Feedback-Loop H-infinity Controller Design for Uncertain Singular Time-Delay Systems

Chwan-Lu Tseng (TW), Shun Yuan Wang (TW), Foun-Yuan Liu (TW), Fu-Rong Jean (TW), Mu-Hua Fu (TW)

The robust H-infinity controller design is investigated in this paper for a class of nonlinear singular systems with state and transmission delays. The proposed controller is configured in multiple feedback loops. Based on the interval type-2 T-S fuzzy modelling and parallel distributed compensation techniques, a fuzzy multiple feedback-loop controller with memoryless state and delayed states is proposed to stabilize the system with required H-infinity performance by using the Lyapunov stability theory. The controller gain matrices can be calculated by solving the linear matrix inequalities. To check the feasibility of the proposed method, a numerical example is given and the simulation results indicate that the proposed multiple-feedback-loop controller is effective.

#2076 Availability Models for Synchronization Server Infrastructure

Carlos Alexandre Melo (BR), Jamilson Ramalho Dantas (BR), Jean Carlos Teixeira de Araujo (BR), Paulo Romero Martins Maciel (BR)

Users of computer systems wish to keep their personal data safe, updated, fair and accessible by other terminals, like personal computers, smart phones, portable consoles and PDAs. To perform these activities, one technology has become popular in our daily lives: data synchronization. Companies that provide this kind of service must do it with the greatest availability possible, since their clients need their data to be available whenever they want to access it, and their clients in the legal field must avoid financial losses through SLA contract breaches. This paper presents hierarchical models for evaluating the availability of a data synchronization server infrastructure. The results show an availability of 98.14% for the proposed architecture, which means an annual downtime of 162 hours. This is almost a week of unavailability, where users cannot perform data synchronization.

#1241 Academic Research Topics Variation and Prediction Based on FARO and Neural Network

Hongyin Zhu (CN), Yi Zeng (CN)

Given the explosive growth of information and the fast variation of academia, researchers may not be able to find the most promising topics to combine with their current research and may be trapped in few familiar research topics without creative ideas. Many studies of recommendation system make effort to address the above problem, but they ignore the different styles of users and generate the recommendation results based on the constant strategy. In this paper, we propose a framework to generate the adaptive recommendation results according to the research styles of users. Our framework contains 3 main parts, the research topic ontology construction, tendency prediction and recommendation. First of all, the fun of academic research ontology (FARO), which has the capacity of describing dynamic and static research features and building social network, is constructed to organize entities about academic research. Secondly, this paper predicts the popularity variation of research topics with the neural network model. Finally, some adaptive topics are recommended to specific researchers according to the evaluation of their research styles. Basically, this paper is inspired by the associative thinking of human brain to combine the advantages of RDF description capacity and the neural network to execute the prediction and recommendation. We test our results based on the publication data of IEEE and Springer. The experimental results demonstrate that our prediction model has a good generalization performance. A questionnaire survey is carried out to assess the recommendation results, and the result shows the feasibility of our method.

#1057 Intelligent Investigation Mechanism based on Fuzzy Markup Language for Social Media Application

Chang-Shing Lee (TW), Mei-Hui Wang (TW), Shih-Ya Lai (TW), Chia-Hsiu Kao (TW), Chang-Yong Wang (TW)

The Intelligent Investigation Mechanism (IIM) based on Fuzzy Markup Language (FML) and genetic learning ability for social media application is presented in this paper. We take the social media contents of presidential election domain on Facebook as an example in this paper, and construct the presidential election ontology for defining the knowledge base and rule base of FML. Seven categories, including Presidential Candidate, Municipality Mayor Supporter, Beneficial Event, Common Student Supporter, Famous Student Supporter, Common People Supporter, and Famous People Supporter, are adopted to present the president election domain ontology. With the defined ontology, we apply the FML to describe the fuzzy variables and fuzzy rules of the presidential election for IIM. The proposed IIM infers the possibility of Candidate Support Degree for each presidential candidate based on the fuzzy variables and the posts on Facebook (FB). The experimental results on 2016 Taiwan President Election show that the proposed IIM with the ability of FML and machine learning is feasible to apply to social media domain. In the future, we will compare our proposed approach with the existing ones and further analyze the experimental results with the actual data.

Big Data Analytics

Organizers: Jose Antonio Iglesias, German Gutierrez, Agapito Ledezma, Araceli Sanchis
October 10 (Monday), 13:30-15:00, InterContinental Budapest, Duna Salon IV
Session Chairs: Jose Antonio Iglesias, German Gutierrez

#1008 Empirical Data Analysis A New Tool for Data Analytics

Plamen Angelov (GB), Xiaowei Gu (GB), Jose Principe (US), Dmitry Kangin (GB)

In this paper, a novel empirical data analysis approach (abbreviated as EDA) is introduced which is entirely data-driven and free from restricting assumptions and pre-defined problem- or user-specific parameters and thresholds. It is well known that the traditional probability theory is restricted by strong prior assumptions which are often impractical and do not hold in real problems. Machine learning methods, on the other hand, are closer to the real problems but they usually rely on problem- or user-specific parameters or thresholds making it rather art than science. In this paper we introduce a theoretically sound yet practically unrestricted and widely applicable approach that is based on the density in the data space. Since the data may have exactly the same value multiple times we distinguish between the data points and unique locations in the data space. The number of data points, k is larger or equal to the number of unique locations, l and at least one data point occupies each unique location. The number of different data points that have exactly the same location in the data space (equal value), f can be seen as frequency. Through the combination of the spatial density and the frequency of occurrence of discrete data points, a new concept called multimodal typicality, τMM is proposed in this paper. It offers a closed analytical form that represents ensemble properties derived entirely from the empirical observations of data. Moreover, it is very close (yet different) from the histograms, from the probability density function (pdf) as well as from fuzzy set membership functions. Remarkably, there is no need to perform complicated pre-processing like clustering to get the multimodal representation. Moreover, the closed form for the case of Euclidean, Mahalanobis type of distance as well as some other forms (e.g. cosine-based dissimilarity) can be expressed recursively making it applicable to data streams and online algorithms. Inference/estimation of the typicality of data points that were not present in the data so far can be made. This new concept allows to rethink the very foundations of statistical and machine learning as well as to develop a series of anomaly detection, clustering, classification, prediction, control and other algorithms.

#1303 Autonomous Data-driven Clustering for Live Data Stream

Xiaowei Gu (GB), Plamen Angelov (GB)

In this paper, a novel autonomous data-driven clustering approach, called AD_clustering, is presented for live data streams processing. This newly proposed algorithm is a fully unsupervised approach and entirely based on the data samples and their ensemble properties, in the sense that there is no need for user-predefined or problem-specific assumptions and parameters, which is a problem most of the current clustering approaches suffer from. Moreover, the proposed approach automatically evolves its structure according to the experimentally observable streaming data and is able to recursively update its self-defined parameters using only the current data sample, meanwhile, discards all the previous data samples. Experimental results based on benchmark datasets exhibit the higher performance of the proposed fully autonomous approach compared with the comparative approaches with user- and problem- specific parameters to be predefined. This new clustering algorithm is a promising tool for further applications in the field of real-time streaming data analytics.

#1503 Social Network Analysis: Evolving Twitter Mining

Jose Antonio Iglesias (ES), Aaron Garcia-Cuerva (ES), Agapito Ledezma (ES), Araceli Sanchis (ES)

The growth of techniques of social network analysis is fast at present. These techniques are of interest to many researchers in different areas such as sociology, communication and computer science, social psychologist and so on. Nowadays, by analyzing how the members of network interact, share information or establish relationships, useful knowledge about them and their relations can be extracted. However, information related to how these members are presented to the world (by their users profiles) could give use also very useful knowledge. In this paper, we present an approach to automatically analyze the Twitter user profiles of a specific community of users. The locations of these users can also be selected by the user. The proposed analysis is done by extracting some characteristics of the collected profiles (of that given community). This analysis includes the detection of outliers, the clustering of profiles and their classification. The most important characteristic of the presented approach is that it can cope with the data of thousands of twitter profiles in real-time. Thus, this work is related to big data in the area of big data analytics. The approach presented in this paper is based on evolving fuzzy systems, which makes possible not only that we can cope with thousands of data in real-time, but also that the knowledge that we obtain from the social networks can be constantly updated (evolving).

#1510 Sequential classifiers for network intrusion detection based on data selection process

David Camilo Corrales Muñoz (ES), Juan Carlos Corrales (CO), Araceli Sanchis (ES), Agapito Ledezma (ES)

With the emergence of large datasets in real-time applications as network intrusion detection, systems classification have gained more attention due to the importance of these applications and the increasing generation of these network traffic information. The proliferation of Internet and networking applications, coupled with the widespread availability of system hacks and viruses have increased the need for network security. However, the huge network traffic data slow down the entire intrusion detection process and may lead to unsatisfactory classification accuracy due to the computational difficulties in handling such data. Classifying a huge amount of data usually lead to higher computational complexity. We propose sequential classifiers based on data selection process for intrusion detection. The performance of the proposed approach is evaluated using a intrusion detection dataset, KDD Cup'99 dataset, which is a typical example of large-scale datasets. The evaluation results show that our approach achieves better precision and lower computational cost compared with the state-of-the-art mechanisms.

#2478 Forecasting Time Series by an Ensemble of Artificial Neural Networks

German Gutierrez (ES), Maria Paz Sesmero (ES), Araceli Sanchis (ES)

Times series forecasting issue can be found in several subject areas as finance and business (e.g. foreign exchange rates, data for prices), industry (energy load and demand), climate and meteorology (e.g. sea surface temperature and El Niño phenomenon), health (e.g. prognosis from medical data) and many others. This paper is focused in univariate time series (x1, x2, ... , xt-1), so unknown future values are obtain from k previous (and known) values, i.e. x t+h = f(xt-1, ... , xt-k). In order to fit a model between independent variables (present and past values) and dependent variables (future values), artificial neural networks (ANNs) lead to similar or better results than those with statistical techniques, especially for non linear time series. In addition, ensembles can be applied to outperform the performance of a single model (e.g. a single ANN). In this work, we present an ensemble of ANNs with three elements, were each of them is specialised in one of the three following versions of the time series data: i) raw time series values (i.e. with no modifications); ii) differencing the time series data (computing the difference between consecutive values); and iii) translating the raw (of differencing) time series data to a sequence of increment(0)/decrement(1) values. The output of the Ensemble merge the answer of the model obtained for each transformation of the time series.

Behavior Modeling for Intelligent Human-Agent Interactions (I)

Organizer: Ming Hou
October 12 (Wednesday), 14:00-15:30, Sofitel Budapest Chain Bridge, Academy 4
Session Chair: Ming Hou

#1513 Effects of Agent Transparency on Human-Autonomy Teaming Effectiveness

Jessie Chen (US), Michael Barnes (US), Anthony Selkowitz (US), Kimberly Stowers (US)

Two human factors studies were conducted to assess the effectiveness of intelligent agents' user interfaces that were designed based on the Situation awareness-based Agent Transparency (SAT) model. Results show that agents' transparency (based on the SAT model) can benefit operator performance and support proper calibration of trust in the agents. Increasing levels of transparency enhanced operator's perceived trust in the agents, but only to a degree. When uncertainty was added to the interface, operator's trust did not further increase. Finally, the subjective workload data suggest that the benefits of increasing agent transparency do not have to be associated with higher levels of operator workload.

#1529 Modeling Behavior of Computer Generated Forces with Machine Learning Techniques, the NATO task group approach

Armon Toubman (NL)

Commercial/Military-Off-The-Shelf (COTS/MOTS) Computer Generated Forces (CGF) packages are widely used in modeling and simulation for training purposes. Conventional CGF packages often include artificial intelligence (AI) interfaces, but lack behavior generation and other adaptive capabilities. We believe Machine Learning (ML) techniques can be beneficial to the behavior modeling process, yet such techniques seem to be underused and perhaps under-appreciated. This paper aims at bridging the gap between users in academia and the military/industry at a high level when it comes to ML and AI. We address specific requirements and desired capabilities for applying machine learning to CGF behavior modeling applications. The paper is based on the work of the NATO Research Task Group IST-121 RTG-060 'Machine Learning Techniques for Autonomous Computer Generated Entities'.

#1603 Learning Objective Agent Behavior using a Data-driven Modeling Approach

Farzad Kamrani (SE), Linus Luotsinen (SE), Rikke Amilde Lovlid (NO)

This paper presents a data-driven approach towards the modeling of agent behaviors in a full-fledged, commercial off-the-shelf simulation milieu for tactical military training. The modeling approach employs machine learning to identify behavioral rules and patterns in data. Potential advantages of this approach are that it may improve modeling efficiency and, perhaps more importantly, increase the realism of the training simulator. In this work, we present an architecture outlining the main components of the data-driven behavior modeling approach. Using a prototype that implements the approach, we conduct and present results from an experiment targeting the learning of cooperative military movement tactics. It is shown that the prototype is capable of identifying the rules of the tactics. Moreover, it is shown that the agents are able to generalize such that the learned behavior can be applied in a new setting different from the one observed in the training data.

#1896 Evolved Creative Intelligence for Computer Generated Forces

Linus Luotsinen (SE), Farzad Kamrani (SE), Peter Hammar (SE), Rikke Amilde Lovlid (NO)

This paper provides an example of using genetic programming for engendering computational creativity in computer generated forces, i.e. simulated entities used to represent own, opponent and neutral forces in military training or decision support applications. We envision that applying computational creativity in the development of computer generated forces may not only reduce development costs but also offer more interesting and challenging training environments. In this work we provide experimental results to strengthen our arguments using a predator/prey game. We show that predator behavior created by a computer, using genetic programming, surpasses predator behavior manually programmed by humans and argue that the sparse automatically generated code is unlikely to be generated by a human and therefore can be considered as a good example of computational creativity. Although the experiments are not conducted in a real-world training simulator they provide valuable insight that exemplifies the opportunities and the challenges of computational creativity applied to computer generated forces.

#1901 The Future of Autonomous Air Combat Behavior

Armon Toubman (NL), Roel Rijken (NL)

Many automated systems (e.g., training simulations and unmanned aerial vehicles) are in operation today that require high-quality models for autonomous air combat behaviour. Such behaviour has long been implemented manually, which is a costly and error-prone approach. Various machine learning techniques for behaviour generation have been applied in this area with mixed results. In related fields, great advances have recently been made with a technique called Deep Reinforcement Learning. This technique excels in extracting important features from complex environments, and may therefore be well-suited to generating air combat behaviour. In this paper, we discuss the application of Deep Reinforcement Learning in the area of air combat, and present the results of initial simulation experiments.

Behavior Modeling for Intelligent Human-Agent Interactions (II)

Organizer: Ming Hou
October 12 (Wednesday), 16:00-17:30, Sofitel Budapest Chain Bridge, Academy 4
Session Chair: Ming Hou

#2500 Assessing Behaviour of Cognitive Agents in a Flight Simulator with Fighter Pilots

Jan Joris Roessingh (NL)

Intelligent, human-like, computer-controlled opponents could improve the training value of tactical training simulators for fighter pilots. To create such opponents, realistic computational cognitive models are needed. We present the evaluation of a cognitive model that has been developed to simulate Situation Awareness (SA) and the ability to be surprised. The crucial element in the model is a mechanism that matches beliefs about the situation from the SA sub-model with expectations about the world from the surprise sub-model. To evaluate its use and realism for the domain, the model was evaluated by operational fighter pilots in a fighter aircraft simulator. They performed in air combat scenarios against opponents whose actions were controlled by the cognitive model. Results indicate that computer-controlled opponents with the integrated SA/Surprise model contribute to a challenging and realistic training environment and could therefore be included in tactical training for operational pilots. The surprise effect in the virtual opponent was indeed recognizable by the human pilots. The human pilots found it less straightforward to judge the quality of the SA of their opponents.

#1087 A Hybrid Modeling Approach for Incorporating Behavioral Issues into Workforce Planning

Joachim Block (DE)

Workforce planning is a critical success factor for every organization and an important field in operations research (OR). In contrast to most existing OR workforce models we explicitly consider the heterogeneity of real world workforce systems by incorporating human attributes and behavior. Our model is based on hybrid systems theory and implemented using different modeling paradigms: agent-based modeling and simulation, discrete event simulation, and system dynamics. It enables practitioners to analyze the evolution of the staff as well as organizational performance under various and changing conditions. Furthermore, our research demonstrates that bridging OR and psychology respectively management science is a promising path for solving complex real world management problems and hybrid modeling facilitates building this bridge.

#1716 The Effect of Display Type on Operator Prediction of Future Swarm States

Phillip Walker (US), Michael Lewis (US), Katia Sycara (US)

Large teams of robots that operate collectively, whose behavior emerges from local interactions with neighbors, are known as swarms. While significant progress has been made improving the hardware, communication capabilities, and autonomous operation of these swarms, we still have much to learn about how human operators control and interact with them. This research is necessary if real world swarms are to be deployed in the future. The study presented here investigates different methods of displaying information about the swarm state to operators, and asks them to make predictions about the swarm's future state. In the study, participants are shown swarms performing one of three different behaviors, and are asked to use the information available from the display to make their predictions. Results show that summarizing the swarm's current state to just an average position and bounding ellipse allowed predictions as accurate as those made when full state information was shown. Furthermore, two leader-based methods were used, whereby the operators were shown only a small subset of the swarm. However, such display methods were inferior for prediction than either the summary center and ellipse or full information methods. With these results, and with participant feedback about the helpfulness of the four display types, we hope future studies can make more informed decision about interface design when it comes to the control of swarms.

#1880 Vertex-Neighboring Multilevel Force-Directed Graph Drawing

Farshad Ghassemi Toosi (IE), Nikola S. Nikolov (IE)

We introduce a new force-directed graph drawing algorithm for large undirected graphs with at least a few hundreds of vertices. Our algorithm falls into the class of multilevel force-directed graph drawing algorithms. Unlike other multilevel algorithms it has no pre-processing step and it also ignores repulsion forces between pairs of non-adjacent vertices. As a result, our algorithm demonstrably outperforms known multilevel algorithms in terms of running time while keeping the quality of the layout sufficiently good.

#1929 Immuno-Inspired Behaviour Adaptation in Multi-Robot Systems

Nikhil S (IN), Tushar Semwal (IN), Shivashankar B. Nair (IN)

Paradigms derived from the Biological Immune System have shown great promise in devising algorithms that can be used in a variety of fields. One such is the Idiotypic Network (IN) proposed by Jerne, wherein the antibodies form a virtual network based on both antigenic and mutual stimulations and suppressions which in turn change their respective concentrations. This paper portrays how INs can be augmented with information sharing and used within a Multi-Robot System (MRS), to learn the right behaviours and actions to achieve a goal inherent to an environment. Each robot in the MRS scenario is equipped with its own IN that shares the information learned from the environment with that of its peers. We also present a case when the environment changes during run-time and the MRS re-learns by making re-adjustments in the concentrations of a new set of antibodies. The results obtained from a real scenario comprising three robots using an IN each, portrayed herein, justify the viability of such an approach.

Robotics, Human Machine Interface, and Haptics (I)

Organizers: Saeid Nahavandi, Edward Tunstel
October 12 (Wednesday), 16:00-17:30, Sofitel Budapest Chain Bridge, Bellevue 3
Session Chairs: Edward Tunstel, Rodney Roberts

#1139 MPC-based Motion Cueing Algorithm with Short Prediction Horizon using Exponential Weighting

Arash Mohammadi (AU), Houshyar Asadi (AU), Shady Mohamed (AU), Kyle Nelson (AU), Saeid Nahavandi (AU)

A motion simulator is an effective tool for training a driver in a safe environment by mimicking motion similar to the real world. To give a realistic feeling of driving and avoid motion sickness, an accurate motion cueing algorithm is required to restrict the platform within the allowed workspace range while regenerating an appropriate motion feeling for the simulator driver. Recently, employing Model Predictive Control (MPC) in the motion cueing algorithm has become popular. In this control method, by predicting future dynamics, an input is optimized to minimize a cost function over a prediction horizon while respecting the constraints. Reducing the prediction horizon is desirable to minimize the computational burden; however it draws the system toward instability. In this research, applying a nonuniform weighting method is proposed to stabilize the motion cueing algorithm using MPC with short prediction horizon and optimized weighting adjustment. Simulation results show the effectiveness of the proposed method.

#1165 High Speed Vision-based 3D Reconstruction of Continuum Robots

Mohsen Moradi Dalvand (US), Saeid Nahavandi (AU), Robert D Howe (US)

Continuum robots offer better maneuverability and inherent compliance and are well-suited for surgical applications as catheters where gentle interaction with the environment is desired. However, sensing their shape and tip position is a challenge as traditional sensors cannot be employed in the same way that they are in rigid robotic manipulators. In this paper, a vision-based shape sensing algorithm for real-time 3D reconstruction of catheters based on the views of two arbitrary positioned cameras is presented. Customized high-speed algorithms are developed for the segmentation and feature extraction from the images. The algorithm is experimentally validated for accuracy by measuring the tip position, bending and orientation angles and for precision by estimating known 3D circular and elliptical shapes of the catheter. Experimental results demonstrate good accuracy and performance of the proposed high speed algorithms.

#1215 Skin Lesion Segmentation using Gray Level Co-occurance Matrix

Mohamed Hassan Mohamed (AU), Mohammed Hossny (AU), Saeid Nahavandi (AU), Anousha Yazdabadi (AU)

Skin lesions screening is an effective method for early detection of melanoma. Mostly, Melanoma appears as hyper-pigmented area relative to the surrounding skin. Lesion segmentation is the first step of skin lesion analysis. Automated segmentation is used to assist the dermatologist to isolate the suspicious lesion from the surrounding background. In literature, Most of the proposed algorithms are tested on non-unified relatively small datasets and it targets certain category of images (clinical or dermosccopic images) or certain artifacts. As a consequent result, these algorithms are not proven to be tested on special difficult cases. Some of these algorithms fail to segment lesion of diffused borders and in presence of high artifactrs components. Iterative Otsu's method is state-of-art segmenetation method and it is of accepted accuracy. However, iterative methods suffer same drawback, they are time consuming and no gautratee to converge to the best solution before the maximum iterations limit reached. This paper study segmentation of relatively big dataset of skin lesion images using GLCM (Gray Level Co-occurrence Matrix). Segmentation results of the proposed method are compared to human-expert extracted lesion borders. we will highlight the major steps towards robust segmentation: pre-processing, segmentation process and post-processing. The proposed method provided XOR error of 19.2% specificity of 98.62% , precision of 96.25% and sensitivity of 80.8% .

#1224 Semantic Body Parts Segmentation for Quadrupedal Animals

Hussein Haggag (AU), Ahmed Abobakr (AU), Mohammed Hossny (AU), Saeid Nahavandi (AU)

Although marker-less human pose estimation and tracking is important in various systems, nowadays many ap- plications tend to detect animals while performing a certain task. These applications are multidisciplinary including robotics, computer vision, safety, and animal healthcare. The appearance of RGB-D sensors such as Microsoft Kinect and its successful ap- plications in tracking and recognition made this area of research more active, especially with their affordable price. In this paper, a data synthesis approach for generating realistic and highly varied animals corpus is presented. The generated dataset is used to learn a machine learning model to semantically segment animal body parts. In the proposed framework, foreground extraction is applied to segment the animal, dense representations are obtained using the depth comparison feature extractor (DCF) and used for training a supervised random decision forest (RDF). An accurate pixel-wise classification of the parts will allow accurate joints localisation and hence pose estimation. Our approach records classification accuracy of 93% in identifying the different body parts of an animal using RGB-D images.

#1236 Haptics-2 - A system for bilateral control experiments from space to ground via geosynchronous satellites

Andre Schiele (NL), Thomas Krueger (NL), Stefan Kimmer (NL), Manuel Aiple (NL), Joao Rebelo (NL), Jan Smisek (NL), Emiel Den Exter (NL), Eloise Matheson (NL), Alejandro Hernandez (NL), Frank van der Hulst (NL)

On June 5th 2015, at 21:10 CEST, the European Space Agency's Telerobotics and Haptics Laboratory conducted the first in history haptic handshake between space and Earth. This demonstration was part of the Haptics-2 experiment, which makes use of two haptic joysticks; one located in space on-board the International Space Station (ISS), and the other one on ground at ESA's laboratory in the Netherlands. Both systems can be connected through the TDRSS geosynchronous satellites via a real-time data link with sufficient performance to perform haptic teleoperation tests. This paper describes the mechatronic design of the haptic devices, the software and the system implementation required for the Haptics-2 experiment. It reports results of a real-time high-frequency characterization of the satellite data-link indicating a round-trip time delay of approximately 850 milliseconds and presents mechatronic performance data of the haptic joysticks. Moreover, the paper presents experimental results from the first haptic handshake conducted between space and ground with astronauts on-board the ISS.

Robotics, Human Machine Interface, and Haptics (II)

Organizers: Saeid Nahavandi, Edward Tunstel
October 12 (Wednesday), 17:30-19:00, Sofitel Budapest Chain Bridge, Bellevue 3
Session Chairs: Edward Tunstel, Rodney Roberts

#1290 Towards an analytic haptic model for force rendering of soft-tissue dissection

Fernando Trejo (CA), Yaoping Hu (CA)

Both surgical simulation and robot-assisted surgery require haptic models of tool-tissue interaction for force rendering. Most efforts of haptic modeling have focused on characterizing tool-tissue interaction of soft-tissue indentation, insertion and cutting. Less attention has been devoted to soft-tissue dissection however. For the dissection, haptic models remain elusive to meet two requirements as: to represent nonlinearity of soft-tissue responses and to comply with the time constraint of 1 ms for force rendering. Hence, this paper presents a modeling framework towards developing an analytic haptic model for force rendering of the dissection. Based on estimation theories, the framework devises an analytic model to approximate an empirical force-distance profile of the dissection. Applying the framework to 2 different empirical profiles as use cases, the derived models estimated about 72% and 91% of the empirical data, respectively. Algorithm implementation of these models in Matlab yielded a computational time of about 24 µs, much less than 1 ms. The outcomes indicate a potential of using the framework to develop an analytic haptic model for force rendering of soft-tissue dissection.

#1425 An Adaptable System for RGB-D based Human Body Detection and Pose Estimation: Incorporating Attached Props

Hussein Haggag (AU), Mohammed Hossny (AU), Saeid Nahavandi (AU), Omar Haggag (AU)

One of the biggest challenges of RGB-D posture tracking is separating appendages such as briefcases, trolleys, and backpacks from the human body. Markerless motion tracking relies on segmenting each depth frame to a finite set of body parts. This is achieved via supervised learning by assigning each pixel to a certain body part. The training image set for the supervised learning are usually synthesised using popular motion capture databases and an ensemble of 3D models covering a wide range of anthropometric characteristics. In this paper, we propose a novel method for generating training data of human postures with attached objects. The results have shown a significant increase in body-part classification accuracy for subjects with props from 60% to 94% using the generated image set.

#1544 A Particle Swarm Optimization-based Washout Filter for Improving Simulator Motion Fidelity

Houshyar Asadi (AU), Arash Mohammadi (AU), Shady Mohamed (AU), Chee Peng Lim (AU), Khatami Seyed Amin (AU), Abbas Khosravi (AU), Saeid Nahavandi (AU)

The washout filter for a driving simulator is able to regenerate high fidelity vehicle translational and rotational motions within the simulator's physical limitations and return the simulator platform back to its initial position. The classical washout filter provides a popular solution that has been broadly utilized in different commercial simulators due to its simplicity, short processing time, and reasonable performance. One limitation of the classical washout filter is its sub-optimal parameter tuning process, which is based on the trial-and-error method. This leads to an inefficient workspace usage and, consequently, generation of false motion cues that lead to simulator sickness. Ignorance of a human sensation model in its design is another drawback of classical washout filters. The purpose of this study is to use Particle Swarm Optimization (PSO) to design and tune the washout filter parameters, in order to increase motion fidelity, decrease the human sensation error, and improve efficiency of the workspace usage. The proposed PSO-based washout filter is designed and implemented using the MATLAB/Simulink software package. The results indicate the effectiveness of the PSO-based washout filter in reducing the human sensation error, increasing the capability of reference shape tracking, and improving efficiency of the workspace usage.

#1641 Nested Marsupial Robotic System for Search and Sampling in Increasingly Constrained Environments

Edward Tunstel (US), Joseph Moore (US), Kevin Wolfe (US), Matthew S Johannes (US), Kapil D Katyal (US), Matt P Para (US), Ryan Murphy (US), Jessica Hatch (US), Colin Taylor (US), Robert Bamberger (US)

This paper presents a nested marsupial robotic system and its execution of a notional disaster response task. Human supervised autonomy is facilitated by tightly-coupled, high-level user feedback enabling command and control of a bimanual mobile manipulator carrying a quadrotor unmanned aerial vehicle that carries a miniature ground robot. Each robot performs a portion of a mock hazardous chemical spill investigation and sampling task within a shipping container. This work offers an example application for a heterogeneous team of robots that could directly support first responder activities using complementary capabilities of autonomous dexterous manipulation and mobility, autonomous planning and control, and teleoperation. The task was successfully executed during multiple live trials at the DARPA Robotics Challenge Technology Expo in June 2015. A key contribution of the work is the application of a unified algorithmic approach to autonomous planning, control, and estimation supporting vision-based manipulation and non-GPS-based ground and aerial mobility, thus reducing algorithmic complexity across this capability set. The unified algorithmic approach is described along with the robot capabilities, hardware implementations, and human interface, followed by discussion of live demonstration execution and results.

#1242 Fall-back layer concept for autonomous or semi-autonomous systems and processes: requirements, concepts, and first tests

Georg Hägele (DE), Dirk Soeffker (DE)

Autonomous or semi-autonomous systems (AS) are needed in different application domains to simplify human tasks. Autonomous and semi-autonomous aerial systems (AES) are most complex examples due to the challenge to perform tasks in complex and dynamic environment, for example in search and rescue applications. If in this context information about the AES environment is not reliable, disturbed, or GPS-signals are not available, safe navigation is required. Here safe navigation denotes spatial movement with freedom from unacceptable collision risk. The safe navigation assurance as well as safety assurance of AS are still open research issues. Traditional combination of safety aspects with mission related tasks and in consequence unmanageable AS system complexity as well as unpredictable effects during the spatial environment interaction makes traditional safety assurance methods inapplicable. From AES-related literature it can be concluded that system safety is mostly considered in conjunction with mission tasks like path planing, reduced to human safety operator as fall-back level, or emergency landing. No integral AES safety concept by the best knowledge of the authors can be found in the literature considering safe situational behavior, system malfunctions, and technical fall-back layer. This paper presents a brief literature review concerning AES systems. A related novel concept for System Safety Surveillance and Control (SSSC) system as AS fall-back layer is introduced. This system is separated in well-defined, safety task-specific modules. In comparison to other approaches, safety can be achieved by separation between regular behavior generation and safety assurance by emergency behavior integration and realization. Proof of concept demonstrates the successful use of SSSC-based fall-back layer using experimental example.

Robotics, Human Machine Interface, and Haptics (III)

Organizers: Saeid Nahavandi, Edward Tunstel
October 12 (Wednesday), 09:30-11:00, InterContinental Budapest, Duna Salon III
Session Chairs: Rodney Roberts, Edward Tunstel

#1659 Impulsive resistance force generated using pulsive damping brake of DC motor

Takumu Okada (JP), Shogo Okamoto (JP), Yoji Yamada (JP)

We developed a method to present an impulsive resistance force by using the passive damping brake of a DC motor. The rapid pulsive change in the resistance forces preceding a main brake increased the perceived resistance of the brake. In a ranking task involving five naive participants, a damping brake with two preceding pulsive resistances was reported to deliver a resistance larger than that due to a simple stepwise brake that achieves the maximum physical braking force. Our technique enhances the abilities of passive force displays, which are inherently safe human-machine interfaces.

#1863 Tissue and Force Modelling on Multi-layered Needle Puncture for Percutaneous Surgery Training

Yonghang Tai (AU), Lei Wei (AU), Hailing Zhou (AU), Saeid Nahavandi (AU), Junsheng Shi (CN)

Percutaneous surgery is a typical minimally invasive surgery. Featuring minimization in trauma and infection rate as well as rapid recovery time to patients, percutaneous therapy has replaced various traditional open surgery approaches and has become an essential approach for a series of clinic operations over the past decades. However, the practice and training for such a vocational manual skill is both difficult and expensive, which imposes negative impacts on its further advances. In this paper, we conducted an immersive needle insertion simulator for percutaneous surgery through visuo-haptic rendering. Multi-layered deformable tissue model with human anatomic textures are simulated and rendered. Mass-spring based force model and algorithm are also employed for realistic trocar needle insertion. Last but not least, a highly immersive virtual training scenario, integrated with a desktop haptic device is implemented to facilitate perceptive and hands-on experiences. Medical professional and trainees have also been invited to practice on the training scenario and provide subjective opinions in refining our implementation.

#1882 Effect of Acceleration and Velocity on Perceptual Force Dead-Band Analysis

Omid Fathollah Nadjarbashi (AU), Zoran Najdovski (AU), Saeid Nahavandi (AU), Shady Mohammad (AU)

Weber's law has been widely used by researchers for perceptual analysis in data reduction algorithms proposed for haptic applications. The law in its basic definition suggests a constant coefficient κ or Just Noticeable Difference (JND). This constant is the percentage of actual stimulus around which the human sensory system cannot notice a change. Moreover, research studies have been conducted to modify the rule to be more efficient and appropriate for haptic applications. Among these studies, the effect of the master operator's velocity on the force-JND used in the slave device's transmission method has been previously discussed for constant velocity within the trajectory. The aim of this research is to overcome some of the limitations within existing research on velocity-adaptive JND, and to investigate the effects of the master operator's acceleration on the force-feedback dead-band threshold. Further, user studies were completed, and the results were investigated to clarify the influence of involving dynamic factors to the JND calculation.

#1945 Driver Behaviour Analysis Using Topological Features

Mostafa Hossny (AU), Shady Mohamed (AU), Saeid Nahavandi (AU), Kyle Nelson (AU), Mohammed Hossny (AU)

Driving behaviour prediction is a challenging prob- lem due to the nonlinearity of human behaviour. Linear and nonlinear techniques have been used to solve this problem, and they provide good results presented in the performance of the current autonomous cars. However, they lack the ability to adapt to abruptness that happens because of the human factor. In this paper, we introduce a method to extract persistent homology barcode statistics. These statistics are useful as a representative of the driving process including the human behaviour. Human factor identification requires finding features that preserve cer- tain properties against scalability, deformation, and abruptness. Topological Data Analysis (TDA) using persistent homology can provide these features for driver behaviour prediction. We captured a driver's head motion as an experimental behavioural cue, combined it with captured simulated vehicle data, like location and velocities. Barcodes are extracted using JavaPlex, then we extracted some statistics to show the significance of these barcode as features for driver behaviour prediction. The correlation between the extracted features shows a promising start for a behavioural tracking applications using TDA.

#1952 Body Joints Regression Using Deep Convolutional Neural Networks

Ahmed Abobakr (AU), Mohammed Hossny (AU), Saeid Nahavandi (AU)

Human pose estimation is a well-known computer vision problem that receives intensive research interest. The reason for such interest is the wide range of applications that the successful estimation of human pose offers. Articulated pose estimation includes real time acquisition, analysis, processing and understanding of high dimensional visual information. Ensemble learning methods operating on hand-engineered features have been commonly used for addressing this task. Deep learning exploits representation learning methods to learn multiple levels of representations from raw input data, alleviating the need to hand-crafted features. Deep convolutional neural networks are achieving the state-of-the-art in visual object recognition, localisation, detection. In this paper, the pose estimation task is formulated as an offset joint regression problem. The 3D joints positions are accurately detected from a single raw depth image using a deep convolutional neural networks model. The presented method relies on the utilisation of the state-of-the-art data generation pipeline to generate large, realistic, and highly varied synthetic set of training images. Analysis and experimental results demonstrate the generalisation performane and the real time successful application of the proposed method.

Robotics, Human Machine Interface, and Haptics (IV)

Organizers: Saeid Nahavandi, Edward Tunstel
October 12 (Wednesday), 11:00-12:30, InterContinental Budapest, Duna Salon III
Session Chairs: Rodney Roberts, Edward Tunstel

#2023 An Empirical Nonlinear Viscoelastic Model of Reflective Force by a Layer of Soft Tissue

Cheongjun Kim (KR), Doo Yong Lee (KR)

Haptic sensation delivered to doctor's hands during CT-guided needle intervention complements insufficient visual information. Exploitation of the haptic information is to be trained using simulation. A model is necessary to compute the reflective forces occurring when the needle tip contacts with layers of soft tissues such as skin, membrane, and other layers of tissues. This paper proposes a nonlinear viscoelastic model based on measurements using porcine soft tissues. A 6-axis force-torque sensor and a needle are attached to the end of a 6-DOF articulated robot to measure the layer forces. The measurement results show that the layer forces increase nonlinearly with displacement of the needle. The force is affected by change of the velocity. It is also shown that the reflective force is relaxed when the needle stops. A standard linear solid model which can describe the relaxation phenomena is modified to describe nonlinear damping and stiffness forces. Accuracy of the developed model is verified through comparison between the model and measured data using porcine tissues. The proposed model can describe the nonlinear stiffness and relaxation phenomena with relative error less than 3.8 %.

#2190 A Symbolic Motion Planning Approach for the Reach-avoid Problem

Laya Shamgah (US), Ali Karimoddini (US), Abdollah Homaifar (US)

This paper addresses the motion planning problem for two autonomous robots (the defender and the attacker) with competitive objectives, which are involved in a reach-avoid scenario. This adversarial aspect of the game makes the problem complex with high computational cost. To address this problem, we propose a novel symbolic approach for the robot motion planning and control of the robots, which can effectively manage the complexity of the problem. The basic idea is to partition the environment into convex regions, and then, capture the desired objectives of the defender and the adversarial behavior of the attacker with temporal logic formulas. We also use finite two-player zero-sum games as a tool for the robot decision-making over the partitioned space. An illustrative examples has been provided to detail the steps of the proposed algorithm and the simulation results are presented to verify the effectiveness of the proposed algorithm.

#1321 Attentional Multimodal Interface for Multidrone Search in the Alps

Alberto Finzi (IT), Cacace Jonathan (IT), Caccavale Riccardo (IT), Vincenzo Lippiello (IT)

We present a multimodal attentional interface suitable for a human operator that monitors and controls the activities of a team of drones during search and rescue missions. We consider a scenario where the operator is a component of the rescue team, hence not fully dedicated to the robots, but only able to interact with them with sparse and incomplete commands. In this context, an adaptive interface is needed to support the user situation awareness and to enable an effective interaction with the drones. In this work, we propose a multimodal attention-based interface designed for this domain. This framework is to filter the information flow towards the operator selecting and adapting the communication mode according to the context and the human state. We illustrate the features of the adaptive system along with an initial assessment in a simulated scenario.

#2386 MyoHMI: A Low-Cost and Flexible Platform for Developing Real-Time Human Machine Interface for Myoelectric Controlled Applications

Ian Donovan (US), Kevin Valenzuela (US), Alejandro Ortiz (US), Sergey Dusheyko (US), Hao Jiang (US), Kazunori Okada (US), Xiaorong Zhang (US)

EMG pattern recognition has been studied for control of prostheses and rehabilitation systems for decades. Existing research platforms for developing EMG pattern recognition algorithms are typically based on MATLAB and the collection of EMG signals is often done by expensive, non-portable data acquisition systems. The requirement of these resources usually limits the use of these platforms in the lab environments and prohibits their widespread to other fields and applications. To address this limitation, this paper presents a low-cost, easy to use, and flexible platform called MyoHMI for developing real-time human machine interfaces for myoelectric controlled applications. MyoHMI facilitates the interface with a commercial EMG-based armband Myo, which costs less than $200 and can be easily worn by the user without the need of special preparation. MyoHMI also provides a highly modular and customizable C/C++ based software engine which seamlessly integrates a variety of interfacing and signal processing modules, from data acquisition through signal processing and pattern recognition, to real-time evaluation and control. The experimental results on able-bodied human subjects for controlling two evaluation platforms in real time verified the merit of the MyoHMI platform and demonstrated the feasibility of a low-cost solution for the development of myoelectric controlled applications.

#1946 Self-Organizing Map for Data Collection Planning in Persistent Monitoring with Spatial Correlations

Jan Faigl (CZ)

This paper introduces an extension of the unsupervised learning method to solve data collection planning problems where particular sensor measurements can be spatially correlated. The problem is motivated by monitoring tasks formulated as the Prize-Collecting Traveling Salesman Problem with Neighborhoods (PC-TSPN). A solution of the PC-TSPN consists of a selection of important sensors, determination of the locations to read data from these sensors, and finding the shortest path to visit the locations. The solution cost is defined as a sum of the travel cost and penalty characterizing additional cost associated to sensors from which data are not retrieved. The penalty represents importance of particular sensor measurements to the quality of the model and existing solutions assume the penalties are constant values. However, for spatially close sensor locations, data from one sensor may contain also information about nearby locations and thus, its penalty depends on locations selected for data collection. The proposed generalization of the PC-TSPN solver allows to consider spatial correlations of sensor measurements and the proposed approach provides better solutions than the previous algorithm with fixed penalties.

Modern Technology on Medicine, Health Care and Human Assist (I)

Organizers: Yutaka Hata, Cathy Helgason, Noboru Takagi, Koichi Tanno, Kazuo Kiguchi
October 10 (Monday), 13:30-15:00, InterContinental Budapest, Duna Salon II
Session Chairs: Noboru Takagi, Cathy Helgason

#1050 Auto-Assisting Figure Presentation System for Inclusion Education

Junji Onishi (JP), Tadahiro Sakai (JP), Masatsugu Sakajiri (JP), Takahiro Miura (JP), Tsukasa Ono (JP)

In most of cases, communications based on multimedia form is inaccessible to the visually impaired. Thus, persons lacking eyesight are eager for a method that can provide them with access to progress in technology. We consider that the main important key for inclusive education is to real-timely provide materials which a teacher shows in a lesson. In this study, we present tactile sense and kinesthetic sense assisting system in order to provide figure or graphical information without an any assistant. This system gives us more effective teaching under inclusive education system.

#1093 Low Vision Aid through Laser Retina Imaging –Toward Building Eyesight-aid

Yasuyuki Murai (JP), Makoto Suzuki (JP), Mitsuru Sugawara (JP), Hisayuki Tatsumi (JP), Miyakawa Masahiro (JP)

Laser retina imaging technology enables creation of a clear picture in any retina area. It is focus-free, i.e. irrelevant of refractive disorder. So in many cases of low vision, one can see the picture by one's own eyesight. In this article we describe possible applications of this emerging technology, including 1. Development of eyesight-aid for low vision, an HMD (head-mounted display) on which this technology is implemented, 2. Creating a vision sensitive area map of retina, a novel notion, precisely. Especially this may innovate perimetry technologies in ophthalmology important in finding disorders in vision. We list up requirements for the eyesight-aid, including a compensation of partial visual field loss. Finally we indicate that part of our requirements is feasible by presenting our preliminary experiments. Indeed, we show that it is possible to detect a pictogram ("Exit") and pedestrian boundaries on the road-side both in the view by existing pattern recognition programs (SURF method).

#1094 Touch Tracking Analysis for Graphics Image Acquisition by the Visually Impaired – Toward Understanding Graphical Image Creation by Touch-Sensing

Yasuyuki Murai (JP), Hisayuki Tatsumi (JP), Iwao Sekita (JP), Miyakawa Masahiro (JP)

One of the problems regarding graphics for blind individual is that we have few data on how he (she) acquires graphical information through touching. In this article, we propose a method of tracking the touch point of his (her) fingertip on graphics material using cameras (an analog of eye-tracking) for analyzing the image acquisition process. We exhibit the method on an edge-outlined tactile picture of a flower and show that it yields basic features of the original outlined flower by an experiment relying on a visually impaired subject. As a linked yet remotely material in Section 3.1 we describe our other application of online tactile map in which we have introduced the idea of sharing positional information between touching a tactile picture and looking into a graphical picture using a tracking technology.

#1182 Consideration of the Experience of a Blind User Using a Tactile Graphics Editor Available for Blind People

Noboru Takagi (JP), Masaki Yuji (JP), Motoyoshi Tatsuo (JP), Morii Shingo (JP)

Tactile graphics are widely used for blind people to access visual information such as maps, diagrams, and graphs and so on. Tactile graphics are usually produced by sighted people, but some of the blind people want to produce tactile graphics by themselves to express their ideas or opinions. A special writing utensil, called a raise-writer, is used when a blind person draw tactile graphics alone. A raise-writer consists of a cellophane sheet and a pen without ink. If a blind person writes characters or line-drawings on the cellophane sheet using the pen, the script swells so that the blind person can feel them. However, once a line has been drawn on a cellophane sheet, it cannot be erased or redrawn, and line-drawings using a raise-writer cannot be utilized by computers. To improve this drawback, we are now developing a system which enables blind people to produce tactile graphics without any help from sighted people. In this paper, we present our system, and discuss the effectiveness of our system through the experience of a blind user.

#1246 Pupil Diameter Measurement in Visible-light Environment Using Separability Filter

Morita Yuki (JP), Hironobu Takano (JP), Nakamura Kiyomi (JP)

The various systems using the information of pupil diameter variation have been studied and developed. These systems are presupposed to be operated on a general-purpose PC or a portable terminal. To obtain the information of pupil diameter, a near-infrared camera and illuminations are required. However, the conventional PC or portable terminal does not have a near-infrared camera and illumination. If the pupil diameter can be measured by using the visible-light camera equipped in the general-purpose PC or the portable terminal, such systems using the information of pupil diameter variation can be widely used. It is difficult to discriminate between the iris and pupil regions in an image captured by the visible-light camera because the iris and pupil colors of Asian people are similar. In this paper, for the generalization of the systems using the information of pupil diameter variation, we proposed the measurement method of the pupil diameter from the image taken by the visible-light camera. From the experimental results, the accuracy of proposed method was equivalent to that of the conventional method of pupil diameter measurement using the near-infrared camera and the illumination.

Modern Technology on Medicine, Health Care and Human Assist (II)

Organizers: Yutaka Hata, Cathy Helgason, Noboru Takagi, Koichi Tanno, Kazuo Kiguchi
October 10 (Monday), 15:30-17:00, InterContinental Budapest, Duna Salon II
Session Chairs: Yutaka Hata, Kazuo Kiguchi

#1341 Gait Analysis of Normal Subjects by Using Force Sensor and Six Inertial Sensor with Wireless Module

Keita Aoike (JP), Kouki Nagamune (JP), Koji Takayama (JP), Kuroda Ryosuke (JP), Kurosaka Masahiro (JP)

Gait motion is strongly relating with human health. Therefore, it is important to analyze the gait motion. This study aims to develop a system to measure sole pressure, acceleration and angular velocity in gait motion. Then the system can measure the parameters by using seven force sensors and six-axis inertial sensor for each sole. The experiment was performed with three normal subjects by using the proposed system. An analysis method consists of three steps. The first step specifies gait cycle from the value of the acceleration. The second step calculates the excursion of ankle joint by integrating the angular velocity. The third step specifies foremost and hindmost points of gravity center in gait cycle from the seven force sensors and calculates anteroposterior distance of gravity centers. The target parameters were excursion of ankle joint and anteroposterior distance of gravity centers. In the experiment, stride lengths of the subjects were three patterns of 10 cm, 50 cm, and 100 cm. There was a tendency that the ankle excursion was small when the stride was small.

#1419 Identification of Ovarian Follicle with Ovum from Ultrasonic Images

Manabu Nii (JP), Hideaki Kozakai (JP), Masakazu Morimoto (JP), Syoji Kobashi (JP), Naotake Kamiura (JP), Yutaka Hata (JP), Seturo Imawaki (JP), Tomomoto Ishikawa (JP), Hidehiko Matsubayashi (JP)

In the infertility treatment, medical examinations using ultrasonic devices, which can diagnose the mother's body safely on real time, are major. It is very difficult to judge the existence of an ovum before carrying out the paracentesis. A system which can distinguish the existence of the ovum in the ovarian follicle using ultrasonic devices is required. In this paper, several features of the deformation of ovarian follicle are defined and extracted from the ultrasonic moving image in a paracentesis operation. These features are extracted from the ultrasonic moving image obtained at the time of an ovum extraction operation. We investigate whether some clusters according to the existence of the ovum are formed using the defined features. Moreover, we also investigate whether some tendency exists in these features by the existence of an ovum.

#1493 Cerebral aneurysm occurrence prediction by morphometric analysis of the Willis ring

Marin Yasugi (JP), Md Belayat Hossain (JP), Manabu Nii (JP), Masakazu Morimoto (JP), Syoji Kobashi (JP)

It is known that lifestyle habit and genetic factor are main reasons that occur cerebral aneurysms. In addition, some studies suggest that cerebral artery shape might be correlated with a risk of occurring aneurysms. For the purpose of preemptive medical care of the cerebral aneurysm, this study proposes a method to estimate a risk of occurring cerebral aneurysms based on the cerebral artery structure. The method extracts morphometric features of the Wills ring such as 3-D artery shape and bifurcation angle in 3-D magnetic resonance angiography (MRA) images. It then estimates the risk of occurring cerebral aneurysms from the extracted features using support vector machines (SVM). To validate the proposed method, we employed 40 subjects with cerebral aneurysms, and 40 subjects without cerebral aneurysms. Leave-one-out cross validation test was performed, and the method using 3-D artery shape achieved a sensitivity of 75% and a specificity of 75%; one using bifurcation angle did a sensitivity of 33% and a specificity of 71%; one using all features did a sensitivity of 68% and a specificity 89%. The results showed that 3-D shape is effective for cerebral aneurysm occurrence risk prediction.

#1507 Application of Self-Organizing Maps to Data Classification and Data Prediction for Female Subjects with Unhealthy-Level Visceral Fat

Naotake Kamiura (JP), Syoji Kobashi (JP), Manabu Nii (JP), Takayuki Yumoto (JP), Ken-Ichi Sorachi (JP)

In this paper, an application of self-organizing maps (SOM's) in classifying and predicting data of female subjects with unhealthy-level visceral fat is discussed. The proposed method chooses subjects fulfilling the standard specified by body mass index and abdominal circumference. It defines the class with subjects of which hemoglobin A1c (HbA1c) values and item values associated with a liver deteriorate, that with subjects having HbA1c and triglyceride values deteriorate, and that with remaining subjects. Normal SOM learning is conducted, using data generated from original values of twelve items such as HbA1c and glutamic-oxaloacetic. The constructed map consists of neurons with labels. The label of a winner determines the class of the presented unknown data. The prediction depends on the label of a winner for the presented unknown data, a set of original data that determine the label, and a set of next year's data of the subjects with the above original data. Experimental results reveal that the proposed method achieves the reasonably favorable accuracies in classifying data and in predicting HbA1c values.

#1657 A fundamental study on the effect of vibration stimulation for motion modification in perception-assist

Kazuo Kiguchi (JP), Koki Honda (JP)

In order to assist the daily life motion of physically weak persons such as elderly persons, many kinds of power-assist robot have been developed. In the case of physically weak persons, perception ability to perceive the surrounding environment is often deteriorated also. A method of perception-assist has been proposed to assist not only the user's motion but also interaction of the user with his/her environment. Perception-assist automatically modifies the user's motion when the power-assist robot detected the possibility of accident such as collision between the user and some obstacles. It is useful function for physically weak persons' daily motion assist. However, since unintentional motion is automatically generated by the robot, regardless of the user's motion intension, the user might feel uncomfortableness. In this paper, another motion modification method is investigated to make natural motion modification in perception-assist. It is known that kinesthetic illusion is generated and subjects feel as if their antagonist muscle is elongated when vibration stimulation is added to tendon of antagonist muscle around a joint. The possibility of the motion modification using kinesthetic illusion by applying vibration to the tendon is investigated in this study. Vibration stimulation is added to biceps brachii for the elbow joint motion. Some features of kinesthetic illusion were obtained during the elbow joint motion by performing the experiments.

Modern Technology on Medicine, Health Care and Human Assist (III)

Organizers: Yutaka Hata, Cathy Helgason, Noboru Takagi, Koichi Tanno, Kazuo Kiguchi
October 10 (Monday), 17:00-18:30, InterContinental Budapest, Duna Salon II
Session Chairs: Yutaka Hata, Koichi Tanno

#2258 Needs and impressions of communication robotics by seniors with slight physical and cognitive disabilities: Evaluation by system usability scale (SUS)

Takahiro Miura (JP), Goto Taichi (JP), Kaneko Kazuki (JP), Sumikawa Yuka (JP), Ishii Ayako (JP), Doke Mio (JP), Suzuki Keita (JP), Okatani Taiyu (JP), Kubota Akihiro (JP), Nihei Misato (JP)

Various types of communication robots have emerged for supporting elderly people with impairments or frailties. However, the need of the robots for healthy elderly persons with decreasing physical and cognitive abilities remains unclear. Knowledge about these needs can help determine the guidelines or implications of the introduction of communication robots for healthy seniors. The objective of this study is to clarify the needs and the impressions of various communication robots for seniors with slight physical or cognitive problems. The scores on the system usability scale (SUS) and interview results indicated that, with increasing participant age, mammal-like communication robots were more preferable than other types. In addition, elderly persons with minor physical problems tended not to prefer manually operated robots.

#2299 A Wave Detection Method for Air-Coupled Ultrasound System on Human Abdominal Region

Takahiro Takeda (JP), Mabuchi Takuya (JP), Naoyuki Takesue (JP), Naoyuki Kubota (JP), Honghai Liu (CN)

This paper describes an air-coupled ultrasound system by using DIO-2000. The system is aimed to use for inner muscle evaluation in rehabilitation process. The system evaluates inner muscle with low constrain than conventional method which measured by using MR image, X-ray CT and contacted ultrasound system. Our air-coupled ultrasound system measures transmitted ultrasound wave with very low power through human abdominal region by employing a pulsar-receiver with high sensitive pre-amplifier, and wave detection method based on fuzzy inference finds transmitted wave from noisy wave. The fuzzy inference is derived from characteristics of transmitted wave. In the experiment, we evaluate the accuracies of wave detection method for human body.

#2320 Band Generation Process for classification of cerebrospinal fluid in Magnetic Resonance Images

Kuan-Ru Lee (TW), Chao-Cheng Wu (TW), Yung-Hsiao Chiang (TW), Jiannher Lin (TW)

Cross section area (CSA) of spinal canal has been an important indicator for lumbar spinal stenosis (LSS), which remains the leading preoperative diagnosis for adults older than 65 years. Until recently, the machine learning algorithms had been investigated in [5-7] for an automatic classification system. The automatic classification system exploited the luminance of cerebrospinal fluid (CSF) as the major features. Unfortunately, the limited sequences of magnetic resonance images, which included only T1 and T2 sequences, produced certain level of false alarm and reduced the classification rate. The band expansion process(BEP) proposed in [8] shed light on this issue by generating additional bands with non-linear functions. The idea of BEP unveils the non-linear relationship among sequences to increase the classification rate. The utilities of BEP had been evaluated in brain MR images [9]. This paper would like to extend the applications of BEP for classification of CSF. The experimental studies further demonstrated the benefits of the BEP.

#2400 Visuospatial working memory game and measured memory performances at various ages

Takahiro Miura (JP), Ken-Ichiro Yabu (JP), Kazutaka Ueda (JP), Tohru Ifukube (JP)

Because of rapid population aging, it is necessary to design and develop senior-friendly or disability-friendly interfaces that can decrease the cognitive workload caused by an interface. At that time, the design implications and evaluation criteria of an interface should be needed for creating senior-friendly and disability-friendly interfaces. One of the elements that relate to memory functions for manipulating interfaces include working memory. However, rough standard of visuospatial memory remains unknown. Particularly, there are little reports about the relations between the age and the volume of visuospatial memory. In this paper, we aim to clarify this relations for proposing interface implications by using a visual pattern span test. For effective measurement of the memory, we implemented a gamified measurement application based on visual pattern span tests. The results indicated that the median numbers of memorable buttons on visuospatial memory were and 7.0 (interquartile range: 5.0--9.0). Also, the number of memorable buttons increases as the age increases until the age ranged 21--25 and then decreases gradually as the age increases after 21-25 years. Our evaluation suggest that it can be effective to measure memory performance of, especially, children by the applications that are designed based on the entertainment concepts including a gamification.

#1438 EPOC aware Energy Expenditure Estimation with Machine Learning

Soljee Kim (KR), Junga Lee (KR), Justin Yong Kwan Jeon (KR), Kyoungwoo Lee (KR)

In 2014, 39 % of adults were overweight, and 13 % were obese. Clearly, knowing exact energy expenditure (EE) is important for sports training and weight control. Furthermore, excess post-exercise oxygen consumption (EPOC) must be included in the total EE. This paper presents a machine learning based EE estimation approach with EPOC for aerobic exercise using a heart rate sensor. On a dataset acquired from 33 subjects, we apply machine learning algorithms using Weka machine learning toolkit. We could achieve 0.88 correlation and 0.23 kcal/min root mean square error (RMSE) with linear regression. The proposed model could be applied to various wearable devices such as a smartwatch.

Knowledge-based and Intelligent Control Solutions for Medical Cyber-Physical Systems (I)

Organizers: Támas Haidegger, Gernot Kronreif, Emmanuel Benjamin Vander Poorten
October 10 (Monday), 13:30-15:00, Sofitel Budapest Chain Bridge, Bellevue 1
Session Chairs: Tamas Haidegger, Gernot Kronreif

#1623 A Haptic Guidance System for Computer-Assisted Surgical Training Using Virtual Fixtures

Minsik Hong (US), Jerzy Rozenblit (US)

A simple and robust fuzzy logic controller with a forbidden region virtual fixture is proposed for a haptic guidance system developed to assist in simulation-based training of laparoscopic surgery. A surgical training system that involves human in the control loop is discussed. It uses a controller which adjusts control outputs for different trainees based on their skill level. The system involves virtual fixtures to improve human manipulation tasks inherent in this problem domain. The proposed controller cooperates with a heuristic-based scaling factor modifier to make such adjustments. The experimental results illustrate the feasibility and effectiveness of the proposed haptic guidance system.

#2158 Reaction force and surface deformation estimation based on heuristic tissue models

Arpad Takacs (HU), Tamás Haidegger (HU), Imre J. Rudas (HU)

Advanced surgical robotic systems aim to offer improved capabilities through automated low-level functions. In the applications, soft tissue mechanics and tool--tissue interaction modeling play an important role in achieving optimal control, relying on model-based control methods. This approach allows for addressing crucial issues during teleoperation, such as time-delay, state observation or stability. This paper presents a novel approach for modeling the behavior of soft tissue during surgical interventions, relying on the widely-employed concept of rheological models. The nonlinear Wiecher model is used for reaction force estimation during tissue indentation, tested on beef liver samples for acquiring mechanical parameters from experimental data. Curve fitting methods were used in both stress relaxation and constant indentation speed compression phases. Reaction forces are estimated using the proposed model, followed by verification tests on ex-vivo beef liver samples. The results of this research showed that the proposed novel rheological soft tissue model is capable of estimating the reaction forces acting on the tool, if the shape of the deformed tissue is known in time. This model can be successfully integrated into closed-loop surgical robot controllers.

#2160 Polytopic Model Based Interaction Control for Soft Tissue Manipulation

Arpad Takacs (HU), József Kuti (HU), Tamás Haidegger (HU), Péter Galambos (HU), Imre J. Rudas (HU)

Reliable force control is one of the key components of modern robotic teleoperation. The performance of these systems, in terms of safety and stability, largely depends on the controller design, as it is desired to deal with various disturbing conditions, such as uncertainties of the model parameters or latency-induced problems. This work presents a polytopic quasi-linear parameter-varying (qLPV) model derived from a previously verified nonlinear soft tissue model, along with a model-based force control scheme that involves a tensor product polytopic state feedback controller. The derivation is based on the Tensor Product (TP) Model Transformation. The proposed force control scheme is verified and evaluated through numerical simulations.

#1068 Cross-Coupling Control of a Powered Wheelchair Driven by Rim Motors

Yee-Pien Yang (TW), Po-Ray Chen (TW)

This paper proposes a time-optimal path-tracking strategy of cross-coupling control for a wheelchair driven by dual power wheels. Each power wheel is integrated by a rim motor, a battery bank, a brake, and a controller. The control strategy is responsible for adjusting the speed ratio of dual power wheels to maintain a direction of motion that the driver commands under any road circumstance. Since the wheelchair motion is dynamically coupled with the left and right wheel speeds, the time-optimal path-tracking strategy is to compensate both wheel speeds with equal speed difference by predicting the intended path of motion. Experimental results show that the proposed cross-coupling control system is robust to driver's weight and road disturbances.

#2442 Dynamic Constraint-based Rendering of Contacts in Haptics

Arash Mohtat (CA), Jozsef Kovecses (CA)

Kinesthetic haptic applications employ force feedback on top of graphic and sound modalities to enable the human operator to interact with objects within a virtual world. The force feedback sensation, in particular, is created by a haptic device that displays the forces arising from this interaction. These forces must accurately emulate a real contact interaction, an objective which is commonly referred to as high-fidelity force feedback rendering. To achieve this, the current paper proposes a constrained-based rendering using a virtual tool that comes into unilateral contact with the virtual objects. Unlike common quasi-static or quasi-dynamic formulations in the haptics literature, a truly dynamic physical interaction between the virtual tool and the objects is modeled here. The paper develops analytical formulations for a canonical problem including colliding contact, sustained contact, slip and stick friction. Initial simulation and experimental evaluations show the potential of this method for handling complicated contact scenarios such as those encountered in haptic simulations of spinal or dental surgeries.

Knowledge-based and Intelligent Control Solutions for Medical Cyber-Physical Systems (II)

Organizers: Tamás Haidegger, Gernot Kronreif, Emmanuel Benjamin Vander Poorten
October 10 (Monday), 15:30-17:00, Sofitel Budapest Chain Bridge, Bellevue 1
Session Chairs: Gernot Kronreif, Tamas Haidegger

#2452 Position Control of Robotic Catheters inside the Vasculature based on a Predictive Minimum Energy Model

Emmanuel Benjamin Vander Poorten (BE), Phuong Toan Tran (BE), Gabrijel Smoljkic (BE), Caspar Gruijthuijsen (BE), Dominiek Reynaerts (BE), Jos Vander Sloten (BE)

Accurate and precise control of catheters inside a vasculature is a difficult yet important task. Current manual approaches require significant surgical skill. Over the years, surgeons build up a sort of mental kinematic map telling them how to handle the catheter in order to steer the catheter tip safely through the vessel system. The input-output behaviour of the catheter is complex and depends heavily on its configuration within and contacts with the vasculature. This paper introduces an alternative approach to control robotic catheters. The input-output behaviour or so-called differential kinematics are derived from a patient-specific vasculature model, following a minimum energy argumentation. The validity of the proposed approach is demonstrated experimentally. Whereas the performance of model-based approaches is obviously greatly influenced by the correctness of estimated parameters, within this work we show experimentally how reasonable performance can already be achieved within the setup that was constructed. We expect that there is still ample room for improvement by, e.g., putting more sophisticated identification, modeling and collision detection schemes into place.

#2348 Using Human Intellectual Tasks as Guidelines to Systematically Model Medical Cyber-Physical Systems

Andrew Yi-Zong Ou (US), Yu Jiang (US), Po-Liang Wu (US), Lui Sha (US), Richard Berlin (US)

In a medical environment such as Intensive Care Unit, there are many possible reasons to cause errors, and one important reason is the effect of human intellectual task. In this paper, we first provide five categories of generic intellectual tasks of humans, where tasks among each category may lead to potential medical errors. Then, we present an integrated modeling framework to model a medical Cyber-Physical-Human System (CPHSystem) and use UPPAAL as the foundation to integrate and verify the whole medical CPHSystem design models. When designing a medical CPHSystem, developers need to consider whether the system design can mitigate the errors caused by these tasks or not. With a verified and comprehensive model, a more accurate and acceptable system can be designed. We use a cardiac arrest resuscitation guidance and navigation system (CAR-GNSystem) as the motivation example for such medical CPHSystem modeling. Experimental results show that the CPHSystem models help determine system design flaws and can mitigate the potential medical errors caused by the human intellectual tasks.

#2481 Robust Lung Segmentation Combining Adaptive Concave Hulls with Active Contours

Sara Soltaninejad (CA), Irene Cheng (CA), Anup Basu (CA)

Lung segmentation is an important first step towards an automated CAD (Computer Aided Detection) system for a variety of medical applications. These applications range from lung nodule detection for identifying cancerous tumors to acinar shadow detection for identifying Tuberculosis. In our prior work we had used the Concave Hull algorithm for lung segmentation. However, our results showed over segmentation. In this work we introduce “Adaptive” concave hulls, combine it with Adaptive Median Filtering, and finally apply an Active Contour Model to make the results much more robust and eliminate the over segmentation and under segmentation problem. Our technique is especially useful for automated detection of Juxtapleural pulmonary nodules that are attached to the chest wall. Experimental results demonstrate the improvements achieved by our new algorithm.

#1208 Information Supervisory Control of Human Behavior – Concept and Experiments Toward Realization

Kunihiko Hiraishi (JP), Naoshi Uchihira (JP), Sunseong Choe (JP), Koichi Kobayashi (JP)

A type of services that requires human physical actions and intelligent decision making can be found in various real fields, such as services by floor staff in hotels/restaurants and caregiving in hospitals/nursing homes. The authors' group calls such a service the physical and adaptive intelligent service, and is developing an ITC-based system, called the smart voice messaging (SVM) system, that assists staff mainly in cooperation and knowledge sharing. In this paper, we propose the concept of information supervisory control (ISC) which will be realized on the SVM system. In this scheme, there is a central commander, called the information supervisor, in the system. The information supervisor provides a group of persons with appropriate information at appropriate timing. The control scheme of ISC is designed based on the concept of situation awareness. The information supervisor collects various information to identify the current situation, and provides the persons with information useful for the current and future situations. Toward realization of ISC, we conduct two experiments in order to know how human activity changes by providing information.

#1539 Improving malignancy prediction through feature selection informed by nodule size ranges in NLST

Cherezov Dmitry (US), Samuel Hawkins (US), Dmitry Goldgof (US), Lawrence Hall (US), Matthew Schabath (US), Robert Gillies (US), Yoganand Balagurunathan (US)

Computed tomography (CT) is widely used during diagnosis and treatment of Non-Small Cell Lung Cancer (NSCLC). Current computer-aided diagnosis (CAD) models, designed for the classification of malignant and benign nodules, use image features, selected by feature selectors, for making a decision. In this paper, we investigate automated selection of different image features informed by different nodule size ranges to increase the overall accuracy of the classification. The NLST dataset is one of the largest available datasets on CT screening for NSCLC. We used 261 cases as a training dataset and 237 cases as a test dataset. The nodule size, which may indicate biological variability, can vary substantially. For example, in the training set, there are nodules with a diameter of a couple millimeters up to a couple dozen millimeters. The premise is that benign and malignant nodules have different radiomic quantitative descriptors related to size. After splitting training and testing datasets into three subsets based on the longest nodule diameter (LD) parameter accuracy was improved from 74.68% to 81.01% and the AUC improved from 0.69 to 0.79. We show that if AUC is the main factor in choosing parameters then accuracy improved from 72.57% to 77.5% and AUC improved from 0.78 to 0.82. Additionally, we show the impact of an oversampling technique for the minority cancer class. In some particular cases from 0.82 to 0.87.

Proactive Healthcare Systems (I)

Organizers: Yo-Ping Huang, Tsu-Tian Lee
October 11 (Tuesday), 09:30-11:00, InterContinental Budapest, Duna Salon IV
Session Chairs: Yo-Ping Huang, Tsu-Tian Lee

#1101 Translating the Viewing Position in Single Equirectangular Panoramic Images

Frode Eika Sandnes (NO), Yo-Ping Huang (TW)

Equirectangular panoramas are popular tools for achieving 360 degree immersed viewing experiences. A panorama captures a scene from one point and panoramic viewers allow the user to control the viewing direction, but the viewer is not allowed to move around. This study proposes a strategy for transforming equirectangular panoramic images with the effect of moving freely in three dimensions. The strategy assumes that the panorama is an enclosed space comprising a flat ground and flat vertical walls. A equirectuangular Hough transform is proposed for detecting the boundaries of the respective planes. The panoramic image is then decomposed into the respective planes, the viewing point is translated and a new panoramic image based on the new viewing position is composed. Preliminary proof of concept test shows that the strategy allows free translation within simple panoramic images.

#1121 Early Detection of Driver Drowsiness by WPT and FLFNN Models

Yo-Ping Huang (TW), Nila Novita Sari (TW), Tsu-Tian Lee (TW)

This paper presents a method that can detect driver’s drowsiness by using the wavelet packet transform (WPT) and functional link-based fuzzy neural network (FLFNN) models. Drowsy drivers have been reported to be vulnerable to car accidents. Early detection of drowsiness can help alert drivers or passengers to provide a safety drive on the road. For those old models or cars without equipped with advanced high technologies, there is a dire need to install sensor devices that can effectively detect drowsy status of drivers at an early stage. Photoplethysmography (PPG) is a non-invasive optical technique that measures relative blood volume changes in the blood vessels and has been universally used for research and physiological study. We develop such PPG sensor devices to be installed on the steering wheel to detect the physiological conditions (such as normal to drowsy) by using parameters extracted from the heart rate variability (HRV) obtained from PPG signal calculation. Experimental results revealed that the proposed model is effective in assessing the drowsy levels of drivers.

#1191 Mining Time-Dependeent Influential Users in Facebook Fans Group

Li-Jen Kao (TW), Yo-Ping Huang (TW), Frode Eika Sandnes (NO)

Klout, a famous App, could measure people’s social network influence power. Klout score is measured according to the data from past 90 days and an individual who has high Klout score is thought as having high social influence power. Lots of businesses or organizations like to hire high Klout score people to help them to diffuse their brand images. However, Klout score cannot tell us who has high influence power in a specific short time period. For example, it is possible that some of the users might always have high influence power on Monday or on Monday morning. These time-dependent influential users probably have low Klout scores in average but have high influence power in some specific time periods. Businesses should not just know who are the high Klout score users but also they should identify who are the time-dependent influential users because all of them may have some sort of power to influence other users’ buying decisions. In this study, a framework based on frequent pattern mining is proposed to find the time-dependent influential users. First of all, the framework will divide a predefined long time period into successive short time segments and then influential transactions that contain Facebook fans’ influence power data will be defined in each time segment. From the frequent patterns, the proper time for time-dependent influence users to spread information can be found. A theoretical experiment is given to verify the effectiveness of the proposed framework.

#1430 A Novel Stabilization Condition for T-S Polynomial Fuzzy System with Time-delay: A Sum-of-Squares Approach

Shun-Hung Tsai (TW), Yu-An Chen (TW), Yu-Wen Chen (TW), Ji-Chang 羅吉昌 Lo (TW), Hak-Keung Lam (GB)

A novel stabilization problem for T-S polynomial fuzzy system with time-delay is investigated in this paper. Firstly, a polynomial fuzzy controller for T-S polynomial fuzzy system with time-delay is proposed. In addition, based on polynomial Lyapunov–Krasovskii function and the developed polynomial slack variable matrices, a novel stabilization condition for T-S polynomial fuzzy system with time-delay is presented in terms of sum-of-square (SOS) form. Lastly, nonlinear system with time-delay and a well-known T-S fuzzy system with time-delay are illustrated to demonstrate the feasibility and effectiveness of the proposed results.

#1452 Visual Tracking of Adaptive Particle Filter with Color Camera and Thermal Camera

Jung-Ting Hsu (TW), Cheng-Ming Huang (TW)

In this paper, a visual tracking system by using the particle filter with a monocular color camera and a thermal camera is proposed to track the target. The thermal camera, which can observe the heat originated from the target such as the human body or vehicle, collaborates with the color camera to track the target in the cluttered environment or under occlusion. First, the extrinsic parameters between the color camera and the thermal camera are calibrated to estimate the homography matrix between two cameras’ coordinates. An adaptive multiple importance sampling scheme is then developed to efficiently generate the particle hypotheses by dynamically fusing the target clues in the color camera and the thermal camera. These hypotheses are verified by evaluating the target similarity on the distributions of color and significant edge in the color image. Moreover, the sparse appearance model is combined into the likelihood evaluation to improve the tracking precision when the target might be occluded. Finally, the proposed approaches have been validated in several scenes to present the tracking performance.

Proactive Healthcare Systems (II)

Organizers: Yo-Ping Huang, Tsu-Tian Lee
October 11 (Tuesday), 11:00-12:30, InterContinental Budapest, Duna Salon IV
Session Chairs: Yo-Ping Huang, Tsu-Tian Lee

#1665 Simple and Practical Skin Detection with Static RGB-Color Lookup Tables: A Visualization-based Study

Frode Eika Sandnes (NO), Levent Neyse (DE), Yo-Ping Huang (TW)

Many skin detection approaches have been proposed in the image analysis literature. Some are simple and static; the others are dynamic and rely on complex machine learning algorithms and training data. Generally the simple approaches are preferred. We hypothesize that the developers' choice for the simple approaches are due to the reasonable quality of results and ease of implementation, since the results of more sophisticated results are not readily available. This paper explores the skin color of a large number of hand samples using color space visualization. The results suggest that a static method may suffice for many applications, but that a small set of rules is not enough to capture the details of skin. Moreover, the results suggest that successful skin detection does not depend on the color space used as there are no apparent advantages of using a perceptual uniform color space such as CIElab. A skin detection approach based on RGB-color table-lookup is proposed that is able to capture the complex skin color cluster shape. The method is practical and simple to implement with minimal computational cost. The lookup table is released into the public domain.

#1906 Dynamic Time Warping for IMU Based Activity Detection

Chan Yang Yun (TW), Yung Hsiang Chou (TW), Hui-Chuan Cheng (TW), Chih-Hsiu Cheng (TW), Kuo-Ho Su (TW)

Based on an IMU motion sensitive device, a dynamic time warping (DTW) to detect risky activities of people under healthcare has been devised and implemented. DTW, beneficial by matching time sequences with nonlinear dynamic alignment of the sample points to optimize the similarity, is especially a candidate for such a kind of activity detection because that the discrete activity signal sequence would be investigated with various time or speed, and often be unequally lengthened. DTW shows potentially an excellence in dealing straightforward with this kind of unequal-length sequence matching problem. In this study, we clarify the use of DTW for such an application in both theory and application aspects. Besides, a related neural network mapping development, often used in solving the same kind of problem, is intentionally introduced in the paper for comparison. A performance investigation in both developments arise to seek an excellent methodology to deal effctively and efficiently with the activity detection. The comparison causally confirms the direct template matching based method DTW is superior in detecting temporally a matched activity from a continuous signal sequence source. DTW has thus been recommended to incorporate with the electronically assistive IMU device for monitoring specifically risky motions of the people who are under remote healthcare.

#2492 Efficient DVFS based Energy Saving Scheme for Video Processing Applications of Mobile Healthcare Systems

Yen-Lin Chen (TW), Ming-Feng Chang (TW), Wen-Yew Liang (TW), Hsin Han Chiang (TW), Tsu-Tian Lee (TW)

Energy efficiency, at the present time, becomes an important consideration in computer software engineering. Dynamic voltage and frequency scaling (DVFS) is an efficient approach for reducing CPU power consumption. This paper exploits DVFS technique to schedule the frame tasks to cores with higher or lower VF settings depending on a task's time-varying compute intensity. The DVFS based scheduling scheme minimizes the number of voltage and frequency transition as possible to solve the limitation of traditional DVFS for multicore systems. The proposed DVFS based scheduling scheme can improve the energy consumption by 9% to 16% with great speedup for parallel execution. This proposed scheme can effectively improve the energy saving efficiency of video processing applications for mobile computing and healthcare systems.

#1233 Cardiovascular Risk Prediction based on Retinal Vessel Analysis using Machine Learning

Karma Mohamed Fathallah (EG), Aniko Ekart (GB), Swathi Seshadri (GB), Doina Gherghel (GB)

Cardiovascular risk prediction is a vital aspect of personalized health care. In this study, retinal vascular function is assessed in asymptomatic participants who are classified into risk groups based on Framingham Risk Score. Feature selection, oversampling and state-of-the-art classification methods are applied to provide a sound individual risk prediction based on RVA data obtained by non-invasive methods. The results indicate that the RVA based cardiovascular risk prediction models are competitive with well established Framingham and Qrisk based models.

#1692 Characterizing Human Perception of Emergent Swarm Behaviors

Phillip Walker (US), Michael Lewis (US), Katia Sycara (US)

Human swarm interaction (HSI) involves operators gathering information about a swarm's state as it evolves, and using it to make informed decisions on how to influence the collective behavior of the swarm. In order to determine the proper input, an operator must have an accurate representation and understanding of the current swarm state, including what emergent behavior is currently happening. In this paper, we investigate how human operators perceive three types of common, emergent swarm behaviors: rendezvous, flocking, and dispersion. Particularly, we investigate how recognition of these behaviors differ from each other in the presence of background noise. Our results show that, while participants were good at recognizing all behaviors, there are indeed differences between the three, with rendezvous being easier to recognize than flocking or dispersion. Furthermore, differences in recognition are also affected by viewing time for flocking. Feedback from participants was also especially insightful for understanding how participants went about recognizing behaviors—allowing for potential avenues of research in future studies.

Collaborative Technologies and Applications (I)

Organizers: Weiming Shen, Jean-Paul Barthes, Junzhou Luo, Amy Trappey, Jano de Souza
October 11 (Tuesday), 09:30-11:00, Sofitel Budapest Chain Bridge, Academy 4
Session Chairs: Weiming Shen, Amy Trappey

#1459 E-MRO Service Policy with Bilateral Requirements using Variable Fuzzy Recognition and Multi-objective Programming

Ling Li (CN), Min Liu (CN), Weiming Shen (CA), Guoqing Cheng (CN)

Motivated by the challenges of seeking the optimal E-business based maintenance, repair and overhaul (E-MRO) service policy, simultaneously considering bilateral requirements of quality of service (QoS), this paper presents a mathematical model based on variable fuzzy recognition and multi-objective programming. Cloud model is utilized to quantify the information of bilateral requirements as the numerical values. Then, the comprehensive satisfaction of multiple attribute is calculated by using variable fuzzy recognition method. Based on bilateral satisfactions, a multi-objective programming model is formulated, where bilateral QoS satisfactions are modeled as objective functions. By using global criteria method, the multi-objective optimization is transformed to an equivalent single objective optimization, which can be solved by LINGO. Finally, the optimal E-MRO service policy satisfying bilateral requirements is obtained. A case study illustrated the feasibility and efficiency of the proposed model.

#1796 Service architecture and evaluation model of distributed 3D printing based on cloud manufacturing

Yinan Wu (CN), Gongzhuang Peng (CN), Lu Chen (CN), Heming Zhang (CN)

3D printing is a kind of important method in the field of rapid prototyping and customized production. In order to achieve the purpose of production integration and product customization of 3D printing, this paper propose a 3D printing cloud integrated platform architecture based on cloud manufacturing. Moreover, how to evaluate and select the services of different distributed 3D printing terminals in cloud platform also requires further in-depth study. To address this issue, a service evaluation model of distributed 3D printing based on cloud manufacturing is designed and proposed in this paper. This model can be used to characterization the evaluation information of each dimension by fuzzy theory, and the evaluation results of the service can be accurately quantified by fuzzy number operation. The illustrative example show that the model and the evaluation method can effectively quantify the service quality, improve the quality and accuracy of services selection.

#1857 A Fine-Grained Permission Control Mechanism for External Storage of Android

Feiqiao Huang (CN), Wenjia Wu (CN), Ming Yang (CN), Junzhou Luo (CN)

Android lacks fine-grained permission control for the external storage. Under the current coarse-grained mechanism, any application is able to access all the data on the external storage very easily. At the same time, many applications store sensitive data into the external storage, and some of these data are highly concerned with user privacy, which could bring severe security problems. In this paper, we propose a fine-grained permission control mechanism for external storage of Android. The mechanism is based on Filesystem in Userspace (FUSE) and offers the following features: protecting user private media files such as photos and videos; isolating the data of each application; providing access control settings for user. We implement this mechanism on the latest Android version, by introducing a new type of GID (ESDS-GID), extending the functionality of the emulated filesystem as well as the system services. The results of functional verification and performance benchmark show that with a reasonable performance overhead which doesn't affect user experience, this mechanism brings considerable enhancement for Android system security.

#1858 An Advanced Collaborative Environment for Software Development

Gregory Moro Puppi Wanderley (FR), Marie-Hélène Abel (FR), Jean-Paul Barthes (FR), Emerson Cabrera Paraiso (BR)

Collaborative software development is a complex activity. An important factor that needs to receive attention in collaborative software development is software quality. High quality software reduces the development and the maintenance; improves delivery schedules; and reduces repairs and rework. In order to measure, evaluate, control and improve the software quality, software metrics can be used. In this research we present an advanced collaborative environment for software development currently being built, called ACE4SD, which intends to support the improvement of the code quality during collaborative software development. ACE4SD is a system of systems composed of a software development environment, a multi-agent system and a platform to capitalize and manage knowledge, all of them being integrated in the same environment. ACE4SD can provide personalized support to team members to improve the code quality and encourage its reuse, it can answer questions or doubts arisen during the development, record document problems and solutions, and improve the awareness and collaboration between the participants.

#1905 A Two-Phase Strategy with Micro Genetic Algorithm for Scheduling Multiple AGVs

Yanjun Shi (CN), Xianchao Wang (CN), Sun Xueyan (CN), Rong Xie (CN), Zheng Xiaojun (CN)

We herein try to schedule multiple AGVs in real time with two-phase strategy in the flexible manufacturing workshops. This study considers the impact of running time, vehicle stopping and turning of AGVs, and deal with static workshop scheduling, real-time shop scheduling with time-window based micro genetic algorithm. And we present a two-stage scheduling strategy for offline shortest path library generation and online optimal scheduling scheme generation. The preliminary experimental results showed the efficiency and stability of the proposed strategy and algorithm for Multiple AGVs system.

Collaborative Technologies and Applications (II)

Organizers: Weiming Shen, Jean-Paul Barthes, Junzhou Luo, Amy Trappey, Jano de Souza
October 11 (Tuesday), 11:00-12:30, Sofitel Budapest Chain Bridge, Academy 4
Session Chairs: Jean-Paul Barthes, Jano de Souza

#1961 A Flexible Architecture for Selection and Visualization of Information in Emergency Situations

Bruno Santos Nascimento (BR), Adriana Santarosa Vivacqua (BR), Marcos Borges (BR)

Emergency command and control centers (CC) are integrated facilities to assist and handle crisis situations. In these CCs, operators suffer both with information shortage and overload. This paper focuses on the information overload problem. Operators often do not have adequate access to information that may be relevant in the decision-making process. In many CC centers, information is stored without filtering or refinement for later use, and its visualization is pre-defined at design time, offering no possibility of customization. To address the problems created by this lack of support, we propose an architecture to enable fast and easy selection from multiple information sources, and definition of appropriate visualizations. Following this architecture, we developed the “Emergency Dashboard”, a system that provides selection of a desired set of data and presents it, using configurable dashboards. We also provide collaborative mechanisms, given that, at times, it is not possible for a single user to handle such large datasets alone.

#2091 Understanding the Resource Positioning Methods that Support Mobile Collaboration

Sergio Ochoa (CL), Daniel Antonio Moreno (CL)

Many mobile collaborative applications use resource positioning to provide services to end-users. Depending on the features of the collaboration activity to be supported, some positioning methods are more suitable than others. Despite the large research done in this area, it is not clear which positioning method is more appropriate to support a particular collaboration activity. This paper presents a survey of positioning methods that can be used to support mobile collaboration. It also characterizes and compares these methods in order to determine which ones are more suitable, depending on the type of activity to be supported. This information helps software designers make this decision when they are conceiving a new mobile collaborative system.

#2183 A Client-Side Directory Prefetching Mechanism for GlusterFS

Zijian Liu (CN), Fang Dong (CN), Zhang Junxue (CN), Pengcheng Zhou (CN), Zhuqing Xu (CN), Junzhou Luo (CN)

Distributed file system has the characteristics of large capacity, good scalability and high reliability, which make it widely used in many areas involving large-scale data storage. It offers simplified, highly-available services for users to access data. However, due to the non-metadata design, the performance of traversal operation on large directories in those non-metadata distributed file systems is poor. With the increasing amount of files, it severely affects the user experience. In this paper, we present a directory prefetching mechanism on the client side to reduce directory traversal operation latency in non-metadata distributed file system. The mechanism, combined with the client’s cache, adopts the directory access history to predict future access pattern and fetches the content of the directory without user intervention. Our goal is to reduce the overall access latency in the non-metadata distributed file system in order to better satisfy the user experience.

#2267 Open Product Design and Production in IoT-enabled Manufacturing Cloud

Chen Yang (CN)

Customized/personalized products are gaining more shares in today’s product market. Such products need collective efforts from consumers, manufacturers and third parties. On the other side, the Internet of Things (IoT) with pervasive sensing/actuating/networking ability greatly facilitates remote operation of manufacturing activities and efficient collaboration among stakeholders. This provides great opportunities to the above demand. Thus we propose a full-connection model of product lifecycle in the IoT-enabled cloud manufacturing environment. The model uses social networks to connect multiple parties and facilitate open innovations, IoT to glue physical space to cyber space and cloud manufacturing to provide various elastic services, so that the on-demand workspace, interaction, information sharing or collective problem solving are enabled. We also propose a supporting infrastructure for this model using the latest information and communication technologies. Finally, we present a RFID (Radio-frequency identification) enabled production system for customized/personalized products with the ability to enable a new paradigm of “dynamic processes and close collaborations among different roles” and secure robust production.

#2427 A Fault Prediction Method Based on Modified Genetic Algorithm Optimized BP Neural Network

Qing Liu (CN), Min Liu (CN), Feng Zhang (CN), Weiming Shen (CA)

In order to improve fault forecasting model accuracy of back propagation neural network (BPNN), an improved prediction method of optimized BPNN based on Multilevel Genetic Algorithm (MGA) was proposed. We design new chromosome with multilevel structure, improve the encoding mode, fitness function and genetic operator. Which can optimizes the initial values of weights, thresholds and the structure of BPNN synchronously. Enhancing the ability of nonlinear learning and generalization of BPNN. Case study of continuous casting equipment verified that the proposed model with higher prediction accuracy is better than classical BPNN and GA-BPNN prediction method for fault prediction.

Collaborative Technologies and Applications (III)

Organizers: Weiming Shen, Jean-Paul Barthes, Junzhou Luo, Amy Trappey, Jano de Souza
October 11 (Tuesday), 14:00-15:30, InterContinental Budapest, Duna Salon IV
Session Chairs: Junzhou Luo, Weiming Shen

#2474 Exploring asymmetric collaboration in social news curation

Daniel Schneider (BR), Jano Moreira de Souza (BR)

We report on the second design cycle of Acropolis, a social computing platform that allows citizens to build and share their own narratives about long-running news stories. A key goal of this research project is to explore the following design opportunity: how can we re-design news stories in order to engage citizens in their reading and curation? In this paper, we describe an asymmetric collaboration approach to engage the crowd of citizens in social news curation. We conclude with the description of a quantitative evaluation conducted during the second design cycle that yielded very encouraging results.

#1939 Collective Motion of Self-Propelled Particles without Collision and Fragmentation

Chenlong He (CN), Zuren Feng (CN), Zhigang Ren (CN)

In this paper, we propose a novel model to generate collective motion of self-propelled particles without collision and fragmentation by means of adjusting the absolute velocity instead of the constant speed used in the original Vicsek model. Interactions among particles are represented by the r-limited Delaunay graph to guarantee the locality of the model. The centroid of the Voronoi cell is set as a destination to scatter particles. The formation of the group is controlled by the surface tension generated by particles on the boundary. Without noise and periodic boundary, given a collision-free and cohesive configuration initially, the abundant types of collective motion emerge from the local behaviors. Numerical simulations demonstrate that our model can produce rich behaviors such as crystallization, rotation, flocking and cluster with different combinations of two coefficients adjusting the amplitude of centering force and surface tension, respectively. Collisions among particles and fragmentations of the group do not appear.

#1610 Temporal and Agent Abstractions in Multiagent Reinforcement Learning

Danielle Marie Clement (US), Manfred Huber (US)

A major challenge in the area of multiagent reinforcement learning has been addressing the problem of scale, more specifically the fact that increasing the number of agents in a system dramatically increases both the cost of representing the problem and the cost of calculating a solution. In single agent systems, temporal abstractions in the form of options have been used to address part of the scaling problem, but only limited work exists for multiagent systems, largely limited to cooperative games. This paper presents a formalization of options for multiagent systems and introduces a framework for agent abstraction that treats coalitions executing options analogously to agents with policies, resulting in a lower-dimensional game whose equilibria approximately correspond to equilibria in the higher dimensional game.

#1490 A Systems-theoretic Approach to Early Concept Development

Cody H Fleming (US)

The so-called ilities" of a system – such as safety, interoperability, and efficiency – should be designed into systems from their very conception, which can be achieved by integrating more powerful analysis techniques into the general systems engineering process. The primary barrier to achieving this objective is the lack of effectiveness of the existing analytical tools during early concept development. This paper introduces a new technique, which is based on general systems theory and hierarchical control theory, that can capture behaviors that are prevalent in complex human- and software-intensive systems. This paper presents a new technique that supports rigorous, systematic analysis of future concepts in order to identify potentially adverse scenarios and undocumented assumptions that may inhibit mission objectives. Furthermore, these techniques are intended to address issues associated with the interaction, integration, and coordination of agents with heterogeneous decision-making capability and qualities, varying levels of automation, and changing roles of human operators."

#2298 Torque Reflecting Coordination Control Interface for Bilateral Shared Autonomous System Over Open Communication Network

Shafiqul Islam (CA), Dias Jorge (PT), Lakmal Seneviratne (AE)

In this paper, state and torque reflection based robust coordination control interface is designed for network based bilateral shared autonomous under asymmetrical delay and uncertainty. The control interaction interface for master and slave manipulator is designed by combining delayed position and velocity signal with the delayed reflected torques from the interaction between human and master and between slave and environment. Robust adaptive control technique is used to deal with uncertainty associated with the gravity, unmodeled dynamic and other external input disturbance. By using Lyapunov method, the convergence of the closed loop system is shown. In contrast with existing force/torque reflection based design, the proposed control interface can deal with uncertainty associated with the gravity, unmodeled dynamic and external input disturbance. Compared with other methods, the proposed interface uses reflected torques from the interaction between master and human and between slave and environment improving the transparency of the bilateral shared autonomous system. Finally, evaluation results are presented to demonstrate the validity of the proposed design for real-time applications.

Networked Systems and Networked Control (I)

Organizers: Lixian Zhang, Huijun Gao, Okyay Kaynak
October 12 (Wednesday), 16:00-17:30, InterContinental Budapest, Panorama I
Session Chairs: Lixian Zhang, Huijun Gao

#1048 Pth moment exponential stability for impulsive stochastic delayed neural networks

Yang Tang (CN), Xiaotai Wu (CN), Wenbing Zhang (CN)

This paper is concerned with pth moment exponential stability of stochastic delayed neural networks. By using the Lyapunov function method, some stability criteria of impulsive stochastic delayed systems are obtained, and these results are applied to the study on the stability criteria of stochastic delayed neural networks. It is shown that if the continuous stochastic delayed neural network is stable and the impulsive effects are destabilizing, then the stochastic delayed neural network is exponentially stable with respect to a lower bound of the impulsive interval. Moreover, if the continuous stochastic delayed neural network is not stable, the impulsive effects can successfully stabilize the delayed neural network for a given upper bound of the impulsive interval. One example is presented to demonstrate the usefulness of the proposed results.

#1089 An H-infinity approach to Fault detection for Multirate Sampled-data Systems with Frequency Specifications

Shengri Xue (CN), Shen Yin (CN), Huijun Gao (CN)

The target of the article is to solve the problem of fault detection for a multirate sampled-data system with frequency specifications. And the multirate condition considered in this article is that different channels of both the inputs and the outputs have different sampling rates. This paper aims to solve this fault detection problem with using a fault detection filter to make the residual system satisfy a given disturbance attenuation level over a restricted frequency range. The problem is solved via reformulating the multirate sampled-data system with extended inputs and outputs and utilizing the generalized Kalman-Yakubovi˘c-Popov lemma to deal with the restricted frequency specifications. Finally, we use an example to illustrate the design procedure and show the advantages of the proposed method.

#1140 Cloud-Aided Moving Horizon State Estimation of A Full-Car Semi-Active Suspension System

Xunyuan Yin (CA), Lixian Zhang (CN), Zhaojian Li (US)

In this work, we investigate a state estimation problem for a full-car semi-active suspension system. To account for the complex calculation and optimization problems, a vehicle-to-cloud-to-vehicle (V2C2V) scheme is utilized. Moving horizon estimation is introduced for the state estimation system design. All the optimization problems are solved in a remotely embedded agent with high computational ability. Measurements and state estimates are transmitted between the vehicle and the remote agent via networked communication channels. The effectiveness of the proposed method is illustrated via a set of simulations.

#1282 Fault-tolerant consensus for a group of double-integrator agents communicating over directed topology

Gaosheng Zhang (CN), Jiahu Qin (CN), Yu Kang (CN), Wei Xing Zheng (AU)

This paper studies the fault-tolerant consensus problem for second-order multi-agent systems with actuator faults and strongly connected topology. The proposed fault-tolerant consensus protocol is an active fault-tolerant control strategy which consists of a nominal control and an estimation of fault severity. To solve the fault-tolerant consensus problem, a Lyapuov method is employed based on the algebraic connectivity of strongly connected digraph. The results show that the consensus will be achieved if the nominal control is designed properly and the estimation of actuator fault is within a certain accuracy. Finally, a simulation example is given to demonstrate the validity of the theoretical results.

#1345 Periodic Model Predictive Control of Multi-Hop Control Networks

Dai Satoh (JP), Koichi Kobayashi (JP), Yuh Yamashita (JP)

In this paper, a new method of model predictive control (MPC) for a multi-hop control network (MHCN) is proposed. An MHCN is a control system in which plants and controllers are connected through a multi-hop wireless network. In the proposed method, (i) control inputs and (ii) paths used in transmission of control inputs are computed with constant period by solving the finite-time optimal control problem. First, a mathematical model for expressing an MHCN is proposed. This model is given by a switched linear system, and is compatible with MPC. Next, the finite-time optimal control problem using this model is formulated, and is reduced to a mixed integer quadratic programming problem. Finally, a numerical example is presented to show the effectiveness of the proposed method.

Networked Systems and Networked Control (II)

Organizers: Lixian Zhang, Huijun Gao, Okyay Kaynak
October 12 (Wednesday), 17:30-19:00, InterContinental Budapest, Panorama I
Session Chairs: Huijun Gao, Lixian Zhang

#1698 Asynchronous H-infinity Stabilization of Switched Systems with Overlapped Time-Varying Detection Delays

Yu Ren (CN), Meng Joo Er (SG), Guanghui Sun (CN)

This paper is concerned with the asynchronous H-infinity state-feedback stabilization problem for a class of switched linear systems with detection delays. Without lose of generality, the switched signal is considered to satisfy dwell time switching. Time-varying overlapped detection delay, which is allowed to be overlapped with others and much more challenging than the detection delay of overlapped-free, is introduced. By establishing the stability of the considered autonomous system, controller is designed such that the closed-loop nominal system is globally uniformly exponentially stable. Stabilization controller, which has an H-infinity disturbance attenuation performance, is further designed for the considered systems with additive disturbance. A numerical example is provided to illustrate the theoretical developments.

#2431 Stability and Stabilization of Polynomial Fuzzy Time-delay Systems under Imperfect Premise Matching

Li Li (CN), Hongwei Xia (CN), Qinghua Zhu (CN), Yanmin Wang (CN), Changhong Wang (CN)

This work focuses on stability analysis and stabilization synthesis problem for a class of Takagi-Sugeno (T-S) polynominal fuzzy-model-based time-delay systems based on the sum-of-squares (SOS) approach. Firstly, a novel stability criterion is proposed based on Lyapunov stability theorey, which is less conservative as the information of the membership functions is included in the stability conditions. Then, a new fuzzy controller with greater design flexibility to stabilize the colsed-loop system is developed. Finally, a simulation example is provided to illustrate the effectiveness of the proposed design methods.

#2432 Stability Analysis and Stabilization for T-S Fuzzy Time-delay Systems with Mismatched Premise Membership Functions

Li Li (CN), Hongwei Xia (CN), Liu Jianwei (CN), Ren Jiadong (CN), Ma Guangcheng (CN)

The stability analysis and control design problem of Takagi-Sugeno (T-S) fuzzy time-delay systems under mismached premise membership functions is investigated in this paper. A membership function dependent stability criterion is derived first based on Lyapunov stability analysis method. As the information of the membership functions is included in the derived criterion, it is less conservtive than those of independent ones. Then, a fuzzy controller is derived to stabilize the corresponding closed-loop system. All the conditions in this paper is described in linear matrix inequalities (LMIs) frame that can be handled numerically. Finally, some numerical examples are presented to indicate the effectiveness of our approach.

#1197 Finite-Time Topology Identification And Function Projective Synchronization Of Cohen-Grossberg Neural Networks With Time Delays And Stochastic Disturbance

Min Han (CN), Yamei Zhang (CN)

We studied finite-time function projective synchronization of unknown delayed Cohen-Grossberg neural networks with stochastic disturbance. A hybrid control scheme is proposed to let the drive- response networks synchronize and have a scaling function relation in finite time with topology identification by using the finite-time stability theory. Furthermore, we estimate the high bounds of the synchronization settling time. Finally, the corresponding numerical simulation and its application in secure communication are provided to verify the correctness of the method we proposed.

Tensor Product Applications

Organizers: Levente Kovács, Péter Galambos
October 12 (Wednesday), 11:00-12:30, InterContinental Budapest, Duna Salon II
Session Chairs: Levente Kovács, Peter Galambos

#1970 Non-simplex Enclosing Polytope Generation Concept for Tensor Product Transformation based Controller Design

József Kuti (HU), Peter Galambos (HU), Peter Zoltán Baranyi (HU)

In polytopic model-based controller synthesis, the vertices of the model determine the achievable performance characteristics. This paper introduces a new concept, that allows for the sophisticated construction of non-simplex enclosing polytopes. The non-simplex structures in general, have much better descriptor properties than the simplex one that leads to less conservative synthesis. The paper demonstrates the workflow of controller design for a nonlinear system through the example of the TORA (Translational Oscillator with a Rotational Actuator) system. The numerical results clearly show that the proposed approach is capable of excluding non-stabilizable regions located between the exact convex hull and the enclosing simplex. The non-simplex polytope leads to an increased number of vertices but it practically does not influence the viability of Tensor-Product (TP) formalization and the feasibility of controller design while the achievable control performance can be improved significantly.

#2303 Minimum LTI Exact Representation of Multi-Parameter-Dependent Systems

Patricia Grof (HK), Yeung Yam (HK)

The aim of this paper is to propose a method that generates the minimum number of linear time-invariant systems (LTIs) used in an affine set to determine any parameter-dependent nonlinear system. The implication is to reduce the order of LTIs containing core tensor, as it can be quite large in the case of a big number of parameters, as previously every parameter was added to the parameter-space in a new dimension. Therefore, this work introduces a joint higher order singular value decomposition and canonical polyadic decomposition (CPD) to derive LTIs and a joint minimum volume simplex analysis CPD decomposition to obtain the convex polytopic model. The results are demonstrated on the example of three degrees of freedom aeroelastic wing section.

#2304 Simplification on a Kinetic Model Network Related to Hydrogen Peroxide Metabolism in Human Erythrocytes

Patricia Grof (HK), Yeung Yam (HK)

The paper discusses how the Tensor Product struc- ture is useful to simplify kinetic models of biological networks and provides basic mathematical tools one can start the kinetic model with. The applied method known as joint HOSVD-CPD decomposition is helpful to identify latent parameters, this work is utilizing it to determine the role of different parameters in a biochemical reaction. A case study is presented demonstrating the results on peroxiredoxin I / thioredoxin / thioredoxin reductase system, as peroxiredoxins might have an important role in cancer modulation. After the transformation, it is clearly shown, which equation is taking part in the reaction, and what are the parameters the network depends on.

#2310 Kronecker Product Approximation with Multiple Factor Matrices via the Tensor Product Algorithm

King Keung Wu (HK), Yeung Yam (HK), Helen Meng (HK), Mehran Mesbahi (US)

Kronecker product (KP) approximation has recently been applied as a modeling and analysis tool on systems with hierarchical networked structure. In this paper, we propose a tensor product-based approach to the KP approximation problem with arbitrary number of factor matrices. The formulation involves a novel matrix-to-tensor transformation to convert the KP approximation problem to a best rank-(R1,...,RN) tensor product approximation problem. Besides, we develop an algorithm based on higher-order orthogonal iteration to solve the tensor approximation problem. We prove that the proposed approach is equivalent to conventional singular value decomposition-based approach for two matrices case proposed by Van Loan. Hence, our work is a generalization of Van Loan's approach to more than two factor matrices. We demonstrate our approach by several experiments and case studies. The results reveal that the tensor product formulation can effectively achieve the KP approximation objective.

#1407 Modeling and Control of Urban Expressways with Emergency using Hybrid Petri Nets

Yaying Zhang (CN), YueFeng Fu (CN)

The urban expressway model based on hybrid petri nets is proposed. With the traffic detecting cameras and coils, the strategies of traffic signal lights and warning lights are enforced aiming to prevent the large-scale congestion in emergencies (e.g. accidents). The simulation results verify the effectiveness of the proposed model and the warning light strategy is demonstrated to be suitable for the controlling of accident-prone weaving sections in the urban expressways.

Model-based Healthcare (I)

Organizers: Levente Kovács, Hamido Fujita, Clara M. Ionescu
October 12 (Wednesday), 14:00-15:30, InterContinental Budapest, Duna Salon II
Session Chairs: Levente Kovács, Clara M. Ionescu

#1147 Design and Implementation of a Patient-specified Cognitive Engine for Robotic Needle Insertion

Xiaoyu Tan (SG)

In order to develop an effective and user-friendly control method for surgical robotic system, we propose a new framework of cognitive engine to supervise and regulate the surgical processes. The framework aims to make the surgical processes understandable by both human operators and robots. A prototype cognitive engine was implemented using ontology and SPARQL query language on JAVA and tested in ex-vivo phantom experiments with a robotic RF needle insertion system. The prototype cognitive engine has successfully guided the robot in execution of surgical procedures.

#1373 Feature Analysis on Heart Failure Classes and Associated Medications

Tun-Wen Pai (TW)

Heart failure (HF) is a major public health problem with an increasing prevalence that has tremendous impact to patients all over the world. However, the signs and symptoms of HF in early stages are not clear, so it is relatively difficult to prevent or predict. HF is also one of complicated diseases, there are yet no strict standards to classify various types of HF patients due to various tendencies in each cause. To discover new evidences and associated medications for each type of HF based on some known features, we primarily divided patients into four major subgroups including systolic, diastolic, valvular, and non-specific types. We have performed statistical analysis and prediction validation according to several selected features for each clustered group from CGMH patient medical records. The constructed reference models could provide necessary measurements and prognosis indications for HF patients to prevent from deterioration. Based on analyzing medication records from all HF patients, we also applied SVM tools to train and classify the associations for different type of HF patients. The predicted results achieved an accuracy rate of 75.26% through a 10-folds cross validation mechanism. In addition, the proposed system effectively predicted patient's survival year and life expectancy with accuracy rates between 80%-87% under different parameter settings.

#1495 Glucose control with incomplete information

Alessandro Borri (IT), Simona Panunzi (IT), Pasquale Palumbo (IT), Costanzo Manes (IT), Andrea De Gaetano (IT)

This paper addresses the problem of glucose control in the presence of sampled measurements. This topic is important in the study and development of the Artificial Pancreas (AP), which is a general expression to describe a set of techniques for the control of the glucose behaviour by means of exogenous insulin administration in diabetic individuals. Differently from most of the approaches available in the literature, we not only assume the lack of insulin measurements, but also the availability of the glucose measurements just at sampling times. An observer is designed for the model-based reconstruction of glucose and insulin trajectories from the glucose samples. On top of that, a feedback algorithm (based on the estimated state) is designed to continuously deliver exogenous intra-venous insulin to the patient. Simulations have been performed in-silico on models of virtual patients identified from real data and in the presence of quantization errors. The preliminary results highlight the potential of the proposed approach.

#1756 Modelling for control of hypnosis - a patient friendly approach

Clara M. Ionescu (BE), Dana Copot (BE), Robin De Keyser (BE)

This paper presents in essence a mathematical framework for over-simplification of pharmacodynamic models to capture drug effects in humans. A large representative class of drugs are classically modelled by Hill equations, and a specific case is discussed in this paper. The proposed model is validated in simulation against a classical model of drug effect for a specific case of hypnotic drug used in general anaesthesia: Propofol. The results support the validity of the proposed model and allow further improvements in the current use of such models. Closed loop control simulations are also included in this paper to further support our claims.

#1312 Algorithms for drawing weakly meshed distribution substation areas

Imre Lendak (CS), Nemanja Kovačev (CS)

This paper presents an algorithm for one line diagram generation of multiple interconnected, i.e. weakly meshed, feeders supplied by one distribution substation. The substation area is modeled with a mathematical graph, which is then prepared and drawn in multiple steps. A node propagation algorithm is applied starting at the substation node to traverse the whole graph and disconnect interconnected feeders at normal open points (NOP), thereby creating a graph without loops. In the second step, the optimal feeder ordering is determined by the genetic algorithm (GA) based on the analysis of NOPs. In the third step each feeder is visualized recursively, with respect to the sub-graph direction based on NOPs. In the fourth and last step the NOPs are reconnected with orthogonal edges, and by inserting artificial nodes wherever necessary. The algorithm was tested on multiple, weakly meshed distribution substation areas extracted from several different European-style distribution network models. It generated visually pleasing one-line diagrams for systems with more than 1000 objects. The quality of the generated one-line diagrams was assessed by a formula, which took into account different characteristics, e.g. diagram area, total edge length, number of crossings.

Model-based Healthcare (II)

Organizers: Levente Kovács, Hamido Fujita, Clara M. Ionescu
October 12 (Wednesday), 16:00-17:30, InterContinental Budapest, Duna Salon II
Session Chairs: Levente Kovács, Clara M. Ionescu

#2169 Modelling xenograft tumor growth under antiangiogenic inhibitation with mixed-effects models

Tamás Ferenci (HU), Johanna Sápi (HU), Levente Kovács (HU)

Antiangiogenic inhibitors offer a promising new treatment modality in oncology. However, the optimal administration regime is often not well-established, despite the fact that it might have substantial impact on the outcome. The aim of the present study was to investigate this issue. Eight weeks old male C57Bl/6 mice were implanted with C38 colon adenocarcinoma, and were given either daily (n=9) or single (n=5) dose of bevacizumab; both receiving the same dose the only difference being the administration pattern. Outcome was measured by tracking tumor volume; both caliper and magnetic resonance imaging was employed. Longitudinal growth curves were modelled with mixed-effects models (with correction for autocorrelation and heteroscedasticity, where necessary) to infer on population-level. Several different growth models (exponential, logistic, Gompertz) were applied and compared. Results show that the estimation of the exponential model is very reliable, but it prevents extrapolation in time. Nevertheless, it clearly established the advantage of the continuous regime.

#2349 Haptic feedback tuning in colonoscopy simulation

Cedric Dumas (FR), Timothy Coles (AU), Hans de Visser (AU), Caroline Cao GL (US), Florian Grimpen (AU)

According to medical experts, haptic realism is difficult to achieve, and even more difficult to have inter-expert agreement on the haptic feedback of one simulation. However haptic feedback is important in medical training, and al-lows educators to share the forces felt during a procedure if they know and trust what a particular virtual simulator will provide to the trainee. A new ap-proach is proposed to refine bio-mechanical models with experts' input, to closely match the forces felt during a simulated procedure with an expert trainer's expectations. By allowing experts to tune a training scenario's haptic feedback as they trial a newly developed case, the experts can replicate their haptic perception and match their expectations with the simulation.

#1971 A New Metaheuristic for the Home Health Care Problem: Caregivers Tours and Conflict Visits

Brahim Issaoui (TN)

In this paper, we try to improve health care services by treating the variation among several issues related to the health field, particularly the Home Health Care Problem (HHCP). In fact, Home Health Care Service (HHCS) is known as a care mode allowing patients who suffer from complex and evolving diseases to benefit at home from medical and paramedical coordinated care that can be only provided in hospitals. In this work, we treat the Caregivers' Tours Problem (CTP) and conflict management sanitary visits to patients' homes. We developed a new three-phase metaheuristic, which optimizes both the daily caregivers' tours to minimize the travel costs and maximizes the planned services in order to address potential conflicts. The obtained numerical results, compared with those provided by the other existing approaches, are motivating and encouraging.

#1392 Interactive Augmented Reality Authoring System using Mobile Device as Input Method

Yoonsik Yang (KR), Jinwook Shim (KR), Seungho Chae (KR), Tack-Don Han (KR)

The proposed system is a user-friendly interactive Augmented Reality Authoring System, which is for users with basic knowledge of augmented reality or without programming skills. The user can wear the head-mounted display and easily create AR content by using sensors on mobile devices. The user can also directly apply a variety of methods to interact with the AR content. Interaction with the AR content is enabled by using the user's hand, which is recognized by the camera attached to the HMD, and the mobile device's sensor data. In order to evaluate the effectiveness of the proposed system, a system prototype was presented to users. A usability test was conducted with regard to AR content production and interactive tasks.

#1298 Order Interface Model for Individuals With Down Sydrome and Emotion Analysis

Nigar Tugbagul Altan Akin (TR), Mehmet Gokturk (TR)

Individuals with Down syndrome should be adapted to society. As there are various projects to achieve this goal, one of them is establishing cafes where all waiters/waitresses are individuals with syndrome. The Down Cafe is the one of these cafes that is located in Istanbul, Turkey. In such cafes, some of the tasks are quite hard to be performed by individuals with syndrome, such as taking orders. The waiters/waitresses with Down syndrome need assistance by their voluntary mothers for such tasks, thus it is actually performed by their voluntary mothers. In this study, a novel user interface is modeled for individuals with Down syndrome to take orders. We then analyzed their emotion mode as they are using the prototype. The interface was tested with existing down café aiters/aitresses and findings were reported. We concluded that using novel assistive user interfaces for people with disabilities, personal assistance by their voluntary caregivers can be minimized as self sufficiency and degree of rehabilitation improves.

Intelligent Internet of Things

Organizers: Xiang Su, Yuhong Li
October 11 (Tuesday), 11:00-12:30, InterContinental Budapest, Ballroom II
Session Chairs: Xiang Su, Yuhong Li

#1423 Enabling User-centered Interactions in the Internet of Things

Teemu Leppänen (FI), Ivan Sanchez (FI), Jilin Yang (FI), Joonas Kataja (FI), Jukka Riekki (FI)

We introduce a novel interaction method which integrates humans into Internet of Things and advances from the existing client-server paradigm. We take advantage of the shared physical space to facilitate decentralized and seamless human-to-thing, human-to-human and thing-to-thing interactions. We build these interactions upon two core technologies: mobile agents and NFC. Mobile agents realize autonomous execution of user-specific interaction tasks among things while facilitating cooperation and interoperability. Humans initiate and control interactions through physical actions that trigger communications, e.g. mobile agent migration, between NFC devices even over disparate systems. Human social relationships are utilized to disseminate tasks further in the IoT system. We discuss the benefits of this method in comparison with the common smartphone-based control of smart spaces. Real-world evaluation shows that this interaction method is feasible for resource-constrained embedded IoT devices.

#1719 Data and Control Points: A Programming Model for Resource-constrained IoT Cloud Edge Devices

Stefan Nastic (AT), Hong-Linh Truong (AT), Schahram Dustdar (AT)

Recent emergence of IoT Cloud systems has fostered proliferation of various applications mainly driven by urgent need to respond to volume, velocity and variety of data generated by IoT Cloud, but also to enable timely propagation of actuation decisions, crucial for business operation, to the Edge of the infrastructure. In such systems, utilizing currently untapped Edge resources such as sensory gateways, and enabling the IoT devices as first-class execution environments plays a crucial role. However, enabling virtually exclusive access to the underlying devices, e.g., field bus sensors and supporting flexible, application-specific customizations for such devices still remain a challenge. In this paper, we introduce Data- and Control Points - a novel programming model and framework for developing applications specifically tailored for resource-constrained Edge devices. Our framework offers programming constructs that enable applications to define custom configurations for and their own view of the underlying devices. By providing an illusion of an exclusive access to the underlying sensors and actuators, our framework supports execution of multiple applications within a single Edge device.

#1764 TM-IdleTimeout: Improving Efficiency of TCAM in SDN by Dynamically Adjusting Flow Entry Lifecycle

Meilian Lu (CN), Wei Deng (CN), Yan Shi (CN)

Ternary Content Addressable Memory (TCAM) is widely used for caching flow entries in Software Defined Network (SDN). However, limited by the current technology level and hardware cost, the capacity of TCAM is difficult to meet the needs for caching flow entries of large scale SDN, which would seriously affect the scalability of SDN. Aimed at the problem, some researches improve the efficiency of TCAM capacity by setting different lifecycle for different flow entries. Such as Openflow protocol proposed the default flow entry lifecycle, AHTM scheme dynamicly adjusted flow entry lifecycle according to the number of interrupted flows. However, these schemes didn't consider the dynamic features of network traffic in SDN, and hardly conform to the actual network demands. In order to effectively utilize TCAM capacity and thus enhance the scalability of SDN, we propose TF-IdleTimeout scheme to dynamically set flow entry lifecycle according to real-time network traffic in SDN-based data center network. Two criterion, called Flow Entry Missing Number and Flow Dropping Number, are used to evaluate the effect. The results show that, compared with existing schemes, TF-IdleTimeout scheme can greatly improve the utilization efficiency of TCAM capacity in SDN.

#2223 OAISIS: an Ontological-based Approach for Interlinking CrowdSensing Information Systems

Nouredine Tamani (FR), Aymen Gasmi (FR), Cyril Faucher (FR), Yacine Mohammed Ghamri (FR)

Nowadays, smartphones and wearable devices are endowed with several sensors, which can harvest large quantities of data about urban areas (location information, pollution levels, etc.), going through a list of personal and surrounding contexts such as noise level, traffic awareness, to name a few. Exploiting this wealth of information provided by the crowd allows developers to design and build several applications over the so-called Mobile CrowdSensing, such as traffic regulation, environmental monitoring, tourism recommendation, etc. However, for this to be possible, many barriers still have to be overcome such as collecting, handling, structuring and representing the crowd data in a suitable way. In this paper, we propose a three-fold solution to the problem of data management in CrowdSensing systems. Firstly, we structure the collected data based on semantic ontologies. Secondly, we enrich the data based on a novel contextual awareness data interlinking. Finally, we refine recommendations with contexts, through taking into consideration meta-information interlinked to the main information of interest. We have implemented our model in a tourism recommendation application as a proof of concept. The experimental evaluation -- which we carried out -- has shown very promising results.

#2237 QryGraph: A Graphical Tool for Big Data Analytics

Sanny Schmid (DE), Ilias Gerostathopoulos (DE), Christian Prehofer (DE)

The advent of Big Data has created a rich set of diverse languages and tools for data manipulation and analytics within the Hadoop ecosystem. The Pig language has a prominent role within this ecosystem as a scripting layer – a convenient way to create analytics jobs that are issued for batch processing in a Hadoop cluster. In order to leverage the benefits of graphical domain specific languages, namely intuitive visual design and inspection, we implemented a web-based graphical tool called QryGraph that complements Pig in various ways. First, it allows a user to create Pig queries in a graphical editor and check their syntax. Second, it allows for creating user-defined query sub- graphs that can be reused across different Pig queries. Third, it provides an administrative interface for managing the execution and overall lifecycle of Pig queries.

Advanced Methods and Applications for Increasing Control Systems Reliability, Safety and Security

Organizers: Emil Pricop, Masaki Samejima, Grigore Stamatescu
October 12 (Wednesday), 17:30-19:00, InterContinental Budapest, Duna Salon IV
Session Chairs: Emil Pricop, Masaki Samejima

#1075 Formal Reasoning on Authentication in Security Protocols

Jaouhar Fattahi (CA), Mohamed Mejri (CA), Ridha Ghayoula (CA), Emil Pricop (RO)

In this paper, we are proposing a new formal framework for reasoning on authentication in security protocols based on analytic functions. We give sufficient conditions that, if satisfied, the protocol is declared correct with respect to authentication. We validate our approach on the Yahalom-Lowe protocol. First, we show that it satisfies these few conditions, thus, we conclude that it is correct for authentication.

#2456 Sidelobe Level Reduction in Linear Array Pattern Synthesis Using Taylor-MUSIC Algorithm for Reliable IEEE 802.11 MIMO Applications

Elies Ghayoula (TN), Jaouhar Fattahi (CA), Ridha Ghayoula (CA), Emil Pricop (RO), Grigore Stamatescu (RO), Jean-Yves Chouinard (CA), Ammar Bouallegue (TN)

The concepts of array processing and smart antenna give a promising solution to the significant increase of data rates in wireless transmission systems. In this paper, we deal with the problem of designing linear antenna arrays for specific radiation properties of MIMO applications based on Direction-Of-Arrival estimation and Taylor beamforming techniques. The objectives of this paper can be summarized as to minimize the maximum sidelobe level (SLL), combined the Taylor method and MUSIC (Multiple Signal Classification) algorithm. The performance of this hybrid optimization determines how well the system is convenient for a reliable wireless communication and interference reduction. This paper will discuss the application of MUSIC algorithm for linear array antenna (4, 8 and 16 antennas) in order to estimate the Direction-Of-Arrival of various angles of elevation and azimuth.

#1941 Fuzzy Reduced Order Observer-Controller Design for Biomechanical Sit-to-Stand Movement

Asif Mahmood Mughal (PK), Kamran Iqbal (US)

Successful execution of biomechanical sit-to-stand (STS) task combines a forward thrust phase with an upward extension phase and stable movement termination. We have previously developed a fuzzy dynamic model to analyze the STS task by joining two local linear models, defined at the equilibrium positions, via Gaussian membership functions. The local linear models were obtained from a four-segment biomechanical representation of the human body dynamics in the sagittal plane. Our fuzzy controller model uses an observer to reconstruct velocity data from noisy observation of joint positions. In this study, we propose a reduced order observer with an optimal controller design for STS task. The fuzzy optimal controller generates feedback and feedforward components of joint torques, whereby the latter are derived from a reference trajectory. Our movement control strategy employing fuzzy reduced order observer with fuzzy controller leads to physiologically tractable simulation of the STS movement with results that are superior to those previously obtained with full order compensators.

#1168 Simple Kernel Search for Large Capacitated Facility Location Problems

Tze Ling Ng (HK)

Capacitated facility location problems (CFLPs) are a well-studied class of problems in the literature. They are mixed integer programs (MIPs) which are non-deterministic polynomial-time (NP) hard that, when the problem is large, require an excessive amount of time to solve to optimality using conventional branch-and-bound or branch-and-cut methods. This paper presents a simple kernel search for solving CFLPs. The algorithm requires only the ability to cast the problem as a sequence MIPs and to solve them using a packaged optimizer. This makes it easier to implement than other heuristics which, to run, require specialized knowledge and the specification of problem specific rules. Also, unlike many of the other heuristics, the simple kernel search is non-stochastic. Preliminary results comparing the algorithm to another kernel search for CFLPs show the simple kernel search to be the faster algorithm. While the results are promising, more testing is required to prove the advantage of the simple kernel search with greater confidence.

Recent Advances in Intelligent Image and Video Analysis

Organizers: Gerald Schaefer, Iakov Korovin
October 12 (Wednesday), 17:30-19:00, InterContinental Budapest, Duna Salon III
Session Chairs: Gerald Schaefer, Iakov Korovin

#1441 The Analysis of Measurement Capabilities Onboard Collinear Digital Stereo Vision Systems

Sergey Valentinovich Kravtsov (RU), Konstantin Rumyantsev (RU)

Presented the technique of the analysis of measurement capabilities of onboard collinear digital stereo vision systems. The approach determination of communication parameters of onboard digital stereo vision systems collinear with the parameters of the mobile platform movement is presented. The results of model calculations are given. The results may be useful for calculating the capabilities of the collinear onboard digital stereo vision system.

#2144 Historic Handwritten Manuscript Binarisation using Whale Optimisation

Ella Hassanien (EG), Mohamed Abd Elfattah (EG), Sherihan Aboulenin (EG), Gerald Schaefer (GB), Shao Ying Zhu (GB), Iakov Korovin (RU)

Preserving the content of historic handwritten manuscripts is important for a variety of reasons. On the other hand, digital libraries are rapidly expanding and thus facilitate to store this information directly in digital form. For digitising text documents, a crucial step is to binarise the captured images to separate the text from the background. In this paper, we propose an effective approach for binarisation of handwritten Arabic manuscripts which employs a whale optimisation algorithm, incorporating a fuzzy c-means objective function, to obtain optimal thresholds. Experimental results confirm the effectiveness of the proposed approach compared to earlier methods.

#2375 Classifying HEp-2 Cells in Immunofluorescence Images Using Multiple Kernel Learning

Gerald Schaefer (GB), Niraj P Doshi (GB), Iakov Korovin (RU), Shao Ying Zhu (GB)

Indirect immunofluorescence (IIF) imaging is an important technique for detecting antinuclear antibodies in HEp-2 cells and therefore employed in the diagnosis of autoimmune diseases and other important pathological conditions involving the immune system. Here, HEp-2 cells are categorised into different groups, which allow to make implications about different autoimmune diseases. Traditionally, this categorisation is performed manually by an expert and is hence both subjective and time intensive. In this paper, we present an effective method for classification of HEp-2 cells in which we first extract local binary pattern (LBP) texture features in form of multi-dimensional LBP (MD-LBP) histograms and then employ a multiple kernel learning approach to classification that integrates a multitude of support vector kernels generated by sampling the feature space. We evaluate our algorithm on the ICPR 2012 HEp-2 contest benchmark dataset, and demonstrate that our employed texture features are indeed useful for the differentiation of HEp-2 cells and that our multiple kernel learning based classification approach outperforms single kernel classification schemes. Our algorithm is shown to provide super performance compared to all techniques that were entered in the competition and to rival results obtained by a human expert.

#2362 Stable aerial image registration for people detection from a low-altitude aerial vehicle

Yumi Iwashita (JP), Yuki Takefuji (JP), Ryo Kurazume (JP)

In this paper, for the purpose of monitoring people moving on the ground from a low-altitude aerial vehicle, we propose a method for stable image stabilization using planar information of the ground. In existing methods the homography-based method has been popularly used for image stabilization. However, in case that captured images consist of non-planar areas, the performance of the homography-based method decreases. The essential-based method works well in this scene, but the accuracy gets worse in case that images mainly include planar areas. Thus in the proposed method, we utilize the Geometric Robust Information Criterion (GRIC) model to choose a method from the homography-based method or the essential-based method. After the selection of the method, we extract a planar area in the scene by fitting a plane using RANSAC, followed by detection of people on the ground with high accuracy. Experimental results confirm that the effectiveness of the proposed method.

#1818 Eyes Detection in Unrestrained Settings using Efficient Match Kernels and SVM Classification

Diego Benavides (BR), Dibio Leandro Borges (BR)

Eye detection is a front end problem to be solved efficiently by face detection and human surveillance systems. Features such as accuracy and computational cost are to be considered for a successful approach. We describe an integrated approach that takes the ROIs outputted by a Viola and Jones detector, constructs HOGs features on those and learn an special function to mapping these features to a higher dimension space where the detection achieves a better accuracy. This mapping follows the efficient kernels match approach which was shown possible but had not been done for this problem before. Linear SVM is then used as classifiers for eye detection from those mapped features. Extensive experiments are shown with different databases and the proposed method achieves higher accuracy with low added computational cost than Viola and Jones detector. The approach can also be extended to deal with other appearance models.

Intelligent Vehicle Systems and Control (I)

Organizers: Jianbo Lu, Tim Gordon, Hong Chen
October 10 (Monday), 13:30-15:00, Sofitel Budapest Chain Bridge, Academy 3
Session Chairs: Jianbo Lu, Tim Gordon

#1124 Driver Behavior Characterization using Multiple Dynamic Models

Sanghyun Hong (US), Jianbo Lu (US), Dimitar Filev (US)

Incorporating driver behavior information into vehicle control strategies can significantly improve performance of vehicle control systems, such as active safety systems and driver assistance systems. This paper proposes an algorithm for driver behavior characterization based on handling limits. In order to implement the handling limit-based algorithm, an interacting multiple model estimation technique is applied, which accounts for probabilistic correctness of the multiple models. The proposed algorithm is validated through experimental tests, and the results illustrate potential of the proposed algorithm as a stochastic approach for driver behavior characterization based on handling limits.

#1328 Driver Parameter Estimation Using Joint E-/UKF and Dual E-/UKF Under Nonlinear State Inequality Constraints

Changxi You (US), Jianbo Lu (US), Panagiotis Tsiotras (US)

In the development of advanced driver-assist systems (ADAS) for lane-keeping, one important design objective is to appropriately share the steering control with the driver. Hence, the steering behavior of the driver must be well known beforehand. This paper adopts the well-known two-point visual driver model to characterize the steering behavior of the driver, and conducts a series of field tests to identify the model parameters to validate the two-point visual driver model in real scenarios. Both an extended Kalman filter and an unscented Kalman filter are implemented for estimating the unknown driver parameters, using a joint-state estimation algorithm and a dual estimation algorithm, and the results are compared.

#1434 Intelligent Electronic Steering Program Based on Road Departure Mitigation Control

Dong Zhang (GB), Tim Gordon (GB), Yangyan Gao (GB), Changfu Zong (CN)

This paper presents an intelligent electronic steering program (IESP), which combines steering shared control with optimal road departure mitigation control. It is based on a recently published control allocation and moderation method designed to improve the vehicle's cornering performance in friction-limiting conditions. Here we develop the concept further in terms of driver-vehicle cooperative control; the potential benefits of steer-by-wire (SBW) system and electronic power assistance steering system (EPAS) are modified to guide the driver's steering behavior. A number of experiments are conducted with different drivers, using a driving simulator. The results show how the proposed IESP provides a positive control influence. The work presents a new approach to vehicle active safety involving driver-vehicle interaction control for partially automated vehicles.

#1758 Localization Tools for Benchmarking ADAS Control Systems

Michael R Hafner (US), Kevin So Zhao (US), Andy Hsia (US), Zach Rachlin (US)

We consider the challenge of testing lane centering ADAS control systems using a differential global positioning system localization strategy. Rather than constructing test scenarios using lane line markers or driving test vehicles on public roads, we develop a testing framework that can be used in both simulation and on open test surfaces with no lane demarcation. The primary sensor we leverage is a differential global positioning system (DGPS), which is used to create a localized lane-offset state relative to a map generated offline. The map is generated either via clothoid path primitives, or from known trajectories. We provide simulation results using the vehicle dynamics simulator CarSim, and provide experimental results taken from a test track.

#1125 Dual Sourcing Problem with Real Option

Juliang Zhang (CN), Han Junjun (CN), Jie Xiang (CN), Hua Guowei (CN)

This paper addresses a single-period dual sourcing problem with real option under uncertain supply and demand. A retailer, who faces the uncertain market demand, can source from a low-price but unreliable supplier and an expensive but reliable supplier. In order to manage the supply uncertainties and decrease the cost, the retailer orders product from the unreliable supplier and buys option from the reliable one at the beginning of the selling season. After the demand realizes and the order is delivered, the option is executed. We develop a model for this problem and characterize the optimal policy. Then we compare the new strategy with the traditional dual sourcing strategy and the instant replenishment strategy with capacity constraint. The conditions that the new strategy has an advantage over the other ones are identified. Numeric experiments are conducted to analyze the impact of the parameters on the optimal policy and the profit in the new strategy and to compare the performance of the traditional dual sourcing strategy and the instant replenishment strategy with capacity constraint.

Intelligent Vehicle Systems and Control (II)

Organizers: Jianbo Lu, Tim Gordon, Hong Chen
October 10 (Monday), 15:30-17:00, Sofitel Budapest Chain Bridge, Academy 3
Session Chairs: Tim Gordon, Jianbo Lu

#1844 Human Control of Systems with Fractional Order Dynamics

Miguel Martinez (GB), Tim Gordon (GB)

In this paper, the manipulative control actions of human operators interacting with fractional order plants are studied. Experimental data were recorded from subjects using a joystick or a steering wheel and responding to plants with different fractional dynamics. From the data it is established that human operators can identify and learn to respond to fractional order plants. Moreover, it is proven that the classical Crossover model is not valid to represent man-machine systems with fractional order dynamics. A generalized Fractional Crossover model is proposed for systems with memory effect. The model is validated with experimental data.

#1771 An Adaptive Control System for Wheeled Mobile Robot by Using Vector Model

Bing-Gang Jhong (TW), Mei-Yung Chen (TW)

In this paper, we present an adaptive control system for wheeled mobile robot. This control system, which is built on the vector model, is constituted by three parts: path planning, localization and robot controller. Therefore, it can use for mobile robot easily with great ability to resist disturbance. A* algorithm is used in path planning, Monte Carlo method is used in localization, and Lyapunov theory is used in controller design to guarantee the stability of the robot control system. This paper also enhances the first two portions to obtain better response and more robust than traditional methods. The simulation result shows the good performance of proposed method in robot system.

#1096 Drivable Space Expansion from the Ground Base for Complex Structured Roads

Kiin Na (KR), Byungjae Park (KR), Seo Beomsu (KR)

For driverless driving cars, it is essential to detect drivable space. It can directly apply to plan driving paths by acquiring the occupancy grid map. In addition, it can enhance object clustering by removing the ground in advance. However, in urban, not only a large number of vehicles are driving at the same time, but also roads with diverse inclinations are complicatedly connected with each other. Thus, it is challenging to extract traversable space properly from complex structured environment. For this reason, this paper proposes the real-time drivable space detection for complex urban environment by integrating the model-based segmentation and the region-based segmentation. Moreover, the proposed method utilizes point cloud from 3D LiDAR because it is effective to understand surrounding topography. It is demonstrated using hand-labeled point cloud dataset collected in various types of urban roads by estimating numerical performances and by visualizing results.

#1460 Obstacle Avoidance of Autonomous Vehicles with CQP-based Model Predictive Control

Houjie Jiang (CN), Zhuping Wang (CN), Qijun Chen (CN), Jin Zhu (CN)

In this paper, an approach for real time obstacle avoidance of autonomous vehicles is presented. A model predictive control (MPC) scheme based on convex quadratic programming (CQP) is developed to generate safety trajectories. To reduce the computational burden in optimizing the performance index of MPC, linear time-varying MPC is adopted and a unique single dimension artificial potential fields (SDAPF) method to utilize the obstacle information is proposed. Autonomous vehicles with proposed method can track the desired path if there is no obstacle on it and avoid both static and dynamic obstacles if the path is occupied. Simulation results show the validity of the approach and its superior real time performance, which is critical to autonomous vehicles.

#1797 Using the Viable System Model to control a system of distributed DC/DC converters

Michael Winter (DE), Stephan Fettke (DE), Joachim Froeschl (DE), Julian Taube (DE), Hans-Georg Herzog (DE)

The complexity of control of the energy flow in automotive power nets has significantly increased in the last decades. Due to the introduction of a second voltage level with new degrees of freedom for an energy and power management, the complexity will further increase. The cybernetic approach of the Viable System Model (VSM) by Stafford Beer has successfully been used as a structural concept for the implementation of an energy management system for a single automotive power net and has significantly reduced the complexity of the control. This paper applies the VSM to the control problem of a group of DC/DC converters, distributed over the whole vehicle, coupling two automotive power nets. Initially it is shown how this new viable system of the converter group fits into the existing approach and how the viable systems of the two power nets form a new VSM. Subsequently, the application of the VSM in the converter group and how it forms a hierarchical control system is described. Additionally, a maximization efficiency point tracking (MEPT) algorithm is implemented in order to have each converter in its best operating point. Finally, the whole system is validated using a physical simulation.

Intelligent Vehicle Systems and Control (III)

Organizers: Jianbo Lu, Tim Gordon, Hong Chen

October 10 (Monday), 17:00-18:30, Sofitel Budapest Chain Bridge, Academy 3

Session Chairs: Jianbo Lu, Tim Gordon

#1553 Multi-spectral Visual Odometry for Unmanned Air Vehicles

Axel Beauvisage (GB), Nabil Aouf (GB), Hugo Courtois (GB)

With the recent increase of interest concerning multi-spectral systems, limitations of classic stereo setups have been overcome to tackle complex navigation problems such as night-time navigation or collision avoidance. However, multi-spectral stereo matching still remains a challenging issue as similarity between stereo pairs is reduced. In this work, we address the problem of visual navigation for multi-modal stereo setups. More precisely, we focus on finding correspondences between visible and long-wave infrared (thermal) images for pose estimation purposes. We present a new visual odometry method for air vehicles using mutual information and phase congruency. Mutual information performs an efficient cross-modality statistical analysis and phase congruency provides a robust spatial information. Hence, both of them are used as criteria for multi-spectral stereo matching. Temporal matching is then performed using feature tracking in each modality separately. This way, cross-modality processing is kept to a minimum, which reduces inaccuracy. This method provides an important number of quad-matches (stereo and temporal), which helps to select the best keypoints for computing a precise motion estimation. In our case, the selection process is performed using a RANSAC scheme. Extensive experimental results show the attractiveness of the proposed technique as a navigation solution. Moreover, results show that tracking features in both modalities makes the technique robust to abrupt navigation changes.

#1957 Feature Abstraction for Driver Behaviour Detection with Stacked Sparse Auto-encoders

Zehra Camlica (CA), Allaa Hilal (CA), Dana Kulic (CA)

Driver behaviour has a significant influence on vehicle accidents. Measuring and providing feedback on driver behaviour can provide significant benefits for understanding and improving road safety. In order to detect driver actions and driving characteristics from the broadest population of drivers, mobile phones can be used to collect low cost information and provide easy accessibility, using sensors available on the mobile phone such as the GPS and IMU. Such information is collected as a time series dataset, which generally has high dimensional variables. Dealing with this high dimensional data is a crucial problem for statistical analysis. Feature abstraction techniques can reduce the dimensionality by extracting salient features from the dataset. This paper proposes a feature abstraction method using stacked sparse autoencoders in order to reduce driver dataset variables. The utility of the derived features is demonstrated on a driver action classification task.

#1074 Tracking Control of Unmanned Ground Vehicles Using State Estimation and Robotic Formalism

György Max (HU), Béla Lantos (HU)

This paper proposes a novel method for the high speed tracking control of unmanned ground vehicles (UGVs) subject to load changes. The vehicle is modeled as a 16 degree-of-freedom multi-body system whose dynamics is derived using robotic formalism. The hierarchical control structure comprises two levels: a high-level (HLC) and a low-level (LLC) control system. The states are estimated with a two-stage Kalman Filter (KF) using GPS and inertial (IMU) sensory information. The LLC system ensures that the vehicle maintains the desired velocity and steering profile by employing PID-type active suspension, velocity and steering control that provide the generalized torques for the vehicle. The HLC utilizes a finite horizon linear quadratic (LQR) optimal controller to eliminate the position and orientation errors that cannot solely be compensated by the LLC system in case of load changes. The HLC control algorithm is based on the kinematic model of the vehicle and the reference trajectories are computed from the prescribed profiles. The optimal solution is given as a time-varying state-feedback control law. The efficiency of the tracking control system for high speed maneuvers is verified under noisy measurements and load changes by simulation.

#2337 Strategic Analysis of the European Gas Crisis

Rami Abdulraheem Kinsara (CA), Yasser T. Matbouli (CA)

The gas crisis that occurred between members of European Union (EU), Ukraine, and Russia in 2006 is strategically investigated using the Graph Model for Conflict Resolution (GMCR). The interdependency and geopolitics of the natural gas supply and demand within Europe is a sophisticated subject. Strategic insights are derived from the review and analysis of the conflict history. The European gas dependency is thoroughly examined, and major events are discussed. The gas crises keep repeating with similar characteristics although an agreement and resolution is achieved every time. The gas supplies were cut several times during the 1990s, significant suspensions occurred in 2006, 2009, and most recently in 2014. The objective is to model and analyze the common characteristics and understand the full picture to form a foundation to gain strategic insights.

#1782 A Basic Study on Temporal Parameter Estimation of Wheelchair Propulsion based on Measurement of Upper Limb Movements Using Inertial Sensors

Takashi Watanabe (JP), Kodai Miyazaki (JP), Maho Shiotani (JP), Andrew Symonds (GB), Catherine Holloway (GB), Tatsuto Suzuki (GB)

Wheelchairs are the most widely used assistive device to aid activities of daily living (ADL) for disabled people. However, manual pushing of a wheelchair frequently leads to overuse of upper extremities causing shoulder pain and carpal tunnel syndrome. The purpose of this study was to test a novel method of estimating temporal parameters of wheelchair propulsion using inertial sensors. In this paper, normalized coordinate values of the vector defined on the upper arm were calculated from an inertial sensor attached on the upper arm. The number of strokes and push cycle timings including duration of propulsion and recovery phases were estimated for steady state wheelchair propulsion. This estimation was completed using a novel vector-based approach and a previously published resultant acceleration method; both were compared to timings measured using the SmartWheel. Measurements were performed on level and sloped surfaces with 10 able bodied subjects. The vector-based method improved estimation of the number of strokes when compared to the resultant acceleration method. However, the push cycle was estimated with better accuracy by the resultant acceleration method. Therefore, a combination of the vector-based and the resultant acceleration methods is proposed to ensure more accurate estimation of temporal parameters. The results suggest inertial sensors can be used to measure wheelchair activity accurately and reliably.

Complexity and Complex Systems in Computational Cybernetics (I)

Organizer: Georgi M. Dimirovski
October 12 (Wednesday), 14:00-15:30, InterContinental Budapest, Duna Salon III
Session Chair: Georgi M. Dimirovski

#1014 A Fast Connected Component Algorithm Based on Hub Contraction

Ye Deng (CN), Jun Wu (CN), Tan Yuejin (CN)

Finding the connected components of an undirected graph is a fundamental computational problem at the heart of many network applications, such as network robustness and computer vision. This paper presents a new form of graph contraction referred to as the "hub contraction," in which the node with the maximum degree is selected as the central node, after which this node and its immediate neighbors are combined to form a new central node. Based on the hub contraction principle, we propose a fast connected component algorithm, which exploits the existence of high-degree nodes to obtain the number and size of connected components. The efficiency of the proposed algorithm was verified by comparing it with other connected component algorithms within random networks and scale-free networks. The results showed the performance of our algorithm to be superior in terms of the processing time it requires, most notably when applied to scale-free networks.

#1213 Decentralized Connective Stabilization of Complexity Large-Scale Systems with Expanding Construction via Observers

Yang Liu (CN), Yuanwei Jing (CN), Hua Xiao Li (CN), Xiaoping Liu (CA)

A decentralized connective stabilization problem based on reduced-order observers is studied for a class of complexity large-scale systems with expanding construction. Without changing the original decentralized control laws, a reduced-order-observer-based decentralized controller is designed for the new subsystem added to an original construction so that both the new subsystem and the resulting expanded system are robustly connectively stable. And the sufficient condition is derived by using Lyapunov theory and LMI approach. Finally, the proposed method is applied to the AGC design of an expanded power system. The simulation results show the effectiveness of the proposed method.

#1376 Flexible Window Control Method Based on Data: A New Technique of AQM

Xudong Yuan (CN), Yuanwei Jing (CN)

This article studies a flexible window control scheme which is based on the queue length in the router, and there is no relationship with the structure of the network. The control method is based a new technique called Active Queue Management (AWM) which is a kind of AQM. One of the features of the AWM is controlling the transfer window directly, another is compatible with every version of TCP. It made the changing rule of window can be designed flexibly, rather than following AIMD method simply. In this article, a data-driven method based on an improved SPD-PD ILC is applied to design the control law of the size of transfer window according to the queue length, which is no need to know the details of the mathematical model of the system.The queue length of the router still can be controlled close to the target value.This means that the structure of the network can be ignored. The method only needs some parameters of the system are bounded.Finally, a simulation is used to prove the method proposed in this paper is effective.

#1420 Tackling Complexity and Missing Information in Adaptive Control by Fixed Point Transformation-Based Approach

Jozsef Kazmer Tar (HU), Imre J. Rudas (HU), Laszló Nadai (HU), Imre Felde (HU), Bertalan Csanádi (HU)

Complexity is the most common feature of the practical task to be solved in control technology. Grasping only a little particular segment of reality, often referred to as "model building", provides us with imprecise and incomplete models of certain subsystems that operate in dynamic interaction with their neglected environment. The classical method of Model Predictive Control (MPC) assumes that our models, though they are not perfect, at least well describe the most important features of the system under control, therefore these models can be used for controller design and the remaining errors can be treated as uncertainties and/or unknown external perturbations. Other practical fact is that the controller normally cannot be provided with complete information on the dynamic state of the controlled system. In the models of biological systems certain "artificial compartments" often occur that are introduced to qualitatively mirror and more or less quantitatively describe the behavior of such systems without assuming that they really "cover" actually existing anatomic components. Consequently, even in principle, it is impossible to directly measure the actual state of such dynamical systems. Further problem is that these variables are assumed to be related to directly measurable quantities by nonlinear functions of uncertain parameters. This fact excludes the possibility of using classical state estimators. Furthermore, these systems normally are "underactuated", i.e. the number of the state variables is greater than that of the independent control signals. The aim of this paper is to show that it is possible to defy these problems by the fixed point transformations-based adaptive controller in controlling depth of hypnosis.

#1542 Cooperative Dancing with an Industrial Manipulator: Computational Cybernetics Complexities

Figen Özen (TR), Dilek Tukel (TR), Kübra Tural (TR)

Synchronization of music and dance of industrial manipulators is studied, simulated and realized. The results are shown in this paper. To formulate the dance, a modified Labanotation software has been developed, and a user-friendly human-machine interface is designed to enable the user to program the robot easily. The system is incorporated with a music analyzer, employing Fast Fourier Transform, to track the beats. The robot dances in synchrony with the input from the music analyzer. Experiments are done on a six degree-of-freedom industrial robot.

Complexity and Complex Systems in Computational Cybernetics (II)

Organizer: Georgi M. Dimirovski
October 12 (Wednesday), 16:00-17:30, InterContinental Budapest, Duna Salon III
Session Chair: Georgi M. Dimirovski

#1612 Overcoming Control Complexity of Constrained Three-ling Manipulator Using Sliding-mode Control

Georgi Marko Dimirovski (TR), Yunlong Liu (CN), Juan Wang (CN), Yonggui Kao (CN)

For constrained three-link manipulation robots it is shown how the complexity of controlling anthropomorphic arm-like manipulators can be considerable ameliorated by designing a sliding-mode control. First, a singular system representation model of a three-link manipulator is established by employing constrained equations and corresponding descriptions of force restriction. Then sliding-mode control with constrained control inputs for three-link manipulator is expatiated as appropriate. Based on quadratic performance index, the optimal sliding mode switching function for three-link manipulator system is derived and a modified reaching law on the grounds of the singular model is constructed using a power function. Then the sliding mode controller for three-link constrained manipulator is designed using the proposed reaching law. Using PUMA-560 the efficiency of the proposed method is demonstrated via main simulation results obtained.

#1666 Complexity of Constrined Switching for Switched Nonlinear Systems with Average Dwell Time; Novel Characterization

Georgi Marko Dimirovski (TR), Jiqiang Wang (CN), Hong Yue (GB)

Theory of switched nonlinear systems is largely based on assuming certain small but finite time interval termed average dwell time, which is a general constraint even when extremely small. Thus most of it is characterized by some slow switching condition with average dwell time satisfying a lower bound. In cases of nonlinear systems, when the switching seizes to be slow, there may well appear non-expected complexity phenomena of particularly different nature. For this class of systems, via shading more light on the underlying system complexities, a fast switching condition with average dwell time satisfying an upper bound is explored and established. A comparison analysis of two innovated but different characterizations of constraint switching via slightly different overview yielded new results on the transient behaviour of switched nonlinear systems while preserving the system stability. The analysis framework is multiple Lyapunov functions approach.

#1898 Synergy of Switched-Fuzzy and Fuzzy-Neural Nonlinear Systems Enhances Complexity and Potential

Vesna Ojleska Latkoska (MK), Tatjana Kolemishevska-Gugulovska (MK), Georgi Marko Dimirovski (TR)

In this paper we present concepts for synergy of switched fuzzy and fuzzy-neural systems. First, an algorithm/procedure for neural network identification of switched fuzzy models, out of input-output data pairs is given. In order to use the existing stability and stabilization results in the field of switched fuzzy systems to the identified switched fuzzy-neural models, an extension of the switched fuzzy model with levels of structure is presented. The proposed concepts are used for identification of discrete switched fuzzy models. To confirm the proposed algorithm/procedure, and the new extended model, a fuzzy-neural identification of the discrete switched fuzzy model for the nonholonomic WMR vehicle is presented. Based on the identified discrete switched fuzzy model for the WMR vehicle, design of discrete switched fuzzy controller is made. The simulation results show the effectiveness of the proposed concepts.

#1318 A Sensor Fault Detection and Isolation Strategy by using A Dendritic Cell Algorithm

Esmaeil Alizadeh (CA), Nader Meskin (QA), Khashayar Khorasani (CA)

In this paper, an online sensor fault detection and isolation (FDI) scheme is proposed based on an emerging Artificial Immune System (AIS) algorithm, namely Dendritic Cell Algorithm (DCA). Our proposed methodology is utilized in a distributed manner in order to perform sensor FDI in complex systems. The proposed methodology is then applied to a wind turbine benchmark model in order to demonstrate its capabilities.

#1279 Dynamic Delay Risk Assessing Using Cost Based FMEA

Amine Boufaied (TN), Rafika Thabet (TN), Ouajdi Korbaa (TN)

To be competitive, supply chains must be able to analyze and to evaluate, in real-time, critical differences between the short-term planned actions and the actual performed actions generating states of undesirable or unacceptable risk. We propose a method for monitoring the dynamic evolution of risk in the operational flow of a supply chain. It consists in an approach assessing risk associated to delays affecting the transportation operations. We use the FMEA analysis around failure scenarios rather than failure modes, and we evaluate risk using probability and cost. A scenario probability is estimated dynamically in discrete points based on events occurrences during the process execution. The proposed approach uses consistent and meaningful risk evaluation criteria to facilitate life cost-based decisions. The implementation of this method is performed by monitoring a delivery process facing risks associated to delays in the transport stream.

Decision Support Systems based on Multicriteria Methods

Organizers: Ana Paula Gusmao, Suzana Daher
October 12 (Wednesday), 17:30-19:00, InterContinental Budapest, Duna Salon II
Session Chairs: Ana Paula Gusmao, Ernando Schramm

#1287 Multicriteria Decision Model for Prioritization of Alternatives on Water Scarcity Situations

Susane de Farias Gomes (BR), Madson Bruno da Silva Monte (BR), Danielle Costa Morais (BR)

In water companies, decisions have to be made in order to guarantee the production workflow and supply the customers. Regarding water scarcity problems they have characteristics such as: they are complex situations and involve many participants of all society. Deciding how to manage the distribution of water in scarcity periods is by far a great challenge to managers in water companies. This study provides a Multicriteria Decision Model (MCDM) for prioritization of alternatives taking into account a scarcity situation. The model uses PROMETHEE II method and yields possible results for some scenarios that could represent the decision maker's preferences.

#1288 Analysis of the decision-makers' weights on preventive maintenance in a water supply system

Madson Bruno da Silva Monte (BR), Danielle Costa Morais (BR), Adiel Almeida-Filho (BR)

In group decision problems, assign weights to decision-makers can be an arduous task because many want not to commit to subsequent judgments. This paper presents a problem about maintenance regarding wells for water distribution and the consequent lack of water. There is three decision-makers, one of them represents the preferences of the population and the others are water company employees, all with conflicting opinions. Due to described situation, they were treated as of equal importance through a voting procedure. Thus, this incited the study of various scenarios simulating the different situations of assigning weights. The results are consistent with the individual preferences and the chosen alternative promotes improvements in the water system. The paper also presents a software to run the applied voting method.

#1569 A multicriteria approach for selection of agile methodologies in software development projects

Vanessa B. S Silva (BR), Fernando Schramm (BR), Adriana Carla Damasceno (BR)

This paper presents an approach, based on the multi-criteria method SMARTER, that can be useful to support decisions involving the selection of the best-fit agile software development methodology for small and medium enterprises. The kickoff of this study was a research regarding measurable criteria that should be considered in this type of decision aiming to answer the needs of specific projects. The evaluation of alternatives is based on a three-point linguistic scale that makes the process friendly and cheap; however, it was observed that this scale provokes a considerable loss of information that can compromise the robustness of the result.

#1748 Model for Contractor Performance Evaluation in Construction Industry

Maria Creuza Borges Araújo (BR), Luciana Alencar (BR), Caroline Maria de Miranda Mota (BR)

The success or failure of a construction project depends largely on the contractor's performance since they are responsible for important activities in the building process. In this way, it is necessary to monitor the performance of the contractors who already working with the organization to control failures during the development of work. Due the complexity and necessity of considering various criteria in the decision making; it is a multicriteria problem. Additionally, contractor evaluation method should classify them according to performance levels to help the client to decide whether to hire the contractor for future projects. In this context, the model proposed uses ELECTRE TRI method to classify the construction contractors according to their performance. Subsequently, a literature review was made to identify the most used criteria to assess contractors in the construction industry. Then, these criteria were used in a numerical simulation of the proposed model.

#1854 Classification of vulnerable areas using Dominance-based Rough Set Approach

Ciro José Jardim de Figueiredo (BR), Debora Viana Pereira (BR), Caroline Maria de Miranda Mota (BR)

The purpose of this paper is to present a multicriteria methodology with spatial visualization, in order to identify most vulnerable areas regarding violence. We used Dominance-based Rough Set Approach to aggregate social, economic, and demographic characteristics, as well to include the preferences of a decision maker. Among the multicriteria methods, this one has the advantage of do not require the establishment of parameters, such as weights and thresholds. The decision maker only needs to choose a set of reference examples that represents his opinion toward the problem. This method applies decision rules to classify the set of alternatives. In this paper, this methodology was used aiming to classify the census tracts of a city in relation to the vulnerability to homicide. The result is a classification of all 1,854 census tracts of the city of Recife (Brazil) into five vulnerability levels. Based on this application, we can conclude, therefore, that this method may be useful to define where public policies should be allocated, when it is concerned with reduction of violence.

IEEE SMC 2016 Best Paper Finalists

October 11 (Tuesday), 09:30-11:00, InterContinental Budapest, Duna Salon III

Session Chairs: T.T. Lee, Tzuu-Hseng S. Li

#2143 Management Of Technologies for Electric Vehicle Efficiency Towards Optimizing Range

Michael Balchanos (US), George Catalin Bucsan (US), Dimitri Mavris (US), Jae Seung Lee (US), Masanori Ishigaki (US), Atsushi Iwai (US)

With the demand and supply for electric vehicles (EVs) in rapid growth at a global scale, due to factors such as environmental awareness, tax and monetary incentives, government regulations, and technological advances, a range of technical issues in efficient EV design has been gaining great attention. With consumer concerns around EV range and battery degradation, several initiatives have been investigating technologies which could further address the above issues. Recognizing the need for increasing the driving range and decreasing the impact of scenarios that negatively affect it as prime design issues, one of the resulting areas of interest is to explore options on better managing energy for heating, ventilation and the air conditioning (HVAC) system, which can decrease the range of EVs by as much as 30% when in use. With key driver for identifying the most promising ideas and technologies worth extensive investigations, the objective is to develop a methodology for managing the selection of technologies during conceptual design, through assessing HVAC power demand effects and employing advanced energy management techniques. A methodology for identifying emerging technology concepts has been outlined and demonstrated in the context of a virtual electric vehicle system. As a result, MOTEVETOR, a portable, interactive multi-criteria decision making tool has been created which allows for performing trades between vehicle configurations carrying different technology packages, as part of supporting EV conceptual design.

#2387 Data Fusion without Knowledge of the Ground Truth Using Tseltin-like Automata

Anis Yazidi (NO), Frode Eika Sandnes (NO)

The fusioning of data from unreliable sensors has received much research attention. The main stream of research assesses the reliability of a sensor by comparing its readings to the ground truth in an online or offline manner. For instance, the Weighted Majority Algorithm is a representative example of a large class of similar legacy algorithms. Recently, some advances have been achieved in identifying unreliable sensors without any knowledge of the ground truth which seems a paradox in itself. In this paper, we present a simple mechanism for solving the problem using Tsetlin-like Learning Automata (LA). Our approach leverages a Random Walk (RW) inspired by Tsetlin LA so that to gradually learn the identity of the reliable and unreliable sensors. In this perspective, we resort to a team of RWs, where a distinct RW is associated with each sensor. By virtue of the limited memory requirement of our devised LA, we achieve adaptive behavior at the cost of negligible loss in the accuracy.

#1978 Convex Polytopic Modeling of Diabetes Mellitus: A Tensor Product based approach

Levente Kovács (HU), György Eigner (HU)

Tensor Product (TP) transformation based modeling and control can be useful in biomedical engineering, since complex nonlinear control tasks can be handled easier with it. Moreover, the modeling approach can handle the Linear Parameter Varying (LPV) models and produces a tensor based system description, which can be used during Linear Matrix Inequality (LMI) based controller design. The TP property makes the usability of the method beneficial as LMI connected techniques allows using the Lyapunov theorems. The aim of the current work is to demonstrate the usability of TP models in biomedical applications, i.e. diabetes modeling. The core model, the minimal model is investigated and simulation results are presented under Matlab.

#1322 Degree of Automation in Command and Control Decision Support Systems

Ryan M Robinson (US), Michael McCourt (US), William D Nothwang (US), Emily Doucette (US), Jess Willard Curtis (US)

This paper investigates the effects of integrating automation into the various stages of information processing in a military command and control scenario. Command and control (C2) is an extreme decision-making paradigm characterized by high uncertainty, high risk, and severe time pressure. We introduce a principled approach to decision support system (DSS) design that specifically addresses these issues. Our approach establishes the principles of communicating confidence in sensor estimates and consequence of actions in an intuitive, timely manner. We hypothesize that automation designed to communicate confidence and/or consequence will improve task performance over systems that neglect these concepts. Toward this end, human-subjects experiments were conducted to compare the effects of displaying confidence/consequence information in a C2 target-tracking and interdiction scenario. Four variations of a decision support interface were designed, each with a distinct "degree of automation'": (i) an instantaneous sensor measurement visualization (baseline), (ii) a confidence-based visualization, (iii) a confidence- and consequence-based visualization, and (iv) a confidence- and consequence-based visualization with explicit decision recommendations. While increasing automation generally improved results, the inclusion of consequence information did not have a major effect, perhaps because the scenario was overly-simplified.

#2484 Texture Evaluation System of Paste Food by Using Elastic Imitation Tongue

Shun Kumakura (JP), Akihide Shibata (JP), Mitsuru Higashimori (JP)

This paper presents a texture evaluation system for nursing-care paste foods with a biomimetic approach. To artificially reproduce human oral processing, an elastic imitation tongue is introduced to the compression test device of paste food. During the compression, the tongue is passively deformed and holds a paste sample. Such a tongue behavior varies with respect to characteristics of paste food. Based on this effect, we propose the method for extracting the cohesiveness of paste food by the pressure distribution measurement and the image processing. Then, we develop the texture evaluation system that estimates the value of human sensory evaluation from the feature value of the pressure distribution. The experimental results show that the proposed method can appropriately estimate the value of human sensory evaluation.

IEEE SMC 2016 Best Student Paper Finalists

October 11 (Tuesday), 11:00-12:30, InterContinental Budapest, Duna Salon III
Session Chairs: T.T. Lee, Tzuu-Hseng S. Li

#1344 An Adaptive Learning Method of Restricted Boltzmann Machine by Neuron Generation and Annihilation Algorith

Shin Kamada (JP), Takumi Ichimura (JP)

Restricted Boltzmann Machine (RBM) is a generative stochastic energy-based model of artificial neural network for unsupervised learning. Recently, RBM is well known to be a pre-training method of Deep Learning. In addition to visible and hidden neurons, the structure of RBM has a number of parameters such as the weights between neurons and the coefficients for them. Therefore, we may meet some difficulties to determine an optimal network structure to analyze big data. In order to evade the problem, we investigated the variance of parameters to find an optimal structure during training. For the reason, we should check the variance of parameters to cause the fluctuation for energy function in RBM model. In this paper, we propose the adaptive learning method of RBM that can discover an optimal number of hidden neurons according to the training situation by applying the neuron generation and annihilation algorithm. In this method, a new hidden neuron is generated if the energy function is not still converged and the variance of the parameters is large. Moreover, the inactivated hidden neuron will be annihilated if the neuron does not affect the learning situation. The experimental results for some data sets were discussed in this paper.

#1405 Feasibility Study for Telexistence on a Ship - Measurement of Delay Time of Satellite Communication

Shinya Sasaki (JP), Tadatsugi Okazaki (JP)

These days, reduction of the young crew, aging, reduce labor costs, and overwork of crew have become serious problems. To solve the problem, navigation supporting system was developed for one person bridge operation. However, technological improvement was more necessary and human error still remained in the system. Thus, with a concept of telexistence, a system for supporting navigation officer was proposed by remote control of a telexistence robot from shore side. The telexistence system was communicated between the telexistence robot on a ship and an experienced mariner from shore by satellite communication. However, for achieving the telexistence system, delay time must be measured because the delay time might cause a marine accident. In this study, the round trip delay time of satellite communication was verified, and the result indicated that the telexistence system worked enough on a ship.

#1520 A New Hybrid Sensorimotor Driver Model with Model Predictive Control

Kazuhide Okamoto (US), Panagiotis Tsiotras (US)

Many driver models are based on the assumption that the driver can be modeled as a linear time-invariant system, which is unrealistic and quite restrictive for most real-life situations. These models generally have difficulty in explicitly representing the differences among human driving behaviors. In this paper we model the human driver as a hybrid controller that switches between long-term, discrete planning tasks and short-term, continuous trajectory tracking tasks. The new driver model is based on the well-known two-point visual driver model, and it uses a model predictive control (MPC) module in the anticipatory channel to better predict deliberative, human driver action. We evaluate the performance of this model, and compare it with other driver models using numerical simulations. The results show that the proposed new driver model reacts to the variation of the direction angle in the same way as human drivers do, and outperforms previous similar driver models.

#1558 Ergonomic Effects of using Lift Augmentation Devices in Mining Activities

Darius Nahavandi (AU), Julie Iskander (AU), Mo Hossny (AU), Haydari Vahid (AU), Shannon Harding (AU)

The mining industry has previously been regarded as a high risk job with safety being the primary concern. Over the years, procedures have been enforced in order to reduce these risks however muscular injuries are still occurring at a significant rate. An assistive technology known as Lift Augmentation Device(LAD) has been in use to reduce the impact on a workers body. This paper provides a musculoskeletal analysis on shoulder and core muscles. Results indicate key differences between manual procedure and LAD-assisted procedures. The LAD-assisted procedure lessened the stretching force on the right shoulder and back muscles at the price of more oscillations in the force applied, while the left shoulder and core muscles suffered more stretching forces and more oscillations in the force applied. Improvements, to be made within the system, are provided.

#1720 Automated Brain Tumor Segmentation using Kernel Dictionary Learning and Superpixel-level Features

Xuan Chen (SG), Binh Phu Nguyen (SG), Chee Kong Chui (SG), Sim-Heng Ong (SG)

Brain tumor segmentation, an essential but challenging task, has long attracted much attention from the medical imaging community. Recently, successful applications of sparse coding and dictionary learning has emerged in various vision problems including image segmentation. In this paper, a superpixel-based framework for automated brain tumor segmentation is introduced. The kernel trick is adopted in dictionary learning to transform superpixel-level features to a high-dimensional feature space where their nonlinear similarities are considered to generate discriminative sparse codes. A graph is constructed from the approximation errors given by dictionaries modeling different brain tumor structures so that superpixels belonging to particular tumor regions can be efficiently identified. The proposed framework is evaluated on brain magnetic resonance images of high-grade glioma (HGG) patients provided by the multi-modal Brain Tumor Segmentation (BRATS) Benchmark. Results show that the proposed framework achieves competitive performance when compared with the state-of-the-art methods.

Regular Papers

Decision Support Systems (I)

October 11 (Tuesday), 14:00-15:30, InterContinental Budapest, Duna Salon III
Session Chairs: Xun Liang, Fei-Yue Wang

#1323 Optimizing the Segmentation Granularity for RTB Advertising Markets with a Two-stage Resale Model

Rui Qin (CN), Yong Yuan (CN), Juanjuan Li (CN), Fei-Yue Wang (CN)

Real Time Bidding (RTB) is an emerging business model and a popular research topic of online advertising markets. Using cookie-based big-data analysis, RTB advertising platforms have the ability to precisely identify the features and preferences of online users, segment them into various kinds of niche markets, and thus achieve the precision marketing via delivering advertisements to the best-matched users. The segmentation granularity used by such platforms, typically referred to as the Demand Side Platforms (DSPs), plays a central role in the effectiveness and efficiency of the RTB ecosystem. In practice, fine-grained user segmentations may lead to increased value-per-clicks and bid prices from advertisers, but at the same time reduced competition and possibly decreased bid prices in each niche market. This motivates our research on the optimal segmentation granularity to solve this dilemma faced by DSPs. Using a RTB market model with two-stage resales, we analyzed DSPs' segmentation strategies taking the revenues of both advertisers and DSPs into consideration. We also validated our proposed model and analysis using the computational experiment approach, and the experimental results indicate that with the increasing of segmentation granularity, the weighted sum of the DSP and advertisers' revenues tends to first rise and then decline in all weight-value cases, and the optimal granularity is greatly influenced by the value of weights. Our work highlights the need for DSPs of moderately using, instead of overusing, the online big data for maximized revenues.

#1388 Microblog User Community Discovery Using Generalized SimRank Edge Weighting Method

Jin Shan Qi (CN), Xun Liang (CN)

This paper proposes a novel edge weighting method which balances local and global weighting based on the idea of shared neighbor ranging between users and the interpersonal significance of social network community. We define that the users within one community should have more similar relationship network structure, and by controlling the measure of neighborhood, this method can adequately adapt to real world. We also propose a new evaluation method: using the communication rate to measure its divided demerit, which can better express network users interact relations than the ordinary modularity measure Q. Furthermore, the fast Newman algorithm is extended so as to be applicable for a weighted network. The experiments demonstrate that the proposed method meets the requirements of balance tremendously and more robust for different kinds of networks.

#1223 Spatio-temporal Route Mining and Visualization for Busy Waterways

Rong Wen (SG)

Route mining for busy waterways is a challenging task. Complicated shipping routes may be generated due to vessels of different types congesting in a narrow water way, frequently changing navigational direction and weaving through multiple crossing traffic. The traditional way using visual bearing and ship-stationed techniques may mitigate hazards of ship collision but lack macroscopic information for safe and efficient shipping navigation. In this paper, we proposed a spatio-temporal mining method to explore vessels' shipping patterns in Singapore Strait. The frequent shipping routes can be automatically extracted using a local polynomial regression based algorithm. Time series clustering across spatial areas is used to associate spatial pattern with temporal pattern. The aim of this study is to provide support for decision-making process in optimal shipping route planning and maritime traffic management. Mapping the pattern information to a virtual geographical information platform enables users to intuitively acquire the knowledge of vessels' shipping patterns.

#2382 Timed-Fuzzy Cognitive Maps: An overview

Evangelia Bourgani (GR), Chrysostomos Stylios (GR), George Manis (GR), Voula Georgopoulos (GR)

Fuzzy Cognitive Maps have been widely used for modeling complex systems but time and evolution of the system has not sufficiently illustrated and taking into consideration within the FCM model. Time is a substantial aspect for any application because factors determining the behavior of the system evolve over time; they affect and change the route of any evolution of the system. This work introduces the combination of Timed Fuzzy Cognitive Maps (T-FCMs), an extension of FCMs, the known soft computing technique that can handle uncertainty to infer a result with Hidden Markov Model (HMM). T-FCM have introduced to take into consideration the time evolution of any system and provides intermediate modeling results. With the combination of HMM, the system will always reach to a decision, as HMM are called in the case that T-FCM do not convergence to an acceptable state and HMM suggests the most probable state (decision-concept).

#2225 A multi-agent approach for building a fuzzy decision support system to assist the SEO process

Sylvain Sagot (FR), Alain-Jérôme Fougères (FR), Egon Ostrosi (FR)

The process of changing a website position, which affects its visibility in the Internet search engine results, is called Search Engine Optimization (SEO). The modeling of SEO process has been considered a complex problem especially because of the dynamic change of the volume of the information, the increase of the diversity of heterogeneous information and their interactions, the lack of transparency of ranking models and the uncertainty of change in terms of results. Thus, SEO process represents a heterogeneous, distributed, complex, dynamic, adaptive, and evolving system. Therefore, from process and organizational points of view, SEO can be modeled by using multi-agent systems. Further to this proposition, we identified several groups of autonomous agents, representing criteria for the implementation of the SEO process. In this study, we tested several SEO criteria in real conditions on the Google search engine. Results from these experiments permitted us to determine the fuzzy decision rules integrated in a SEO decision support system. These fuzzy decision rules can assist SEO practitioners in their work to take good decisions according to the client’s needs and the search engine criteria impact evolution.

Decision Support Systems (II)

October 12 (Wednesday), 17:30-19:00, InterContinental Budapest, Panorama II
Session Chairs: Orlando Belo, Nishi Tatsushi

#2157 A mixed integer linear programming approach to schedule the operating theatre

Feten Maaroufi (TN), Hervé Camus (FR), Ouajdi Korbaa (TN)

The problem studied in this paper is to allocate and to sequence the elective operation on operating theatre (OT). We develop a mixed integer linear programming (MILP) model to solve this problem. Decisions in this model include the allocation of operations to material resources and human resources, the starting time of them and the starting time for each surgeon. To show the efficiency of this model, we decide to compare it with a constraints programming (CP) approach. The performance of these models is tested using a benchmark of the literature. The results indicate the efficiency of the MILP model compared with the CP model in terms of computational time.

#1273 Modeling an Opportunistic ETL Agent Based System Using YAWL

Orlando Belo (PT), Nuno Gomes (PT)

ETL systems are responsible for populating data warehouses' storage structures with historical subject-oriented business data. To do that in the most appropriated manner ETL systems require special computational means, involving frequently the manipulation of large amounts of data that come usually from disparate information sources. Planning and designing ETL systems are very complex tasks, where the occurrence of errors is not rare. In some particular situations, this may jeopardize the successful implementation of the entire system. Therefore, ETL systems modeling is a very important activity in an ETL project, since it allows for sketching and validating different kinds of implementations accordingly all operational requirements defined. This will reduce significantly project costs originated by misinterpreted or badly mapped specifications. In this work we propose a different approach for modeling ETL systems, using ETL patterns as main systems components of an ETL system that will be used and tested in a standard simulation environment using the workflow language YAWL. The system is supported by a cooperative community of agents that are in charge to put in practice the tasks specified of a specific ETL pattern and, together, execute the entire set of tasks required by a particular ETL system package.

#1937 Column Generation Heuristics to Airline Crew Scheduling Problem for Fair Working Time

Nishi Tatsushi (JP), Iijima Yu (JP)

In this paper, the modeling and solution strategies of a practical airline crew scheduling problem are studied. The airline crew scheduling problem to achieve the equalization of working time taking into account for practical constraints such as international and domestic flights, holiday assignments, and grouping constraints is formulated as an integer programming problem. The problem is reformulated as a set partitioning problem by Dantzig-Wolfe decomposition. The column generation algorithm is applied to solve the linear relaxation of the original problem. In order to improve the performance of the algorithm, a column fixing strategy with backtracking is proposed. In the proposed method, the schedule for all crews is obtained efficiently by exploiting the fixing of columns and the execution of the column generation procedure. The backtracking is introduced to find a feasible solution efficiently. The computational results show that the proposed algorithm can find better solutions than greedy-heuristics and the branch and bound procedure solving the original problem by a commercial solver.

#1248 An Integrated Decision Support System for Emergency Evacuation Management

Liu Yi (CN), Gangqiao Wang (CN), Zeyu Jiang (CN), Jing Qian (CN), Yongqiang Chen (CN)

Evacuation management related problems involves multidisciplinary response tasks. Integrate decision support demands for intelligent management, collaboration and visualization of multiple model and data resources in distributed and heterogeneous environment. In this paper, a service-oriented distributed architecture is developed for integrated decision support in emergency evacuation management. The suggested architecture takes advantages of the combination of SOA environment and ontology-based resource management approach. It focuses not only on interoperability of disperse resource, but also integrated decision support capability by means of integrated resource management, modeling support, integrated simulation and collective results analysis. The main advantage of the proposed architecture is that multi-dimensional evacuation management operation decisions are jointly handled in an integrated manner. A case study of implementation of the architecture demonstrated the feasibility of integrated decision support, which enables analyzing collective results and even revealing sine implicit information.

#2388 Improved sEMG Signal Classification using the Twin SVM

Prof Jayadeva (IN), Sumit Soman (IN), Sridhar P Arjunan (AU), Dinesh Kant Kumar (AU)

Identifying wrist and finger flexions from surface Electromyogram (sEMG) signals finds several applications for developing prosthesis-based device control. However, sEMG signals can be corrupted by muscular activity from multiple sources at the site of acquisition, and hence the identification of intents from these signals presents a challenge. Moreover, there can be multiple intents which need to be recognized, hence a robust classifier is required. The accurate recognition of these movements is imperative as it enables reliable control of devices. In this paper, we use the Twin Support Vector Machine (Twin SVM) classifier to identify 15 classes of wrist and finger flexions using one-v/s-rest classification approach. Our work uses sEMG data obtained from nine subjects, including an amputee volunteer. We compare the improved accuracy obtained in using Twin SVM against LIBSVM (a standard SVM implementation) to demonstrate the effectiveness of the classifier. We use a simple feature - the Root Mean Square (RMS) value of the signal during the trial as features for the classifier. Our results demonstrate the effectiveness of using the Twin SVM in a multi-class scenario with unbalanced datasets, which holds significance in addressing the broader challenges in classification presented in several applications based on processing of biomedical signals.

Enterprise Information Systems

October 10 (Monday), 17:00-18:30, InterContinental Budapest, Panorama I
Session Chairs: Amy J.C. Trappey, Carlos C. Insaurralde

#2043 Find the Most Suspicious Tax Evasion Groups from a Taxpayer Interest Interacted Network

Feng Tian (CN), Xing Wan (CN), Tian Lan (CN), Tianliang Qi (CN), Qing Hua Zheng (CN), Kuo-Ming Chao (GB)

Ranking similar structure groups/subgraphs can contribute to importantly practical applications, such as finding the most suspicious tax evasion group within a heterogeneous information network. This problem, however lacks attentions in the current research community. Inspired by social network analysis, this paper coins a definition of a taxpayer interest interacted network (TPIIN), in which persons or companies act as nodes as well as the arcs act as the relationships between persons and/or companies, and the weight of an arc is equal to the interest affiliated degree (IAD) of a direct tie or link according to various economic behaviors between persons and/or companies. Moreover, we adopted four operations, Maximum, Minimum, Addition, and Multiply, to calculate the IAD of a trail, then propose a voting algorithm based on the four operations to compare the suspicion degrees of all groups containing the same trading relationship arc. Experiments are carried out and their results verify the proposed method.

#1132 A Systematic Approach to Design of a Text Categorizer

Roger Bradford (US), John Pozniak (US)

In this paper, we implement a systematic approach to text categorization using latent semantic indexing (LSI). A novel feature of our approach is that we iteratively refine the LSI space used for categorization. Using a verification set, we also employ LSI to determine the values of all parameters controlling the steps of the categorization process. Our approach is designed to scale to enterprise-level implementations. We test the categorizer using the standard Reuters 21578 test set. In order to accurately compare our results with other prior work, we carried out a review of over 500 previous reports of document categorization using the Reuters 21578 collection. At least within the scope of that review, the categorization performance reported here is the best yet attained for the single-label case on this standard test set.

#2436 Psychological Ownership: A Human Factor to Consider for the Success of Technology Enterpreneurial Activites

Aurona Gerber (ZA), Alta Van der Merwe (ZA)

The concept of psychological ownership where someone can identify something as their own is part of every person's life. Psychological ownership is important because someone that own something take responsibility for its wellbeing. Currently there is no mechanism to measure psychological ownership of equipment within the context of small entrepreneurial business in South Africa. In this MOSAIC-2B project case study cinema-in-a-backpack equipment was given to entrepreneurs to empower them to start their own successful businesses screening multi-media content in rural South Africa. This research aimed to identify whether or not individuals developed psychological ownership towards the cinema equipment and what the possible effects of having psychological ownership could be. This study resulted in the development of a measuring tool for psychological ownership in the context of small entrepreneurial businesses in South Africa. Psychological ownership can give valuable insight into how entrepreneurs run their businesses in South Africa and this study also established that individuals that perceive themselves as successful has a higher indication of psychological ownership.

#2497 Patent Portfolio Analysis of E-payment Services Using Technical Ontology Roadmaps

Amy J.C. Trappey (TW), Charles Trappey (TW), Abby P.T. Hsu (TW)

Electronic payment (e-payment) is a subset of an e-commerce (EC) and critical to enhance customer loyalty. A well-designed e-payment service creates new commercial advantage and should be protected as intellectual property. This research develops an ontology roadmap using computer assisted methods to classify e-payment patents. The results of roadmap provide patent portfolio visualization which helps EC enterprises utilize strategic information for competitive advantages. This research also employs patent value indicators to benchmark patent portfolios. In the case implementation, two leading EC enterprises, Amazon and Alibaba, are studied using their e-payment patents as input to implement the proposed methodology. The roadmaps and value assessment results help to describe their underlying competitive advantages and provide management implications for business development.

#2502 Follow-up Methods for Autonomic Repairing Process

Carlos C. Insaurralde (GB), Pattanathu K. S. M. Rahman (GB), Manu Ramegowda (GB), Chandra M. Vemury (GB)

The technical maintenance of civil concrete structures is not really cheap. A way to reduce maintenance-related costs is to have a concrete capable of repairing itself when damaged. This paper presents a cybernetic engineering approach for self-healing in concrete. The approach is inspired by the biological self-healing principle to make self-repairing possible in concrete. It consists of adding biological and chemical agents (bacteria) to concrete mix along with Shape Memory Alloys (SMA) to get an improved self-healing effect. A challenging issues related to this approach is that effective monitoring of the progress of the self-healing process. The main challenge is the diagnosis and even prognosis of the cybernetic concrete health. This paper proposes different testing methods to monitor the self-healing in cybernetic concrete. These methods allow for diagnosis and prognosis of the self-healing process in the above concrete. Experimental results from the above tests carried out in conventional and cybernetic concrete samples are shown. Conclusions and future work are also presented.

Infrastructure Systems and Services

October 12 (Wednesday), 09:30-11:00, InterContinental Budapest, Duna Salon IV
Session Chairs: Cristina Muresan, Dana Copot

#1437 Programming Sensor Networks with Nomadic NFC Transponders

Teemu Leppänen (FI), Joonas Kataja (FI), Ivan Sanchez (FI), Jukka Riekki (FI)

We present how NFC transponders can be used for energy efficient programming of closed-loop sensor networks, to update or augment the existing functionality. Use cases include road tunnel inspection, water pipeline monitoring and maintaining safety information on behalf of mine workers. We utilize opportunistic movement of the human operator, the flow of fluid in a pipeline or material in mines, to move the NFC transponder in the system effortlessly and without external network connectivity. Transponders contain mobile agents in their memory, which are injected into the system when transponder comes to the proximity of a node with NFC reader component. Then mobile agents autonomously operate their tasks, i.e. collect and process sensor data in the devices, detect events from data, control physical components and report their results. Mobile agents can adapt to the operational conditions of the system and physical environment, e.g. to save energy or operate in isolated network segments in fault situations. Real-world evaluation shows that this method is energy efficient in comparison with communications atop similar wireless sensor network.

#2446 A Socio-Technical Perspective to Flexible Design of Energy Infrastructure Systems

Yeshambel Girma Melese (NL), Rob Stikkelman (NL), P.M. Herder (NL)

Systems engineering is the dominant approach for designing flexibility in infrastructure systems. However, the approach merely focuses on physical elements of the system as 'objects of design', whereas hardly any attention is given to the institutional structures (e.g. contracts) required to realize the system. In this paper, the conceptual gaps of systems engineering approach when it comes to infrastructure systems design is discussed. As a way to address these conceptual gaps a theoretical framework that integrates the technical/engineering perspective and the actor/institutional perspective is proposed. The framework promotes design procedures for integrating flexibility, not only in the technical elements of the system, but also in the institutional structure.

#2449 Performance Evaluation of a Lightweight Virtualization Solution for HPC I/O Scenarios

David Beserra (BR), Edward Moreno David (BR), Patricia Takako Endo (BR), Jymmy Barreto (BR)

Our investigation aims to answer which scenarios LXC, a lightweight virtualization solution, can offer a better performance than KVM, a hypervisor-based virtualization, or even equal to native environments. For that, we are considering HPC I/O bound applications and the effects of resource sharing on the performance of virtualized environments with both tools. We conducted experiments with traditional benchmarks in two different scenarios: without communication between benchmark processes in execution and; with processes communication in a cooperative way. Results indicate that LXC can offer a better performance for I/O-bound applications in most cases than KVM; and LXC is less affected while we increase the degree of resource sharing between multiple abstractions hosted at the same host server.

#1063 Factors impacting accurate Cole-impedance extractions from magnitude-only measurements

Todd Freeborn (US), Elwakil Ahmed (AE), Brent Maundy (CA)

The Cole impedance model is widely used in applications involving the electrical impedance of biological tissues. Typically requiring post-processing to determine its four parameters from electrical impedance measurements. Here, a non- linear least squares optimization routine is applied to extract the Cole impedance parameters from collected magnitude responses (not requiring direct impedance measurements). The aim is to quantify the impact of the measured frequency range, number of collected datapoints, and level of noise in the magnitude-only measurements on the accuracy of the extracted parameters. Further investigating the impact the optimization settings have on the accuracy and time required to extract the parameters. The aim is to understand these factors' effects towards the implementation of embedded systems utilizing this method to extract the impedance parameters.

#2178 Towards a Holonic-Control Inspired Local Market Approach used in Intelligent Energy Systems

Cyndi Moyo (AT), Filip Pröstl Andrén (AT), Thomas I. Strasser (AT), Thomas Heistracher (AT), Jia Lei Du (AT), Ulrich Hofmann (AT)

The realization of a sustainable energy system for the future requires intelligent automation approaches and operational concepts, in addition to the usage of renewable sources. This paper analyzes the usage of the holonic-control principle as an open, scalable, and interoperable automation solution for setting up a local energy market in the context of smart buildings and energy-efficient neighborhoods. The necessary requirements, the corresponding automation architecture and validation through a co-simulation based proof-of-concept are discussed in this work.

Intelligent Transportation Systems

October 10 (Monday), 17:00-18:30, InterContinental Budapest, Panorama V

Session Chairs: Abdollah Homaifar, Mariagrazia Dotoli

#2352 Identification of Anomalies in Lane Change Behavior Using One-Class SVM

Saina Ramyar (US), Abdollah Homaifar (US), Ali Karimoddini (US), Edward Tunstel (US)

Advanced driver assistance systems are required to detect latent hazards posed by surrounding vehicles and generate an appropriate response to enhance safety. Lane changes constitute potentially risky maneuvers, as drivers involved encounter latent hazards due to surrounding vehicles. A careful study of lane change behavior is therefore essential in identifying potential abnormalities that may lead to various hazards, during the process of a lane change. In this study, an anomaly detection technique is used to compare snapshots of normal and dangerous lane change maneuvers, to identify the abnormal instances. A one-class support vector machine is used and tested for novelty identification of naturalistic driving study data. The results show that the technique is able to detect dangerous lane changes with high accuracy. In addition, results suggest that dangerous behavior could occur before, after or during a lane-change maneuver.

#1149 A Technique for the Optimal Management of Containers' Drayage at Intermodal Terminals

Mariagrazia Dotoli (IT), Nicola Epicoco (IT)

This paper focuses on optimizing one of the most critical activities in door-to-door intermodal transportation, i.e., the containers' drayage by road. We present a technique to solve in an exact and optimal way the pick-up and delivery problem under the typical assumptions of intermodal transportation: full truck load, split delivery, clustered backhauls, and time windows. The method allows limiting the distance traveled by road, enabling to match a delivery with a pick-up request, while respecting customers' service time windows, vehicles availability, and rental needs. Thus, intermodal companies can manage vehicle routing and scheduling problems in an integrated way. The technique effectiveness is shown by way of a real case study.

#1886 System optimal route choice strategy based on ant colony system

Yisheng An (CN)

The research presents in this paper develops an Ant Colony System (ACS) based system optimal route choice strategy to ensure the rational traffic flow assignment for urban traffic network. In this work, the traffic flow and impedance function of each road section are calculated firstly, and then the individual traveler's route choice behaviors on network nodes are simulated based on applying the pseudo-random state transition rule, route and road section pheromone update formula, which implement the synthesizing of static prior knowledge, dynamic traffic state and the randomness of route choice. This paper's findings reveal that the designed strategy is in a position to reflecting the overlay and delay effect of route choice under different Origin-Destination (OD) demands. In addition, the findings can obtain better network equilibrium comparing with the incremental assignment method, and will benefit for achieving the route guidance system with time varying traffic conditions.

#2109 Reliable and Low-cost Cyclist Collision Warning System for Safer Commute on Urban Roads

Homayoun Najjaran (CA), Jessica Van Brummelen (CA), Bara Emran (CA), Kurt Yesilcimen (CA)

Collision warning and avoidance is a well-established area of research for the automotive industry. However, there is little research towards vitally important collision warning systems for cyclists, who are increasingly jeopardized by motorists on urban roads, especially as quiet, fast electric vehicles become more popular. This paper describes the hardware and software of a low-cost collision warning system for cyclists. Installed on the back of a bike seat, the system consists of a single-beam laser rangefinder and two ultrasonic sensors that detect oncoming vehicles from behind, two handlebar eccentric mass vibrators that provide left and right haptic feedback to the cyclist, and a taillight that warns oncoming vehicles. Executed by an Arduino microcontroller, its software consists of a fuzzy rule-based inference system (FIS), which computes the collision risk and generates appropriate warning signals in a similar way to how a cyclist would assess collision risk based on the distance, velocity and direction of an approaching vehicle. The device was prototyped and statistically evaluated by a survey taken from a pool of seven participants. The participants tested the system before and after receiving initial training. The experimental results demonstrate the efficacy of the proposed system in warning cyclists in an intuitive manner, without distracting them.

#1483 Demand Responsive Mobility as a Service

Jecinta Wairimu Kamau (JP)

Fundamental requirements in mobility are time, cost and comfort. Individual car ownership satisfies comfort component and to some extent, the time component as well. However, owning and maintaining a car is prohibitive for many due to cost and convenience implications. In selecting other public modes of transportation, a taxi or rental car would provide a more comfortable ride with little to none waiting time and conforms to the passenger's mobility requirements. However, the cost is too high and cannot be sustained as a regular mode of transport. On the other hand, shared public transport such as bus or train is more affordable but requires the passenger to conform their schedule to a set timetable that operates no matter the changes in demand. In developing countries, however, the shared public transport alternatives do not have timetables and waiting time could be up to an hour. Recent research in shared mobility systems, specifically Demand Responsive Transport (DRT), addresses this situation. Solutions to DRT trip scheduling are constrained to the variation of DRT specifications but does not vehicle schedule and quorum specifications considerations. We aim to reduce passenger waiting time for shared mobility and propose a design of a DRT-based Demand Responsive MaaS (Mobility as a Service) model that provides centralized management and ICT support. Our design adds time constraints of vehicle schedule to the DRT problem. We propose a trip scheduling and cost sharing algorithm for our designed model and base our approach on a DRT heuristic algorithm and a quorum to enforce a minimum demand. A simulation experiment showed average waiting time reduced by 44.4% compared to other DRT time optimization solutions. We conducted a pilot study in Dhaka, Bangladesh for 4 months. Actual average waiting time reduced to 25% compared to current public transport in Dhaka.

Robotic Systems (I)

October 10 (Monday), 13:30-15:00, Sofitel Budapest Chain Bridge, Academy 4
Session Chairs: Xinjun Mao, Michael Goodrich

#1382 Hierarchical Planning for Error Recovery in Automated Industrial Robotic Systems

Satoru Matsuoka (JP)

In recent high mix/low volume production plants, automated industrial robots which prevent temporary stop and recover from unexpected errors autonomously are needed. Under the present circumstances, the automated error recovery is not enough, and is restricted only to simply retrying the erroneous command. In this paper, a hierarchical planning system that realizes autonomous error recovery of robots is proposed, and repair strategy to realize a variety of flexible error recovery is reported. A partial order planning scheme provides a robotic system with broader re-planning capability based on semantic information represented by conceptual graph. To verify its effectiveness, a number of cooperative work simulations of multiple robots are demonstrated.

#2334 Context-aware switching between localisation methods for robust robot navigation: a self-supervised learning approach

Raul Guilherme (PT), Francisco Marques (PT), André Filipe Lourenço (PT), Ricardo Mendonça (PT), Pedro Santana (PT), Jose Barata (PT)

This paper presents an incremental learning mechanism for context-aware switching between localisation methods which are available to the robots control system (e.g., GPS-based, map-based). The goal is to avoid the cumbersome and error prone manual mapping between localisation methods and environmental contexts. At each moment, the system determines which localisation method is performing best by comparison with the motion estimates produced by an odometer, assumed as accurate in the short-time. Then, the best performing method is associated to the current environmental context, which is defined by a novel descriptor built from the local occupancy grid. The result of this instance-based learning process is used online to estimate which localisation method performs the best in the current environmental context. The switching process is facilitated by the use of the de facto standard Robot Operating System (ROS) framework. The system was instantiated in a differential-wheeled robot equipped with a short-range 2-D laser scanner, and successfully validated on a set of field trials.

#1103 Combining Re-Allocating and Re-Scheduling for Dynamic Multi-Robot Task Allocation

Yin Chen (CN), Xinjun Mao (CN), Fu Hou (CN), Qiuzhen Wang (CN), Shuo Yang (CN)

Multi-robot systems (MRS) working in open and dynamic environments are expected to deal with uncertain arrival of new tasks and environment changes, by repeatedly adapting the current task allocation and schedule, in order to maintain its performance (e.g., total utility, balance, etc.). This paper presents an adaptive approach to multi-robot task allocation (MRTA), which combines two adaptive measures corresponding to different levels of a MRS: (1) re-allocating at inter-robot level, for balancing task allocation, and improving total utility of the MRS, and (2) re-scheduling at intra-robot level, for maintaining each robot's utility against the influence of both re-allocating and environment changes. Our approach is expected to have significantly higher adaptation power than both re-allocating only and re-scheduling only cases. An experiment is conducted to evaluate our approach's capability of improving balance and total utility of the MRS, under different environment settings and different combinations of re-allocating and re-scheduling.

#1352 Topology-Aware RRT* for Parallel Optimal Sampling in Topologies

Daqing Yi (US), Michael Goodrich (US), Thomas Howard (US), Kevin Seppi (US)

In interactive human-robot path-planning, a capability for expressing the path topology provides a natural mechanism for describing task requirements. We propose a topology-aware RRT* algorithm that can explore in parallel any given set of topologies. The topological information used by the algorithm can either be assigned by the human prior to the planning or be queried from the human in posterior path selection. Theoretical analyses and experimental results are given to show that the optimal path of any topology can be found, including a winding topological constraint wherein the robot must circle one or more objects of interest.

#1546 A Hybrid Probabilistic and Point Set Registration Approach for Fusion of 3D Occupancy Grid Maps

Yufeng Yue (SG), Danwei Wang (SG), P.G.C.N. Senarathne (SG), Diluka Moratuwage (SG)

One of the major challenges in multi-robot exploration is to fuse the partial maps generated by individual robots into a consistent global map. We address 3D volumetric map fusion by extending the well known iterative closest point(ICP) algorithm to include probabilistic distance and surface information. In addition, the relative transformation is evaluated based on Mahalanobis distance and map dissimilarities are integrated using relative entropy filter. The efficiency of the proposed algorithm is evaluated using maps generated from both simulated and real environments and is shown to generate more consistent global maps.

Robotic Systems (II)

October 10 (Monday), 15:30-17:00, Sofitel Budapest Chain Bridge, Academy 4
Session Chairs: Eiji Konaka, Rudolf Jakša

#1432 WiFi RSS Fingerprint Database Construction for Mobile Robot Indoor Positioning System

Abdul Halim Ismail (MY), Hideo Kitagawa (JP), Tasaki Ryosuke (JP), Kazuhiko Terashima (JP)

Mobile robot positioning in an indoor environment via fingerprinting technique is made by matching the unknown WiFi data to a spatial WiFi power map database. In past years, this technique has gained reasonable accuracies in the cost of high labor yielded for the database. Thus, automatic database construction by means of interpolating missing data is desired. This paper described a variation of Inverse Distance Weight (IDW) interpolation which is the Modified Shepard's Method (MSM) for our medical-oriented mobile robot – Terapio. By properly selecting the reference locations, we found that this method is better than the conventional IDW method and comparable to the recently popular Kriging interpolation algorithm in an indoor environment by employing the state-of-the-art WKNN positioning algorithm.

#2251 Handling State Uncertainty in Distributed Information Leader Selection for Robotic Swarms

Anqi Li (US), Wenhao Luo (US), Sasanka Nagavalli (US), Nilanjan Chakraborty (US), Katia Sycara (US)

In many scenarios involving human interaction with a remote swarm, the human operator needs to be periodically updated with state information from the robotic swarm. A complete representation of swarm state is high dimensional and perceptually inaccessible to the human. Thus, a summary representation is often required. In addition, it is often the case that the human-swarm communication channel is extremely bandwidth constrained and may have high latency. This motivates the need for the swarm itself to compute a summary representation of its own state for transmission to the human operator. The summary representation may be generated by selecting a subset of robots, known as the information leaders, whose own states suffice to give a bounded approximation of the entire swarm, even in the presence of uncertainty. In this paper, we propose two fully distributed asynchronous algorithms for information leader selection that only rely on inter-robot local communication. In particular, by representing noisy robot states as error ellipsoids with tunable confidence level, the information leaders are selected such that the Minimum-Volume Covering Ellipsoid (MVCE) summarizes the noisy swarm state boundary. We provide bounded optimality analysis and proof of convergence for the algorithms. We present simulation results demonstrating the performance and effectiveness of the proposed algorithms.

#2149 A Biologically Inspired Multimodal Whisker Follicle

Hasitha Bandara Wegiriya (GB), Nantachai Sornkarn (GB), Harry Bedford (GB), Thrishantha Nanayakkara (GB)

Mammalian whisker follicle contains multiple sensory receptors strategically organized to capture tactile sensory stimuli of different frequencies via the vibrissal system. There have been a number of attempts to develop robotic whiskers to perform texture classification tasks in the recent past. Inspired by the features of biological whisker follicle, in this paper we design and use a novel soft whisker follicle comprising of two different frequency-dependent data capturing modules to derive deeper insights into the biological basis of tactile perception in the mammalian whisker follicle. In our design, the innervations at the Outer Conical Body (OCB) of a biological follicle is realized by a piezoelectric transducer for capturing high frequency components; whereas the innervations around the hair Papilla is represented by the hall sensor to capture low frequency components during the interaction with the environment. In this paper, we show how low dimensional information such as the principle components of co-variation of these two sensory modalities vary for different speeds and indentations of brushing the whisker against a surface. These new insights into the biological basis of tactile perception using whiskers provides new design guidelines to develop efficient robotic whiskers.

#1624 Robotic Attention Manager using Fuzzy Controller with Fractal Analysis

Peter Polák (SK), Rudolf Jakša (SK), Ján Vaščák (SK)

This paper is focused on the application of fractal analysis in the attention management of humanoid robot. We designed a fuzzy controller to combine the face detection, movement detection and the fractal dimension signals to control the head movement of robot Nao. Also, the gaze problem is addressed by the controller. Implementation details are included in the paper, including configuration parameters, which we found optimal according to subjective analysis and possibilities of current hardware. We found the fuzzy controller to be advantageous for implementation of attention manager because of smoothing of the movement of robot when compared to the simple rule based implementation, and also because the fuzzy controller implementation of manager is more clear then a naive if-then heuristics code. We also found the fractal dimension to be useful additional signal for attention management of robot, which can be computed in near real-time on current hardware and static input images.

#1031 Parameter design for two-dimensional truss binary manipulators based on the Kolmogorov-Smirnov statistic and maximum empty circles

Eiji Konaka (JP)

In this study, a two-dimensional truss binary manipulator is considered as a controlled plant. The reachable points of the binary manipulator form a discrete set of points, and their distribution depends on the parameters of each binary actuator, e.g., the binary actuator lengths. In this paper, a novel parameter design method for the binary manipulators is proposed. In this method, two different criteria, the Kolmogorov-Smirnov (KS) statistic and radius of the maximum empty circle (MEC) are combined. Minimizing the KS-statistic maximizes the density of reachable points and makes their distribution close to uniform one. In addition, minimizing the radius minimizes the upper bound of the positioning error of end effector. Numerical design results for the two-dimensional truss binary manipulator are presented to demonstrate the usefulness of the proposed method.

#2324 Specific Validation Analysis of Stochastic ICING Model Based Estimation of Insulin Sensitivity Profile Using Clinical Data

Balázs István Benyó (HU), Kent Stewart (NZ), József Homlok (HU), Chris Pretty (NZ), Geoff Chase (HU), Béla Paláncz (HU)

In this paper the performance of an insulin sensitivity profile estimation method is analysed from the the aspects of clinical applicability. In our previous studies it has been demonstrated that the grey box variant of the ICING (Intensive Control Insulin-Nutrition-Glucose) model may be successfully applied to improve the estimation accuracy of the insulin sensitivity profile of intensive care patients. This may enable the application of the model in the clinical treatment, especially in tight glycaemic control. The sensitivity estimation accuracy itself and the accuracy improvement compared to previous methods are highly variable, it strongly depends on the range of blood glucose concentration. In the present study the insulin sensitivity estimation is analysed from the clinically relevant aspects. Modelling error represented by the difference of measured and computed the blood glucose concentration was considered on the total glucose concentration range (measured in mmol/l) - $0 < c\,G < 20$ - of the cohort data set as well as on its four subregions, namely hypoglycaemic ($0 < c\,G \le 4$), normoglycaemic ($4 < c\,G \le 6.5$), mild-hyperglycaemic ($6.5 < c\,G \le 10$), and severe-hyperglycaemic ($10 < c\,G \le 20$). The results of the computations indicate that the SDE model was significantly better in the normoglycaemic and mild-hyperglycaemic ranges, somewhat better in the hypoglycaemic range and nearly the same in the severe-hyperglycaemic range. The 97 % of all of the concentration values were in the normoglycaemic and the mild-hyperglycaemic range (5841 values), which amplifies our statement in these ranges, but further study is necessary the ensure the verdict for the hypoglycaemic and severe-hyperglycaemic ranges.

#2042 Calculating the Response Time of Action Flow in Stochastic Process Algebra Models

Jie Ding (CN), Leijie Sha (CN), XinShan Zhu (CN)

Response time plays an important factor in determining the Service Level Agreement (SLA). For the reason that actual measurement costs a large amount of resource, theoretical/numerical analysis based on Stochastic Process Algebra (SPA) is a good choice to obtain the response time of concurrent systems. Among all SPAs, Performance Evaluation Process Algebra (PEPA) is the most popular one due to its precise semantics. As a result, this paper gives two methods, theoretical and numerical, for analyzing response time between two specified actions. These two methods are restricted in the scenarios that there are no actions can be performed parallelly in a response. In addition, theoretical analysis just applies to small scale models.

#2490 A New Approach to Non-Fragile Output Feedback Controller Design for Uncertain Takagi-Sugeno Fuzzy Systems

Jun Yoneyama (JP)

The paper discusses non-fragile output feedback control design Takagi-Sugeno fuzzy systems with uncertain parameters. In control design for physical systems, there are chances that malfunction in actuator and round-off error of the control gain calculation may occur. Hence, controller gain variations as well as uncertainty in the system parameters should be considered in the control design. For an uncertain fuzzy system, a design method of a non-fragile output feedback controller is proposed by introducing a new type of controllers where the integrals of the membership functions are involved. A non-parallel distributed compensator (Non-PDC) is a generalization of a parallel distributed compensator(PDC), which is a traditional controller for fuzzy systems, and is used for the control design. A non-fragile non-PDC output feedback controller for uncertain fuzzy systems is obtained from new fuzzy multiple Lyapunov functions and its control design conditions are given in terms of a set of linear matrix inequalities(LMIs), which are easily numerically solvable. The descriptor system formulation, which leads to relaxation in controller design conditions, is also employed. These approaches reduce the conservatism of the control design conditions. Finally, numerical examples are given to illustrate our nonlinear control design and to show the effectiveness over other existing results.

#1114 Managing a Holistic Supply Chain Network for Proactive Resilience

Junwei Wang (HK), R. R. Muddada (CA), Andrew Ip (HK), W. J. Zhang (CA)

A concept called holistic supply chain network (H-SNC for short) was proposed by our group before. The nature of H-SNC is that several supply chain networks intertwine and inter-dependent to each other to form a more sophisticated network. It is our belief that management of such a supply chain network has a close tie to financial crisis in 2008 and subsequent global economic recession. This paper proposes a theory for managing the H-SNC system to enhance the resilience of this kind of system in a proactive manner. By proactive resilience it is meant that the disruption of supply chain in future could be avoided at large if not all. The proposed theory includes a model that represents the economic health of a firm in the context of a supply and demand network. The model can capture not only a firm’s own resource and capability but also its supplier and its consumer. How the resilience of such an H-SNC system can be enhanced is demonstrated by a potential technique to share the information of the health state of firm and the knowledge of disruptions over the entire network in future if one or more firms in the network fail to function.

#1235 Strictly Formalized Situation-Operator-Modeling technique for fall-back layer modeling for autonomous or semi-autonomous systems requiring software-based fail-safe behavior

Georg Hägele (DE), Dirk Soeffker (DE)

Autonomous and semi-autonomous aerial systems (AES) are often needed to perform tasks in complex and dynamic environments, especially in logistics and transportation applications. If information about the vehicle’s environment are not reliable, disturbed, or GPS-signals are not available safe behavior like navigation is required. Here safe navigation denotes spacial movement with freedom from unacceptable collision risk. The safe navigation assurance as well as safety assurance of AES are still open research issues. Traditional combination of safety aspects with mission related tasks and in consequence unmanageable AES system complexity as well as unpredictable effects during the spatial environment interaction makes traditional safety assurance methods inapplicable. From AES related literature it can be concluded that system safety is mostly considered in conjunction with mission tasks like path planing, reduced to human safety operator as fall-back level, or emergency landing. No integral AES safety concept by the best knowledge of the authors can be found in the literature considering safe situational behavior, system malfunctions, and technical fall-back layer. This paper introduces Strictly Formalized Situation-Operator-Modeling (sf-SOM) technique for AES safe behavior assurance. In combination with the System Safety Surveillance and Control (SSSC) system concept a AES fall-back layer concept can be realized. In comparison to other approaches, in this concept a separation between regular behavior generating mission-tasks and safety assurance non-mission tasks is used. Furthermore, the system is separated in well-defined, safety task-specific modules and can be realized using standardized industrial programming languages and programmable safety device. Proof of concept using an industrial Programmable Logic Controller demonstrates the successful use of SSSC-based fall-back layer also for comparable applications.

System Modeling and Control (II)

October 10 (Monday), 17:00-18:30, Sofitel Budapest Chain Bridge, Bellevue 3
Session Chairs: Jingshan Li, Bálint Kiss

#1609 Detailed octocopter modeling and PD control

Nedim Osmic (BA)

This paper presents a detailed octorotor model derivation. The full derivation of the rigid octorotor body dynamics based on the Newton-Euler approach including the Gyroscopic effect and motor dynamics is given. We also discuss a generalization of the model thus making it applicable to any symmetric and balanced multirotor aerial vehicle (MAV) system with even number of rotors. Finally, simple stabilization control is designed and compared with the state of the art results.

#1206 An Adaptive Unscented Kalman Filtering Approach using Selective Scaling

Jaehoon Kim (KR), Bálint Kiss (HU), Dongik Lee (KR)

Classical Kalman filters require the exact knowledge of process noise and measurement noise covariance matrices. Different versions of Adaptive Kalman filters are used in situations where the noise covariance matrices are partially or fully unknown. In the discrete time case, one option is to use innovation-based adaptation laws to update the covariance matrices using measured data in a finite length observation window. This paper presents an augmented version of adaptive Kalman filters where additional state variables are used to estimate parameter values and/or unknown inputs. The behavior of the augmented state variables is modeled as random walk. The convergence properties of such adaptive filters may be poor, especially when the parameter values or the unknown inputs undergo a step-like change. To improve convergence, the paper suggests a selective scaling method so that uncertainty is scaled up for state variables which are not measured or belong to the set of augmented states if a specific scaling condition is satisfied. The method is applied for adaptive unscented Kalman filters that estimate parameters or unknown friction forces of a mechanical system as part of the augmented state vector. Simulation results for such applications are presented to show the effectiveness of the method.

#1497 Tube-based robust MPC for pump scheduling in water distribution systems

Istvan Selek (FI), Enso Ikonen (FI), Csaba Hos (HU)

This paper proposes a (tube based) robust MPC approach for the class of ”well-designed” water distribution systems subject to water demand uncertainties. The underlying mathematical problem is formulated within a robust decision making framework where the operational decision (which is obtained using feedback) is cost efficient and feasible under a range of water demand realizations. An application to the efficient pump scheduling of the water distribution system of the city of Sopron (Hungary) is presented.

#1761 Population-Independent Subsidy and Lump-Sum Tax Based Control of Multipopulation Replicator Dynamics

Ryo Kadoya (JP), Takafumi Kanazawa (JP)

Many social systems consist of many selfish players. All players may not have the same sense of values, and players who have different senses of values can be considered to belong different populations. As a model of such systems, multipopulation replicator dynamics has been proposed. In general, the desirable state may not be realized in the systems of many selfish players. In order to realize the desirable state, the government that offers subsidies to players regardless of their populations has been introduced. In previous work, however, it is assumed that there exists an equilibrium point that corresponds to the desirable state. In this paper, in addition to the subsidy, we introduce a lump-sum tax that makes a desirable non-equilibrium target state an equilibrium point and formulate replicator dynamics with the lump-sum tax and the subsidy. We also derive the stabilization conditions of the target state in two-population two-strategy games.

#1326 An Iterative Method for Analysis of Joint Visit Model at Dean East Clinic

Hyo Kyung Lee (US), Xiang Zhong (US), Jingshan Li (US), Albert J. Musa (US), Philip A. Bain (US)

This paper introduces a case study at Dean East Clinic to model patient flow with joint visits by provider and medical assistant (MA). A Markov chain model is presented to describe the patient flow and provider and MA services. To reduce the state space dimension, a convergent iterative procedure is proposed. The study is extended to non-Markovian case by introducing an empirical formula based on the mean and coefficient of variation (CV) of service times. The results have been validated with good accuracy using both collected and randomly generated data.

Intelligent Power and Energy Systems (I)

October 11 (Tuesday), 09:30-10:00, Sofitel Budapest Chain Bridge, Bellevue 3

Session Chairs: Roozbeh Razavi-Far, Po Lun Chang

#2447 Multi-step-ahead prediction techniques for Lithium-ion batteries condition prognosis

Roozbeh Razavi-Far (CA), Shiladitya Chakrabarti (CA), Mehrdad Saif (CA)

This paper focuses on the use of different multi-step prediction techniques for long-term prognosis of the Lithium-ion batteries condition. Various inductive algorithms including adaptive neuro-fuzzy inference systems, random forests, and group method of data handling are used along with three strategies for multi-step prediction and prognosis. These prediction strategies including iterative, direct, and DirRec schemes make use of the historical and current data in different manners to forecast the future values of the capacity over a long horizon for estimation of the remaining useful life (RUL) of the Li-ion batteries. These multi-step predictors are trained by means of constant current Li-ion battery datasets. The attained results present the effectiveness of these techniques for the long-term prognosis of the RUL of the batteries. Besides, a statistical analysis of the attained results indicates that the RF predictor outperforms other techniques.

#1025 Small-Signal Analysis of a Kilo-Watt-Grade Power Converter

Kai-Jun Pai (TW)

A power converter supplying kilo-watt-power from its output side is developed in this paper. The composition of its power-stage includes an AC-DC converter and a DC-DC converter. The topology used by the DC-DC converter is the phase-shifted full-bridge with parallel current-doubler rectification converter (PSFB-PCDRC). For the sake of feedback controller design, the small-signal model of PSFB-PCDRC will be set up and employed further to analyze frequency responses. Moreover, the three-terminal switch model is used in this paper, therefore, the transfer function of PSFB-PCDRC is available to be acquired to simulate and analyze the frequency responses. Via practical measurements, the derivation of small-signal model and system compensation parameters can also be approved. The analysis and design procedure will be presented thereafter in the paper. Moreover, the simulations and experimental results are verified that both of which exactly correspond to the anticipated results of the theory, and furthermore, the validity of proposed design approach will also be approved and demonstrated.

#1842 An Analog Ensemble-based Similarity Search Technique for Solar Power Forecasting

Andre Gensler (DE), Bernhard Sick (DE), Vitali Pankraz (DE)

Power forecasting for renewable energy power plants has been a highly active field of research during the past decade. In order to support the operation of the power grid, sophisticated algorithms have to predict the future development of power generation. Algorithms in the class of analog ensembles conduct the process of forecasting by finding historically similar situations (e.g., by comparing weather situations), and merging the historic power generation time series during similar periods to an overall power forecast. However, these algorithms often only use very simple similarity measures, which in turn do not make optimal use of the historic information available. In this article, we propose and compare advanced search strategies for similarity assessment. These strategies include the assessment of forecasting time periods as a whole instead of granular points in time, and joint time windows of historic- and future weather situations. Also, historic power time series are used directly in the comparison strategy. Furthermore, we propose a combined scheme to perform automated feature selection and -weighting for individual weather parameters. We evaluate the proposed technique on a solar farm data set consisting of 21 photovoltaic power plants which is made publicly available. In the evaluation we show that advanced comparison strategies not only offer an advantage over simple strategies, they are even able to outperform other reference techniques, e.g., such based on physical models.

#2338 Nonlinear Phenomena of Varying Reference Current Boost DC-DC Converting Solar Cell System with Incremental Conductance Method for MPPT

Po Lun Chang (TW)

In recent years, carbon reduction is the trend of the world, and inexhaustible solar power is booming. The current efficiency of solar power generation is still low. Therefore, improvement of the power generation efficiency will be the research objective to scientists all over the world. The maximum power point tracking (MPPT) is an effective way to improve efficiency. Existing maximum power point tracking methods are incremental conductance method, perturbation and observation method, voltage feedback method and so on. Because of the output voltage of the solar cell is lower than the normal one. This paper chooses boost DC - DC converter as the converter system to enhance the output voltage of the solar cell. In this paper, the nonlinear phenomena of boost DC-DC converting solar cell system with incremental conductance method for MPPT by varying reference current is studied. Considering converter operation in continuous conduction mode (CCM) with inductor current, Firstly the solar cell maximum power tracking system and converter working principle are explained. Secondly, the construction of solar maximum power tracking with incremental conductance method and boost DC - DC converter equivalent circuit model, then mathematical model is derived, and simulated by MATLAB / SIMULINK software package. Through the time-domain waveforms, phase plane and bifurcation diagrams, to explore the changing the reference current system from a periodic steady-state into the chaos of nonlinear phenomena, chaos evolution mechanism of the system is analyzed.

#1073 An average consensus approach for the optimal allocation of a shared renewable energy source

Raffaele Carli (IT), Mariagrazia Dotoli (IT), Gregorio Andria (IT), Anna Maria Lucia Lanzolla (IT), Raffaele Garramone (IT)

This paper investigates the problem of optimally distributing the energy produced by a shared renewable energy source among users, without relying on a centralized decision maker. We assume that each user is only allowed to communicate with his neighbors and buys energy from a producer under non-linear pricing. We formulate a quadratic programming problem aimed at ensuring a social welfare-optimal allocation of the shared resource. We propose a low-complexity distributed algorithm that relies on average consensus. We show the convergence of the proposed algorithm to the unique optimal solution of the resource allocation problem. We also provide numerical simulations demonstrating that the approach allows exploiting the potential of renewable energy sources' sharing to reduce users' energy consumption costs.

Intelligent Power and Energy Systems (II)

October 11 (Tuesday), 11:00-12:30, Sofitel Budapest Chain Bridge, Bellevue 3
Session Chairs: Amir Zanj, Bruno Rossi

#1621 Dynamic analysis of Thermoviscoelasticity in Multi-Physical systems: A Bond Graph Approach

Amir Zanj (AU), Fangpo He (AU), Peter C. Breedveld (NL)

Controlling thermo-mechanical behavior of multi-physical systems has always been a challenging issue, as the general behavior in this case is a result of complex energetic transactions between the existing subdomains. In this study we propose a novel thermo-viscoelastic model in which the thermo-mechanical behavior of the system is generated from the interactive dynamics of its involving subdomains. The proposed model then provide an energetic structure by means of which the general dynamics of the system is obtained with respect to the constructive dynamics of each subdomain. This added capability to the model leads to automatically capturing the thermo-mechanical phenomena inside the system. The obtained simulation results for a simple structure, highlighting the impacts of the internal dynamics on the observable behavior of the system, prove the capability of the model to cover a wide range of thermo-mechanical behavior including material softening, vibrational heating, dilation, relaxation, conduction, and damping.

#1647 Anomaly Detection in Smart Grid Data: An Experience Report

Bruno Rossi (CZ), Stanislav Chren (CZ), Barbora Buhnova (CZ), Tomas Pitner (CZ)

In recent years, we have been witnessing profound transformation of energy distribution systems fueled by Information and Communication Technologies (ICT), towards the so called Smart Grid. However, while the Smart Grid design strategies have been studied by academia, only anecdotal guidance is provided to the industry with respect to increasing the level of grid intelligence. In this paper, we report on a successful project in assisting the industry in this way, via conducting a large anomaly-detection study on the data of one of the power distribution companies in the Czech Republic. In the study, we move away from the concept of single events identified as anomaly to the concept of collective anomaly, that is itemsets of events that may be anomalous based on their patterns of appearance. This can assist the operators of the distribution system in the transformation of their grid to a smarter grid. By analyzing Smart Meters data streams, we used frequent itemset mining and categorical clustering with clustering silhouette thresholding to detect anomalous behaviour. As the main result, we provided to stakeholders both a visual representation of the candidate anomalies and the identification of the top-10 anomalies for a subset of Smart Meters.

#2011 Single-machine batch scheduling under time-of-use tariffs: new mixed-integer programming approaches

Junheng Cheng (FR), Feng Chu (FR), Ming Liu (CN), Weili Xia (CN)

Time-of-use (TOU) pricing has been implemented by many electricity suppliers to alleviate the peak load of power grid, which provides a good opportunity for industrial consumers to reduce their energy bills. In industrial enterprises that involve batch processing machines, energy expenditure often accounts for large portion of the final product cost. Optimizing batch scheduling under TOU tariffs in these enterprises will be of great significance. This study investigates a single machine batch scheduling problem under TOU tariffs. The objective is to minimize the total electricity cost by optimally scheduling all jobs within a given planning horizon. Two mixed integer linear programming (MILP) models, which are respectively based on time-index formulation and time-interval formulation, are developed for the problem. The models are solved by CPLEX. Computational results on randomly generated instances demonstrate the effectiveness of the proposed approaches.

#1784 Applications of Support Vector Machines to Standby Power Reduction

Jin-Shyan Lee (TW), Jian-Da Tong (TW)

In recent years, energy conservation is a very important issue. The main purpose of this paper is to deal with standby power reduction. Most existing approaches combine multiple meter outlets with the remote control to reduce the standby power of household appliances. However, they have to use extra sensors or even require manual operations to achieve desired results. In this paper, a novel method applying the support vector machines (SVMs) algorithm with a smart meter to analyze users' daily usage of household appliances has been proposed. By using the prediction of future usage, the automatic power management and power consumption reduction could be achieved.

#1038 Measuring the Effectiveness of Zonal Heating Control for Energy Saving

Mohamed Farhat Ibrahim (CA), Mostafa Mohamed (CA), Behrouz H. Far (CA)

This paper measures the heat energy consumption in a typical Canadian house taking into account a commonly used furnace. The aim of this work is to measure and analyze the energy savings for homes if zonal heat control system is used. A control circuit is used to sense the indoor and outdoor temperature and turns the furnace ON or OFF according to the preferred temperature chosen by the householders. Zonal heat control is performed by closing the heating vents in the unoccupied areas in the house during night times. Over one-month test period in wintertime; the measurement results proved that this zonal control system can save the energy of heating up to 36% depending on the weather temperature. The study results support the anticipation that, more save in energy consumption can be reached by controlling the delivery of heat on a zone-by-zone basis.

Model-Based Systems Engineering

October 10 (Monday), 17:00-18:30, Sofitel Budapest Chain Bridge, Bellevue 2
Session Chair: Jatindra Kumar Deka

#1461 Simulating SysML Transportation Models

Christos Kotronis (GR), Anargyros Tsadimas (GR), George-Dimitrios Kapos (GR), Vassilis Dalakas (GR), Mara Nikolaidou (GR), Dimosthenis Anagnostopoulos (GR)

Model-based Systems Engineering (MBSE) promises efficient and effective systems development, by providing integrated system model views and streamlining the transition between different development activities. For instance, system testing with simulation should be provided as a simple facility for the performance evaluation of complex systems. Transportation systems are complex and their behavior is determined by dynamic factors. However, research efforts define simulation models for transportation systems, using custom or simulation-specific notation. Additionally, model-based approaches for transportation systems emphasize peripheral issues, such as safety conditions and environmental impact. In this work, a framework that enables seamless performance evaluation of Railway Transportation System (RTS) models via simulation is proposed. The de facto standard for MBSE modeling, Systems Modeling Language (SysML), is selected as the modeling infrastructure, while other standards, like Query/View/Transformation (QVT), are used for the generation of executable simulation models. The latter can be simulated in Discrete Event System Specification (DEVS) simulators and the simulation results are returned in the RTS SysML model. Additionally, the application of the framework in the public RTS of Athens and the obtained simulation results are presented.

#2409 Detecting and Diagnosing Open Faults in NoC Channels on Activation of Diagonal Nodes

Biswajit Bhowmik (IN), Santosh Biswas (IN), Jatindra Kumar Deka (IN), Bhargab B. Bhattacharya (IN)

In an on-chip network (NoC), the channels often experience several open faults because of certain manufacturing or in-field defects. Such faults may cause enormous loss of packets degrading the reliability and performance of the system. A reliability-aware NoC should include a module that has the capability of detecting and locating an open fault in the channels so as to enable alternative routing paths and to prevent excessive packet loss. This paper proposes an on-line test scheme that detects open faults and locates the faulty channel-wires in an NoC. The proposed scheme makes use of diagonal-driven test strategy and scales well when the size of the NoC increases. We evaluate the performance of an NoC under large-traffic scenario and our simulation results establish the effectiveness of the proposed scheme in terms of several network-metrics.

#2407 A Topology-Agnostic Test Model for Link Shorts in on-Chip Networks

Biswajit Bhowmik (IN), Jatindra Kumar Deka (IN), Santosh Biswas (IN), Bhargab B. Bhattacharya (IN)

With the ever-shrinking global geometries on a die and the concomitant rise in the complexity of interconnections in an on-chip network (NoC), the links used therein often suffer from various manufacturing defects such as shorts. These defects not only cause logical or functional errors but also give rise to various other system level failures such as duplication, misrouting, or dropping of a packet, thereby impacting the performance of the network significantly. This paper proposes an on-line test method that detects the presence of pairwise shorts, if any, and identifies the faulty links. Several performance metrics are evaluated to demonstrate the impact of these faults, and simulation results demonstrate 100%coverage. The proposed method scales well to large-size NoCs irrespective of the topology and link-width.

#1334 Predicting Crime with Routine Activity Patterns Inferred from Social Media

Mohammad Al Boni (US), Matthew Steven Gerber (US)

Prior work in statistical crime prediction has not investigated micro-level movement patterns of individuals in the area of interest. Geotagged social media implicitly describe these patterns for many individuals; however, methods of extracting such patterns and integrating them into a statistical model remain undeveloped. This paper presents methods and experiments that begin to fill this gap. We investigate the use of spatiotemporally tagged Twitter posts for inferring micro-level movement patterns, and we use real crime data to develop and test a model informed by such patterns. Our results indicate improved performance for 15 of the 20 crime types studied, when comparing our model with a baseline that does not use micro-level movement patterns.

#1884 Optimal Allocation of Ad Inventory in Real-Time Bidding Advertising Markets

Juanjuan Li (CN), Xiaochun Ni (CN), Yong Yuan (CN), Rui Qin (CN), Fei-Yue Wang (CN)

With the rapid development of big data analytics in online marketing, real-time bidding (RTB) has emerged as a promising business model in recent years and now becomes one of the major online advertising channels. Based on analysis of Web Cookies, RTB platforms are able to precisely identify the features and preferences of target audiences visiting publishers' websites, and forward the information to competing advertisers submitting bids for their best-matched audience in real-time ad auctions. As the supplier of ad impressions, publishers typically have multiple channels to sell their ad impressions (i.e., ad inventory), making their strategies for allocating ad inventory one of the most critical research problems. In this paper, we strive to study publishers' optimal strategy of allocating ad inventory across online channel of RTB-based auctions and offline channel prevailingly realized in the form of guaranteed contracts. Considering the ad reserve price as the control variable, we establish the optimization model. We also explicitly take the default penalty in offline channels into consideration, so as to balance the short-term online revenue and long-term offline revenue. In our work, we analyze altogether three kinds of strategies for publishers to allocate their ad inventory in pursuit of the optimal strategy, and validate our model and analysis via computational experiments. We find that there is no dominant strategy that can outperform others in all cases, and interestingly, publishers using the hybrid-channel strategy do not always gain more revenues than those using the single-channel strategy.

Human Factors

October 11 (Tuesday), 14:00-15:30, Sofitel Budapest Chain Bridge, Academy 3

Session Chairs: Setsuo Tsuruta, Takashi Kawabe

#2293 Dictionary-Based Sentiment Classification Method Considering Subject-Predicate Relation

Rainer Knauf (DE), Yukiko Yamamoto (JP), Takashi Kawabe (JP), Setsuo Tsuruta (JP)

In order to achieve enhanced credibility of social networking services such as twitter, it is necessary to (1) identify the topic and to (2) check, if the majority of the tweets having the same topic show the same opinion. Therefore, it is indicated to improve the accuracy for analyzing the caller's emotional expression of the "emotional polarity classification", which is used for opinion classification. For this reason, a semantic orientation acquisition technique is proposed, which integrates "another part-of-speech based semantic orientation dictionary" and a subject predicate relationship considered semantic orientation dictionary of phrases (semantic orientation table). As a feature of the proposed method, a semantic orientation of an adjective or predicate due to its greatest impact on identification semantic orientation of each tweet or document is determined. In addition, the dictionary is created by using tweets. Usual methods have problems with the opinion classification (90 % of the tweets are judged negative), but the proposed method has a more correct to negative judge rate of 60%. An integrated semantic orientation dictionary of phrases is used to improve precision of the classification.

#1508 Unmanned Aerial Vehicle Control Interface Design and Cognitive Workload: A Constrained Review and Research Framework

Wenjuan Zhang (US), David Feltner (US), James Shirley (US), Manida Swangnetr (TH), David B. Kaber (US)

Unprincipled design of unmanned aerial vehicle (UAV) control interfaces can increase operator cognitive workload and degrade performance. It is important to identify optimal interface design features that can serve to prevent cognitive overload under demanding task scenarios and environmental conditions. The present research summarized literature on critical issues in supervisory control interface design, current UAV interface design approaches and existing evaluation methods. A research framework was also proposed for a project to systematically and quantitatively relate UAV control interface features to cognitive workload outcomes. The framework also supports development an effective and efficient interface evaluation tool to predict cognitive workload based on specific design features.

#1091 Effect of Physical Workload on Navigation Task Performance by High-Fit Young Males

Maryam Zahabi (US), Wenjuan Zhang (US), Carl Pankok (US), Mei Ying Lau (US), James Shirley (US), David B. Kaber (US)

Many occupations require both physical exertion and the ability to navigate in an environment, simultaneously. This study assessed the effect of physical exertion intensity on direction determination and distance estimation. Thirty high fit young males between the ages of 18 and 34 completed a lab experiment. Results showed that while high fit young males were accurate in determining direction across levels of physical exertion, they were significantly less accurate in distance estimation under high exertion intensity. Although accuracy in direction determination was not affected by physical exertion level, response time was significantly shorter when participants were subject to low physical loading in comparison to medium and high loading. In addition, we found that distance estimation response time increased as physical workload increased. Findings of this study can be used to enhance presentation of navigation information in occupations that require concurrent physical activity and navigation.

#1848 Influence of Cultural Factors in Dynamic Trust in Automation

Shihyi Chien (US), Michael Lewis (US), Katia Sycara (US), Jyi Shane Liu (TW), Asiye Kumru (TR)

The use of autonomous systems has been rapidly increasing in recent decades. To improve human-automation interaction, trust has been closely studied. Research shows trust is critical in the development of appropriate reliance on automation. To examine how trust mediates the human-automation relationships across cultures, the present study investigated the influences of cultural factors on trust in automation. Theoretically guided empirical studies were conducted in the U.S., Taiwan and Turkey to examine how cultural dynamics affect various aspects of trust in automation. The results found significant cultural differences in human trust attitude in automation.

#1701 Study on Communication Channel Property of Deliberation Support System for Citizen Participation: Comparison between FTF Type and Social Media Type Discussions

Asai Toshiko (JP), Chiaki Takenouchi (JP), Akinori Minazuki (JP), Hidehiko Hayashi (JP)

Because of the spread of using social networking service in various situations, it is becoming easier to transmit information. However, the communication channel of SNS has some negative aspects like a lack of rich expressions of information compared to the communication channel of face-to-face (FTF). Also, in the FTF communication environment, it is necessary to improve a limitation of room or costs of moving to a place. In recent years, under the influence of future uncertainty, much attention has been paid to group decision-making based on discussion as one side of democracy. Deliberation Democracy is one of them. From the viewpoint of information communication technology and deliberation democracy, we will consider effective utilization of Deliberation Support System. In this paper, it is targeted the citizen deliberation or dialogue or discussion. We analyzed that the difference of Communications with the Social Media and FTF type. We clarified the difference of the communications frequency and the content between participants and viewers. As a result, when the case not done was compared when social media were used, a synchronous number of conversations (conversation rates) obtained the difference (93.6% (social media use), 67.6% (Do not use it)). Therefore, social media are used, their active was clarified. Moreover, it was clarified that the extension of the discussion that had been occasionally expressed only by the discussion between the performers tended to be brought by the viewer in the analysis of a qualitative content.

Human Performance Modeling

October 12 (Wednesday), 17:30-19:00, InterContinental Budapest, Ballroom II

Session Chairs: Mitsuru Higashimori, Takahiro Wada

#1347 Computation of the Vestibulo-Ocular Reflex for eye closure based on the 6DOF-SVC model

Tomoya Uefune (JP), Takahiro Wada (JP), Kohei Sonoda (JP)

Many mathematical models have been proposed to represent the Vestibulo-Ocular Reflex (VOR) that occurs during human head movement. It is known that the accuracy of these conventional models decreases when humans take on additional mental tasks. On the other hand, the 6DOF-SVC model, a mathematical model of motion sickness caused by the vestibular sensory system, includes a sub-model block representing the prediction accuracy of their own body movement, which is thought to be affected by mental tasks. Therefore, we aimed to describe the influence of mental tasks on VOR, and proposed a new mathematical model of VOR that utilizes estimated body movement calculated by the 6DOF-SVC model for calculating VOR. First, simulation experiments that compared human sensation in the horizontal direction during off-centered rotation based on measurements obtained from subjects, demonstrated that the direction of the gravito-inertial acceleration (GIA) estimated by the proposed model was in accordance with its human sensation in the steady state. Second, a model evaluation experiment was conducted to compare the measured VOR with the estimated VOR. The result demonstrated that the accuracy of the proposed model is as high as that of the conventional model. This suggests that the proposed model successfully includes the effect of estimation of body movement without decreasing the accuracy of the model compared to the conventional model.

#1820 Exact Maximum Entropy Inverse Optimal Control for Modeling Human Attention Scheduling and Control

Felix Martin Schmitt (DE), Hans-Joachim Bieg (DE), Dietrich Manstetten (DE), Michael Herman (DE), Rainer Stiefelhagen (DE)

Maximum Causal Entropy (MCE) Inverse Optimal Control (IOC) has become an effective tool for modeling human behavior in many control tasks. Its advantage over classic techniques for estimating human policies is the transferability of the inferred objectives: Behavior can be predicted in variations of the control task by policy computation using a relaxed optimality criterion. However, exact policy inference is often computationally intractable in control problems with imperfect state observation. In this work, we present a model class that allows modeling human control of two tasks of which only one be perfectly observed at a time requiring attention switching. We show how efficient and exact objective and policy inference via MCE can be conducted for these control problems. Both MCE-IOC and Maximum Causal Likelihood (MCL)-IOC, a variant of the original MCE approach, as well as Direct Policy Estimation (DPE) are evaluated using simulated and real behavioral data. Prediction error and generalization over changes in the control process are both considered in the evaluation. The results show a clear advantage of both IOC methods over DPE, especially in the transfer over variation of the control process. MCE and MCL performed similar when training on a large set of simulated data, but differed significantly on small sets and real data.

#1177 Human Skill Capture: A Hidden Markov Model of Force and Torque Data in Peg-in-a-Hole Assembly Process

Yu Chen Zhao (GB), Ali Al-Yacoub (GB), Yee Mey Goh (GB), Laura Justham (GB), Niels Lohse (GB), Mike Jackson (GB)

A new model has been constructed to generalise the force and torque information during a manual peg-in-a-hole (PiH) assembly process. The paper uses Hidden Markov Model analysis to interpret the state topology (transition probability) and observations (force/torque signal) in the manipulation task. The task can be recognised as several discrete states that reflect the intrinsic nature of the process. Since the whole manipulation process happens so fast, even the operator themselves cannot articulate the exact states. Those are tacit skills which are difficult to extract using human factors methodologies. In order to programme a robot to complete tasks at skill level, numerical representation of the sub-goals are necessary. Therefore, those recognised 'hidden' states become valuable when a detail explanation of the task is needed and when a robot controller needs to change its behaviour in different states. The Gaussian Mixture model (GMM) is used as the initial guess of observations distribution. Then a Hidden Markov Model is used to encode the state (sub-goal) topology and observation density associated with those sub-goals. The Viterbi algorithm is then applied for the model-based analysis of the force and torque signal and the classification into sub-goals. The Baum-Welch algorithm is used for training and to estimate the most likely model parameters. In addition to generic states recognition, the proposed method also enhances our understanding of the skill based performances in manual tasks.

#1088 Combining 3D Joints Moving Trend and Geometry Property for Human Action Recognition

Bangli Liu (CN), Hui Yu (GB), Xiaolong Zhou (CN), Honghai Liu (CN)

Depth image based human action recognition has attracted many attentions due to the popularity of the depth sensors. However, accurate recognition still remains a challenge because of various object appearances, poses and video sequences. In this paper, a novel skeleton joints descriptor based on 3D Moving Trend and Geometry (3DMTG) property is proposed for human action recognition. Specifically, a histogram of 3D moving directions between consecutive frames for each joint is constructed to represent the 3D moving trend feature in spatial domain. The geometry information of joints in each frame is modelled by the relative motion with the initial status. The proposed feature descriptor is evaluated on two popular datasets. The experimental results demonstrate the superior performance of our method over the state-of-the-art methods, especially the higher recognition rates for complex actions.

#1130 Evidence of Usability: Evaluation of Burn ICU Clinician Decision Support

Christopher Nemeth (US), Tony Hamilton (US), Dawn Laufesweiler (US), Maria Serio-Melvin (US), Josh Blomberg (US), Craig Fenrich (US), Sarah Murray (US), Jeremy Pamplin (US)

Burn Intensive Care Unit (BICU) clinicians and clinical teams need to make time-pressured diagnostic and therapeutic decisions as they care for fragile patients. The decisions and related behaviors that we term "cognitive work" rely on complex sets of information that are currently fragmented among multiple databases. The efforts clinicians must make to use them and other information sources pose barriers that delay patient care and increase care cost, length of stay, and the potential for misadventures. We report on the results of a usability assessment to evaluate the decision and communication support prototype that we have developed over the past three years. Initial results indicate the research design, development, as well as close collaboration among researcher, developer and clinician, have resulted in a prototype that clinicians indicate successfully supports their work. We anticipate that better support for decision making and communication among members of the ICU staff who use this Cooperative Communication System (CCS) will improve efficiency and reliability, and as a result, improve patient safety and optimize patient outcomes.

Human-Machine Cooperation and Systems

October 11 (Tuesday), 14:00-15:30, Sofitel Budapest Chain Bridge, Academy 4
Session Chairs: Michael McCourt, Keiichi Horio

#1522 Passive Switched System Analysis of Semi-Autonomous Systems

Michael McCourt (US), Ryan M Robinson (US), William D Nothwang (US), Emily Doucette (US), Jess Willard Curtis (US)

While autonomous capabilities have proliferated across a wide range of commercial and domestic applications, some tasks require intermittent aid from a human operator. Guaranteeing the safety of these intermittently-teleoperated systems requires stability guarantees that hold in the presence of switching. In this paper, we consider the problem of controlling a robotic vehicle using both a human controller and an autonomous controller. The strategy is to allow the human operator to switch between manual control and autonomous control as needed. The feedback loop is analyzed and shown to be stable using a notion of passivity from nonlinear system analysis. Finally, an example is provided to demonstrate the approach.

#1537 Towards human-robot interaction: a framing effect experiment

Paulo Eduardo Ubaldino De Souza (FR), Caroline Ponzoni Carvalho Chanel (FR), Sidney N Givigi (CA), Frederic Dehais (FR)

Decision making is a critical issue for humans operating unmanned vehicle. However, it is well admitted that many cognitive biases affect human judgments leading to suboptimal or irrational decisions. The framing effect is a typical cognitive bias yielding people to react differently depending of the context, the probability of the outcomes and how the problem is presented (loss vs. gain). There is a need to better understand the effects of these biases in operational contexts to optimize human robot interactions. We therefore conducted an experiment involving a framing paradigm in a search and rescue mission (earthquake) and in a Mars rock sampling mission. We manipulated the framing (positive vs. negative) and the probability of the outcomes. Our findings revealed that the way the problem was presented (positively or negatively framed) and the emotional commitment (saving lives vs. collecting the good rock) statistically affected the choices made by the human operators.

#1588 Online motion synthesis with minimal intervention control and formal safety guarantees

Martijn J.A. Zeestraten (IT), Aaron Pereira (DE), Matthias Althoff (DE), Sylvain Calinon (CH)

We present a framework for online coordinated obstacle avoidance with formal safety guarantees. Such a formally verified trajectory planner can be used in shared human-robot workspaces to guarantee safety. The obstacle avoidance is based on estimation of the human occupancy on two different time scales. A long-term plan is created based on a probabilistic task representation, learned by demonstration, and an estimate of the human occupancy to be avoided. Using an additional overapproximative, short-term prediction of human motion we guarantee that the robot can always account for sudden or reflex movements. We demonstrate our two-level obstacle avoidance in simulation. The results show that our method reduces the number of safety stops one would encounter when using only the formal safety verification, and synthesizes alternative movement plans that preserves the coordination observed in the original demonstrations.

#1355 Overcoming Drawback of Feature Instantaneous Bandwidth Using EMD for Epileptic Seizure Classification by RMS frequency

Arindam Gajendra Mahapatra (JP), Keiichi Horio (JP)

The work addresses classification of EEG signals into seizure and non-seizure by applying EMD and SVM with proposal of new feature Root Mean Square (RMS) frequency and feature using Hilbert marginal spectrum which overcomes the drawback of feature instantaneous bandwidth. We have success in achieving the consistency with the new features which shows classification average accuracy of 97.72% and highest accuracy reached to 100% for seizure and non-seizure signals.

#1052 Determining mission evolution through UAV telemetry by using decision trees

Juan Jesús Roldán (ES), Pablo Garcia-Aunon (ES), Jaime del Cerro (ES), Antonio Barrientos (ES)

The control and monitoring of UAV missions is a challenge in terms of operator workload. Two relevant issues are the situational awareness and the decision support of operators. This paper proposes a system that is able to analyze the telemetry of UAV to deduce the state of mission. This system uses Petri nets for determining the state and decision trees for estimating the evolution. Both the Petri nets and the decision trees are generated automatically from the telemetry of previous missions. The whole system is validated by monitoring a set of UAV missions in a realistic simulator. The results can be applied to diverse areas, including the development of intelligent and adaptive interfaces or decision support systems.

Human-Computer Interaction

October 12 (Wednesday), 09:30-11:00, Sofitel Budapest Chain Bridge, Bellevue 1

Session Chairs: Georgios Fainekos, Jonghoon Seo

#1972 PAVES: Partnering with Autonomous Vehicles, Environments, and Systems

Umesh Krishnamurthy (US), Maglio (US)

Despite the growing prominence and capabilities of self-driving cars, little is known about human interaction with such autonomous vehicles. We are studying human interaction with multiple levels of automation and navigation in a simple driving simulator to discover principles for interaction design that encourage effective partnership between people and automated vehicles. We have conducted two experiments so far. In the first, participants completed driving tasks based on two different factors: automated versus manual control and navigation in low-level versus high-level language, which were combined via a factorial design into four conditions for each participant in the form of different driving scenarios. Performance was measured by travel time, frequency of driving and navigational errors, and levels of user satisfaction. The second iteration had all automated driving, with participants merely supervising while we gave varying amounts of verbal input.

#1883 A study of Displaying 3D Electronic Text Using Augmented Reality via Leap Motion

Seiji Sugiyama (JP), Miyuki Shibata (JP), Satoshi Hiratsuka (JP)

In this research, a new displaying and controlling method for three dimensional electronic texts using augmented reality via Leap Motion that is a very small and reasonable hand motion sensor is proposed. Recently, electronic texts in two dimensions have been popularized because of developed tablets with high quality display, easy storing and retrieving through the Internet better than paper media. However, it is difficult to understand contents written in separated pages, to feel physical thickness, to tie plural pages simultaneously, and to transform paper shapes or viewing angles. To cope with these difficulties, electronic texts become 3D model on web browsers and can be controlled in 3D via hand motions using a contact-less sensor in this research. As a result, operational feeling such as real paper media can be realized on PC. Our prototype system that can display 3D electronic texts and can be controlled via hand motions is presented.

#1735 ColorCodeAR: Large identifiable ColorCode-based augmented reality system

Seungho Chae (KR), Jonghoon Seo (KR), Yoonsik Yang (KR), Tack-Don Han (KR)

Augmented reality (AR) is widely used in various applications of computer vision, such as marker-based AR and markerless-based AR. These AR techniques are used in various fields, including industry, education, and medicine. Using marker-based AR, employees can easily perform step-by-step maintenance and repairs, and they can register parts information for large plants. However, conventional marker-based AR relies on a relatively small number of recognizable IDs compared to barcode markers. In this paper, to address the insufficient identification volume in conventional AR systems, we integrate barcode-based code technology with marker-based AR technology. Based on the results of an experiment, we applied ColorCode to our marker-based AR system. Nevertheless, difficulties arise when applying ColorCode to an AR system, owing to its recognition distance and relatively small size, compared to other AR codes. In this paper, therefore, we complemented quad detection with a tracking technique for various angles and distances, facilitating reliable recognition of the color-code-based AR system, Moreover, we added a tracking module to address the system's failure to detect markers. The experimental results demonstrate that the proposed system offers stable recognition.

#2024 Arabic Sign Language Recognition System based on Wavelet Networks

Fatma Guesmi (TN), Tahani Bouchrika (TN), Olfa Jemai (TN), Mourad Zaied (TN), Chokri Ben Amar (TN)

Developing an automatic arabic sign language recognition system is of great importance, it can be used as a communication means between hearing-impaired and other people. Such systems, are generally composed of two main stages: Hand detection and hand gesture recognition. To ensure these two steps, two versions of wavelet network classifiers will be used aiming at comparing their performances to employ the best one in our application. These two classification engines are the wavelet network classifier learnt by fast wavelet transform (FWNC) and the separator wavelet network classifier (SWNC). The exprimental results show the effectiveness of our proposed approaches of hand detection and hand gestures recognition.

#2289 Extended LTLvis Motion Planning Interface

Wei Wei (US), Kangjin Kim (US), Georgios Fainekos (US)

This paper introduces an extended version of the Linear Temporal Logic (LTL) graphical interface. It is a sketch based interface built on the Android platform which makes the LTL control interface more straightforward and friendly to non-expert users. By predefining a set of areas of interest, this interface can quickly and efficiently create plans that satisfy extended plan goals in LTL. The interface can also allow users to customize the paths for this plan by sketching a set of reference trajectories. Given the custom paths by the user, the LTL specification and the environment, the interface generates a plan balancing the customized paths and the LTL specifications. We also show experimental results with the implemented interface.

Human-Machine Cooperation and Systems and Intelligent Internet Systems

October (10 Monday), 17:00-18:30, InterContinental Budapest, Duna Salon III

Session Chairs: Shing-Hong Liu, Sang-Wook Kim

#2377 A Wearable ECG Apperatus for Ubiquitous Health Care

Shing-Hong Liu (TW), Guo-He Cai (TW), Yung Fa Huang (TW), Yung-Fu Chen (TW)

The goal of this research is to develop a wearable electrocardiogram (ECG) apparatus with Bluetooth 4.0 function which can detect the heart beats, mental index and physical activity in real time. It measured one lead ECG signal. Its specification follows the standard of International Electrotechnical Commission (IEC) for medical electrical equipment and ambulatory electrocardiographic systems (Holter ECG system). Moreover, its ingress protection rating has IP 68 degree. Thus, the user could wear it all day and to do any exercise including swimming. In order to let patients feeling comfortable, its weight is light and could full run above 24 hours. The data was storage in a 4G flash memory. We also proposed a method to detect the heart beats and frequency parameters of heart rate variability (HRV) in real time. This algorithm can be embedded in a single chip microcontroller. We used the MIT-BIH Arrhythmia Database to evaluate the performance of our designed system. The sensitivity and positive predictivity arrives 99.7% and 99.0%. The results show our designed Bluetooth wearable ECG apparatus can record the ECG signal and detect the heart beats, HRV and step counts in real time. It is very suitable to apply in the ubiquitous healthcare.

#1873 Recommendation of Research Papers in DBpia: A Hybrid Approach Exploiting Content and Collaborative Data

Yeon-Chang Lee (KR), Jungwan Yeom (KR), Kiburm Song (KR), Jiwoon Ha (KR), Kichun Lee (KR), Jangho Yeo (KR), Sang-Wook Kim (KR)

DBpia is the largest digital-bibliography service provider in Korea. It provides several convenience functions for researchers. DBpia users (i.e., researchers) can search for papers via several search routes such as publications, publishers, authors, and keywords for their convenience. Although the researchers can exploit the search functions, they may still have a number of search results as candidate papers to read. Therefore, it is crucial to provide a function of recommending most relevant papers to an individual user. In this paper, we (1) discuss several methods with four datasets of DBpia in the context of paper recommendation using content-based or graph-based recommendation, and (2) propose a hybrid approach suitable for paper recommendation combining the content-based and the graph-based approaches.We lastly conduct extensive experiments by a real-world academic literature dataset in DBpia to verify the effectiveness of our proposed approach.

#1145 Obstacle Avoidance for Passive Robot Walking Helper Based on Receding Horizon Control

Yi-Hung Hsieh (TW), Chun-Hsu Ko (TW), Kuu-Young Young (TW)

With the arrival of aging society, the passive robot walking helper is introduced to provide safe mobility for the elders, which features continuous energy dissipation from the system and is thus intrinsically safe. As both static and moving obstacles may be present in daily activities, obstacle avoidance during guidance is very imperative for its practical use, which motivates us to propose such a scheme based on receding horizon control. With a desired goal to reach, the proposed scheme first plans a smooth path for the walking helper to follow. A novel strategy, combined with receding horizon control, is then proposed to avoid the incoming obstacles detected by the equipped sensing system. Experiments based on our developed passive robot walking helper, i-Go, are conducted in real environments to demonstrate the effectiveness of the proposed scheme.

#1541 Contact Distinction in Human-Robot Cooperation with Admittance Control

Fotios Dimeas (GR), Alexandros Kouris (GR), Nikos Aspragathos (GR)

The emerging field of physical human-robot interaction raises the need to distinguish collisions over intended contacts in order to guarantee safe and seamless interaction. In this paper, a novel contact distinction method is proposed that monitors the externally applied forces/torques and is able to distinguish unexpected collisions from intended contacts during cooperative tasks. The method is based on a frequency domain analysis of the externally applied forces using the Fast Fourier Transform. Moreover, a tuning method is proposed to adjust the thresholds for the detection, according to the desired dynamic behavior of the admittance controller. The collision distinction method is evaluated experimentally in a human-robot cooperation task with multiple subjects using a 7DOF LWR manipulator.

#1307 A control architecture for hybrid underwater intervention systems

Juan Carlos García Sánchez (ES), Javier Pérez (ES), Paulo Menezes (PT), Pedro J. Sanz (ES)

As far as we know, currently all the underwater interventions, requiring robotic manipulation, are carried out by using a well-known technology, based on the commercial work class ROVs (Remotely Operated Vehicles). These systems require a lot of support, including a vessel in the surface, where a pilot (i.e. user expert) is able of teleoperating the actions of the ROV by means of an umbilical cable. On the other hand, from the last ten years new research has been developed, promoting in the market the so called Autonomous Underwater Vehicles (AUVs), enabling interventions. Obviously the AUVs have some main advantages over ROVs: no vessel, umbilical or pilots are needed now, but presenting a critical drawback: any kind of potential manipulation skills are impossible. Thus, the present situation becomes in a new vehicle: the Hybrid-ROV (HROV), trying to join the best of both systems, ROVs and AUVs. However, new problems arise concerning the HROV control. Now the system can operate in two different ways: autonomous or teleoperated, and so, a new control approach should be developed. This paper presents a control architecture for an HROV, discussing details of this approach from the human-robot interaction viewpoint.

Evolutionary Computation

October 12 (Wednesday), 09:30-11:00, Sofitel Budapest Chain Bridge, Academy 3
Session Chairs: Ana Maria de Almeida, Hidehiro Nakano

#1383 Semantic Segmentation using Three-Dimensional Cellular Evolutionary Networks

Ken Shimazaki (JP), Tomoharu Nagao (JP)

Image segmentation and image recognition are challenging processes, and the methods of merging those two processes like semantic segmentation have been studied. However, it is a lot of labor to construct the processes of segmentation and recognition manually, so automatic construction of those approaches using machine learning or evolutionary computation have been proposed. In this paper, we propose a model of pixel-wise image segmentation and recognition using Cellular Evolutionary Networks (CEN). Our proposed model is composed of a regular array of the identical feed forward networks, represented in Cartesian Genetic Programming (CGP), and each CGP connects with neighbor CGPs. Besides, we also propose a new model of CEN called Three-Dimensional Cellular Evolutionary Networks (3D-CEN), which is composed of multiple CENs. We applied CEN and 3D-CEN to road scene images and verified the effectiveness of our method, and experimental results showed that our new model acquired better performance compared with other methods if efficient evolution for CEN is done.

#1888 Improved NSGA-III using neighborhood information and scalarization

Burhan Khan (AU), Michael Johnstone (AU), Samer Hanoun (AU), Chee Peng Lim (AU), Douglas Creighton (AU), Saeid Nahavandi (AU)

Recent efforts in the evolutionary multi-objective optimization (EMO) community focus on addressing shortcomings of current solution techniques adopted for solving many-objective optimization problems (MaOPs). One such challenge faced by classical multi-objective evolutionary algorithms is diversity preservation in optimization problems with more than three objectives, namely MaOPs. In this vein, NSGA-III has replaced the crowding distance measure in NSGA-II with reference points in the objective space to ensure diversity of the converged solutions along the pre-determined solutions in the environmental selection phase. NSGA-III uses the Pareto-dominance principle to obtain the non-dominated solutions in the environmental selection phase. However, the Pareto-dominance principle loses its selection pressure in high-dimensional optimization problems, because most of the obtained solutions become non-dominated. Inspired by θ-DEA, we address the selection pressure issue in NSGA-III, by exploiting the decomposition principle of MOEA/D using reference points for multiple single-objective optimization problems. Moreover, similar to MOEA/D, the parent selection process is restricted to the neighboring solutions, as opposed to random selection of parent solutions from the entire population in NSGA-III. The effectiveness of the proposed method is demonstrated on different well-known benchmark optimization problems for 3- to 10- objectives. The results compare favorably with those from MOEA/D, NSGA-III, and θ-DEA.

#1390 Hierarchical feature construction for image classification using genetic programming

Masanori Suganuma (JP), Daiki Tsuchiya (JP), Shinichi Shirakawa (JP), Tomoharu Nagao (JP)

In this paper, we design a hierarchical feature construction method for image classification. Our method has two feature construction stages: (1) feature construction by a combination of primitive image processing filters, and (2) feature construction by evolved filters. We verify the image classification performance of the proposed method on the MIT urban and nature scene dataset. The experimental results show that the two-stage feature construction improves the classification accuracy compared to single stage feature construction. In addition, the proposed method outperforms several existing feature construction methods.

#1802 A genetic algorithm application for automatic layout design of modular residential homes

Ana Maria de Almeida (PT), Bruno Taborda (PT), Filipe Santos (PT), Kwiecinski Krystian (PL), Sara Eloy (PT)

This work presents an evolutionary approach that enables the automatic design of modular residential homes in mass customized production. Given a set of modular placement rules for the design, the formal problem can be viewed as a two-dimensional single large object placement problem with fixed dimensions and additional positioning constraints. This formulation results in the search of a floor plan layout constrained by dimensional and positional restrictions over a combinatorial size search space. A genetic algorithm strategy for the automation of floor plan design was implemented and shown to deliver the required design solution layouts. The layouts, when embedded into a proper graphical interface system will allow for future owners to acquire houses fitting their exact needs at affordable prices, improving the quality of living while simultaneously complying with a language of design.

#1943 Analysis for basic dynamics and performances of piecewise particle swarm optimizers

Tomoyuki Sasaki (JP), Hidehiro Nakano (JP), Arata Miyauchi (JP), Akira Taguchi (JP)

In our previous study, a piecewise-linear particle swarm optimizer (PPSO) has been proposed. The dynamics of each particle in PPSO can be controlled by two thresholds for convergence and divergence modes. Each threshold can be determined by the particle's trajectory and the system parameters. However, the conditions of these thresholds for finding desired solutions have not been clarified. In this paper, these conditions are investigated by the theoretical analysis and numerical experiments. Furthermore, the solving performances for threshold patterns are compared in the numerical experiments.

Neural Networks and Applications

October 12 (Wednesday), 17:30-19:00, Sofitel Budapest Chain Bridge, Academy 4

Session Chairs: Jan Faigl, Min Han

#1353 Self-Organizing Map-based Solution for the Orienteering Problem with Neighborhoods

Jan Faigl (CZ), Robert Pěnička (CZ), Graeme Michael Best (AU)

In this paper, we address the Orienteering problem (OP) by the unsupervised learning of the self-organizing map (SOM). We propose to solve the OP with a new algorithm based on SOM for the Traveling salesman problem (TSP). Both problems are similar in finding a tour visiting the given locations; however, the OP stands to determine the most valuable tour that maximizes the rewards collected by visiting a subset of the locations while keeping the tour length under the specified travel budget. The proposed stochastic search algorithm is based on unsupervised learning of SOM and it constructs a feasible solution during each learning epoch. The reported results support feasibility of the proposed idea and show the performance is competitive with existing heuristics. Moreover, the key advantage of the proposed SOM-based approach is the ability to address the generalized OP with Neighborhoods, where rewards can be collected by traveling anywhere within the neighborhood of the locations. This problem generalization better fits data collection missions with wireless data transmission and it allows to save unnecessary travel costs to visit the given locations.

#2032 A Novel Progressive Multi-label Classifier for Class-incremental Data

Mihika Dave (IN), Meng Joo Er (SG), Sahil Tapiawala (IN), Rajasekar Venkatesan (SG)

In this paper, a progressive learning algorithm for multi-label classification to learn new labels while retaining the knowledge of previous labels is designed. New output neurons corresponding to new labels are added and the neural network connections and parameters are automatically restructured as if the label has been introduced from the beginning. This work is the first of the kind in multi-label classifier for class-incremental learning. It is useful for real-world applications such as robotics where streaming data are available and the number of labels is often unknown. Based on the Extreme Learning Machine framework, a novel universal classifier with plug and play capabilities for progressive multi-label classification is developed. Experimental results on various benchmark synthetic and real datasets validate the efficiency and effectiveness of our proposed algorithm.

#1199 PID and Neural Net Controller Performance Comparsion in UAV Pitch Attitude Control

Muluken Regas Eressa (ET), Danchen Zheng (CN), Min Han (CN)

This paper reviews the performance difference and similarity in modeling system dynamics and the efficiency of error elimination with fewer fluctuation and adaptability to set point variation between the traditional fixed parameter proportional-integral-derivative controller and the model reference neural net controller applied to aircraft pitch attitude control. The designs of both controllers are presented. System identification using neural net was implemented to capture the system dynamics. Finally, the performances of the controllers were tested using a slow and fast varying input signals within the given bandwidth.

#1584 Incremental Learning of Neural Network Classifiers Using Reinforcement Learning

Sourabh Bose (US), Manfred Huber (US)

With the availability of more data, classification is increasingly important. However, traditional classification algorithms do not scale well to large data sets and are often not suited when only limited samples of the dataset are available at any point in time. The latter arises, for example, in streaming data when the accumulation of data a priori is infeasible either due to limitations in memory or computation, or due to privacy and data ownership limitations. In these situations, traditional classification algorithms are difficult to apply since they are generally not incrementally trainable on changing data sets. To address this, this paper presents a novel approach that first uses Reinforcement Learning to learn a policy to incrementally build neural network classifiers for a broad distribution of problems and subsequently applies it to new data to learn a classifier for this specific problem. In both phases, learning operates on a sequence of small, randomly drawn subsets of the data, thus making it suitable for streaming data and for very large data sets where processing the entire set is not feasible. Experiments comparing this approach with kernel SVMs and large neural networks applied to the complete dataset show that this approach achieves comparable performance. Additional experiments were done to evaluate the performance of this approach for real world, streaming datasets and datasets with concept drift properties.

Optimization

October 11 (Tuesday), 14:00-15:30, Sofitel Budapest Chain Bridge, Bellevue 2
Session Chairs: Jyh-Cheng Yu, Toshiyuki Miyamoto

#2429 A Population-Based Simulated Annealing Algorithm

Alireza Askarzadeh (IR), Leandro dos Santos Coelho (BR), Carlos Eduardo Klein (BR), Viviana Cocco Mariani (BR)

Simulated annealing (SA) is a solo-search algorithm, trying to simulate the cooling process of molten metals through annealing to find the optimum solution in an optimization problem. SA selects a feasible starting solution, produces a new solution at the vicinity of it, and makes a decision by some rules to move to the new solution or not. However, the results found by SA depend on the selection of the starting point and the decisions SA makes. In this paper, in order to ameliorate the drawbacks of the algorithm, a population-based simulated annealing (PSA) algorithm is proposed. PSA uses the population's ability to seek different parts of the search space, thus hedging against bad luck in the initial solution or the decisions. A set of benchmark functions was used in order to evaluate the performance of PSA algorithm. Simulation results accentuate the superior capability of PSA in comparison with the other optimization algorithms.

#2343 Evolutionary Algorithm Using Progressive Kriging Model and Dynamic Reliable Region for Expensive Optimization Problems

Jyh-Cheng Yu (TW), Suprayitno (TW)

Surrogate based optimization provides an efficient approach for expensive optimization requiring either costly experiments or time consuming simulations. However, a "good" surrogate model requires lots of training data which is impractical in applications. This work proposes an evolving algorithm, POSER, combining a progressive Kriging model and a constrained search in the dynamic reliable regions to provide a reliable and efficient search for a surrogate with limited generality. The proposed algorithm starts from a Kriging model from a small sample size and improves progressively using sequential infilling samples. In general, the prediction accuracy is worse for a design farther away from the training samples for an inadequate surrogate. Therefore, the prediction error of the Kriging model is applied to establish the reliable region of the surrogate to guide the evolutionary searches in the neighboring region of samples for a quasi-optimum. A hybrid infilling strategy switches between exploitation and exploration to improve sample efficiency. The reliable regional surrogate evolves and refines only at the most promising regions of optimum. The process iterates until the convergence of optimum. Optimization of two benchmark numerical functions and an engineering case study are shown and compared with previous literatures. The proposed algorithm outperforms the literature results with a much smaller sample, which demonstrates the robustness and efficiency in the future applications of expensive optimization.

#1357 Multi-Objective Embarrassingly Parallel Search with Upper Bound Constraints

Toshiyuki Miyamoto (JP), Masato Yasuhara (JP), Kazuyuki Mori (JP), Shoichi Kitamura (JP), Yoshio Izui (JP)

Optimization plays an important role in various disciplines of engineering. Multi-objective optimization is usually characterized by a Pareto front. In large scale multi-objective optimization problems, determining an optimal Pareto front consumes large time. Thus, parallel computing is used to speed up the search. Constraint programming is one of the logic-based optimization techniques for solving combinatorial optimization problems. In our previous study, we proposed the multi-objective embarrassingly parallel search (MO-EPS) for multi-objective constraint optimization, which combines two strategies: a constraint programming-based strategy to determine Pareto front and a parallel search for constraint programming. In this study, we propose the MO-EPS with upper bound constraints, an extended algorithm of the MO-EPS.

#1160 A novel algorithm for scheduling intrees on two parallel machines with unavailabilities

Khaoula Ben Abdellafou (TN)

This paper considers the two-parallel-machine scheduling problem with precedence constraints. One of the machines may not always be available due to machine breakdowns or preventive maintenance during the scheduling period. All execution and communication times between tasks are considered unitary and all unavailability dates are known in advance. The considered task graph (since tasks are related by precedence constraints) is an intree, where each task can have many predecessors but only one successor. The considered objective function in this paper is the makespan denoted Cmax. To solve the problem, a new optimal algorithm entitled Scheduling Intrees with Unavailability constraints (SIwU) is proposed. The used strategy is to find the best trade-off between the minimization of the communications and the minimization of the difference in load between the processors in order to minimize the makespan. Algorithm details and key ideas proving the optimality of the algorithm are described.

#1266 Novel Single-objective Optimization Problem and Firefly Algorithm-based Optimization Method

Ryuta Oosumi (JP), Kenichi Tamura (JP), Keiichiro Yasuda (JP)

This paper proposes a new formulation for single-objective optimization problems and a Firefly Algorithm (FA)-based optimization method for problem formulation. The formulated problem requires a set of solutions with approximately the same evaluation values and appropriate differences in relation to decision variables. The FA-based optimization method was developed based on an analysis of the FA search mechanism. Finally, the performance of the developed method is verified.

Machine Vision and Evolutionary Computation

October 11 (Tuesday), 11:00-12:30, Sofitel Budapest Chain Bridge, Bellevue 2
Session Chairs: Egbert Gedat, Helio Pedrini

#1169 Multiple Human Skeleton Recognition in RGB and Depth Images with Graph Theory, Anatomic Refinement of Point Clouds and Machine Learning

Egbert Gedat (DE), Pascal Fechner (DE), Richard Fiebelkorn (DE), Ralf Vandenhouten (DE)

Computer visual recognition of multiple human poses infers technological benefit in a variety of systems, including security surveillance, medical therapeutics, sports analytics and many more. For this goal the set of detected body parts on color or depth images must be aligned to reconstruct the skeletons of the humans. Here, an algorithm is introduced that models the body part point clouds using principal component analysis to obtain anatomically correct positions of joints, and that assembles the redundant and/or incomplete number of candidate joints with graph theoretical methods using Suurballe's k-shortest disjoint paths algorithm to build the skeletons. The computations were applied to MOCAP database motions rendered in Blender to produce idealized classified point clouds, and to real human depth images classified with decision forests similar to Shotton et al. For MOCAP data, in 68 images showing 3 persons all 204 skeletons were correctly aligned using 4.285 of 4.682 joints with no false assignment. For 33 real human images each showing 3 people, 71 skeletons were correctly detected with 1 false detection and 17 misses, which is promising with respect to non-perfect body part classification in real world.

#1868 Adaptive Video Shot Detection Improved by Fusion of Dissimilarity Measures

Anderson Carlos Sousa Santos (BR), Helio Pedrini (BR)

Due to the large amount of videos generated through several data sources, the development of efficient mechanisms for storing, indexing, retrieving and visualizing their content is a challenging task. Temporal video segmentation is the automatic process of detecting transitions in video sequences, which is a fundamental step in the analysis of video content. This work proposes and evaluates an improved shot detection method based on the fusion of multiple frame dissimilarity measures and an adaptive threshold strategy. Experimental results demonstrate that the combination of different temporal features associated with an adequate threshold estimation can substantially improve the performance of individual methods.

#2235 Reference Point Specification in MOEA/D for Multi-Objective and Many-Objective Problems

Hisao Ishibuchi (JP), Ken Doi (JP), Yusuke Nojima (JP)

Recently a number of evolutionary multi-objective optimization (EMO) algorithms have been proposed using the framework of MOEA/D (multi-objective evolutionary algorithm based on decomposition). Those algorithms are characterized by the use of uniformly distributed normalized weight vectors from which a set of uniformly distributed reference lines is generated. Their basic idea is to search for a Pareto optimal solution along each reference line. While they are different in various aspects such as fitness evaluation, solution assignment to each reference line, and solution replacement, they share the same basic idea (i.e., to search for a Pareto optimal solution along each reference line). The importance of weight vector specification has been emphasized in the literature. However, the specification of a reference point has not been examined in detail whereas it plays an important role as a starting point of all reference lines. The reference point usually consists of the best value of each objective over the examined solutions, which is an approximation of the ideal point. However, this approximation is not good in early generations where the true ideal point may be much better than the best value of each objective over the examined solutions (even if it is very good in later generations). Based on these discussions, we propose a reference point specification method.

#1911 An MOEA/D Combining with Tabu Search for a Double Row Layout Problem with Center Islands

Xueqing Liu (CN), Xingquan Zuo (CN)

Double row layout problem (DRLP) is to arrange facilities along two parallel rows to minimize the material flow cost. In this paper, we extend the DRLP to propose a DRLP with center-islands, termed DRLP-CI. A mixed integer programming (MIP) formulation is established for this problem. An improved MOEA/D with tabu search (TS) (MOEA/D-TS) is proposed to address it. Experiments verify the efficiency and effectiveness of the proposed approach. The MOEA/D-TS is better than CPLEX under limited computation time.

#1267 Functional Specialization Based Search Strategy for Multi-objective Optimization

Seijun Morita (JP), Kenichi Tamura (JP), Keiichiro Yasuda (JP)

In this paper, we propose a new search strategy based on functional specialization for multi-objective optimization and a new multi-objective optimization method. The proposed strategy is based on two ideas. The first idea is the state evaluation and classification of search points to realize an advanced search structure. The second idea is to use operations with different features to achieve an efficient search. The proposed method takes advantage of this search strategy to achieve high convergence and a well diversified solution set during multi-objective optimization. The performance of the proposed method was verified by a numerical simulation using typical benchmark problems.

Machine Learning

October 12 (Wednesday), 16:00-17:30, Sofitel Budapest Chain Bridge, Bellevue 2
Session Chairs: Han-Joon Kim, Lonnie Thomas Parker

#2099 An Online Universal Classifier for Binary, Multi-class and Multi-label Classification

Meng Joo Er (SG), Rajasekar Venkatesan (SG), Ning Wang (CN)

Classification involves the learning of the mapping function that associates input samples to corresponding target label. There are two major categories of classification problems: Single-label classification and Multi-label classification. Traditional binary and multi-class classifications are sub-categories of single-label classification. Several classifiers are developed for binary, multi-class and multi-label classification problems, but there are no classifiers available in the literature capable of performing all three types of classification. In this paper, a novel online universal classifier capable of performing all the three types of classification is proposed. Being a high speed online classifier, the proposed technique can be applied to streaming data applications. The performance of the developed classifier is evaluated using datasets from binary, multi-class and multi-label problems. The results obtained are compared with state-of-the-art techniques from each of the classification types.

#1442 A New Faster First Order Iterative Scheme for Sparsity-based Multitask Learning

Mridula Verma (IN), Prayas Jain (IN), Kaushal Kumar Shukla (IN)

Multitask learning methods facilitate learning multiple related tasks together and improvise results as compared to the schemes where each task is considered independently. In order to incorporate the shared information in multiple tasks, various regularizers have been integrated in pre-existing techniques. In this paper, we explore the problem of convex formulations of multitask learning with sparsity inducing regularizers. The main contribution of this paper is to introduce a novel first order iterative procedure (MTL-FIBM) which we prove to converge faster than previously existing work. Our method belongs to the class of proximal gradient-based techniques, where the loss function is considered to be smooth and the regularization function maybe non-smooth. We performed extensive experiments with synthetic as well as two real datasets namely School and Parkinson Tele-monitoring datasets and show that the experimental results agree with the theoretical analysis of our algorithm. Results demonstrate the efficacy and improvement in terms of speed and accuracy.

#1728 Intelligent Team Navigation and Coordination for Undersea Environments

Lonnie Thomas Parker (US), Scott R Sideleau (US), Ramprasad Balasubramanian (US)

As the number of unmanned vehicles within the undersea environment increases, the ability to relay information between agents in a timely and reliable way is a valuable capability. Two-way communication among static nodes within the undersea environment, alone, is a challenge riddled with uncertainty, both in terms of the quality of the information transmitted and the reliability of the established link. The problem is further complicated when these nodes are mobile, effectively changing their positions relative to each other. To mitigate the issues associated with underwater communications, we present a navigation strategy designed on principles of machine learning, specifically a Multi-Armed Bandit (MAB) approach. Our work leverages the probabilistic nature of the communications environment to dictate in situ next-waypoint selection for a two-agent scenario, expandable to N agents. We contrast a Markov bandit formulation with several approaches to waypoint selection to highlight the value of using intelligent decision making in situ. This work shows the relevance of real- world acoustic communications performance to real-time decision making for a team of autonomous vehicles.

#2291 Semantic Text Classification with Tensor Space Model-based Naïve Bayes

Han-Joon Kim (KR), Jiyun Kim (KR), Jinseog Kim (KR)

This paper presents a semantic naïve Bayes classification technique that is based upon our tensor space model for text representation. In our work, each of Wikipedia articles is defined as a single concept, and a document is represented as a 2nd–order tensor. Our method expands the conventional naïve Bayes by incorporating the semantic concept features into term feature statistics under the tensor-space model. Through extensive experiments using three popular document collections, we prove that the proposed method significantly outperforms the conventional naïve Bayes. Surprisingly, the classification performance amounts to almost 100% in terms of F1-measures when using Reuters-21578 and 20Newsgroups document collections.

#2419 Intelligent Anticipatory Agents for Changing Environments

Md Murad Hossain (AU), Sameer Alam (AU)

The agent computing paradigm is rapidly emerging as one of the powerful technology to deal with the uncertainty in dynamic environment. Recently, traditional learning classifier system are challenged by changes in the context. In this paper, an anticipatory agent based on the Anticipatory Learning Classifier System (ACS) for learning in changing environments is presented. This research aims to develop an agent learning architecture using anticipatory system that will enable intelligent agent to be able to detect environmental changes, adapt functionality at run-time to achieve goal. For achieving the intended target, an extension to the ACS framework called "Greedy Covering" to the ACS framework have been proposed. The novelty of the approach is in determining the changes in the environment and to generate optimal rules to adapt and reestablish the optimal policy to reach the goal state. The proposed algorithm is evaluated on several synthetic maze design and simulate a variety of changing environments. Experiment results indicate that up to 65% changes in an environment the ACS with the greedy covering can reestablish the optimal performance without increasing the number of classifiers.

Poster Sessions

October 10 (Monday)

InterContinental Budapest

	Poster Spot 1	Poster Spot 2
12:00-13:30	**Lunch**	
13:30-15:00	Poster Session I1	Poster Session I2
15:00-15:30	**Coffee break**	
15:30-17:00	Poster Session I3	Poster Session I4
17:00-18:00	Demo Session	
18:30-21:00	**BMI Reception**	

Sofitel Budapest Chain Bridge

	Poster Spot 1	Poster Spot 2
12:00-13:30	**Lunch**	
13:30-15:00	Poster Session S1	Poster Session S2
15:00-15:30	**Coffee break**	
15:30-17:00	Poster Session S3	Poster Session S4
17:00-18:30		

October 11 (Tuesday)

InterContinental Budapest

	Poster Spot 1	Poster Spot 2
09:00-09:30	**Coffee break**	
09:30-11:00	Poster Session I5	Poster Session I6
11:00-12:30	Poster Session I7	
12:30-14:00	**Lunch**	
14:00-15:30		
17:00-18:00	**Horse Show**	
18:00-19:00	**Award Ceremony**	
19:00-21:00	**Conference Dinner**	

Sofitel Budapest Chain Bridge

	Poster Spot 1	Poster Spot 2
09:00-09:30	**Coffee break**	
09:30-11:00	Poster Session S5	Poster Session S6
11:00-12:30	Poster Session S7	
12:30-14:00	**Lunch**	
14:00-15:30		
17:00-18:00	**Horse Show**	
18:00-19:00	**Award Ceremony**	
19:00-21:00	**Conference Dinner**	

October 12 (Wednesday)

InterContinental Budapest

	Poster Spot 1	Poster Spot 2
09:00-09:30	**Coffee break**	
09:30-11:00	Poster Session I8	Poster Session I9
11:00-12:30	Poster Session I10	Poster Session I11
12:30-14:00	**Lunch**	
14:00-15:30	Poster Session I12	Poster Session I13
15:30-16:00	**Coffee break**	
16:00-17:30		

Sofitel Budapest Chain Bridge

	Poster Spot 1	Poster Spot 2
09:00-09:30	**Coffee break**	
09:30-11:00	Poster Session S8	Poster Session S9
11:00-12:30	Poster Session S10	Poster Session S11
12:30-14:00	**Lunch**	
14:00-15:30		
15:30-16:00	**Coffee break**	
16:00-17:30		
17:30-19:00		

October 10 (Monday)

InterContinental Budapest

Time	Session ID	Spot	Paper ID	Paper Title
13:30-15:00	Poster Session I1	Poster Spot 1	#1684	A New Stable Election-based Routing Algorithm to Preserve Aliveness and Energy in Fog-supported Wireless Sensor Networks
13:30-15:00		Poster Spot 1	#2397	Optimal Design and Scheduling of Cellular Manufacturing Systems: An Experimental Study
13:30-15:00		Poster Spot 1	#2408	On-Line Detection and Diagnosis of Stuck-at Faults in Channels of NoC-based Systems
13:30-15:00		Poster Spot 1	#1120	Viable diagnosis of complex active systems
13:30-15:00		Poster Spot 1	#1439	Optimization of Tire Noise by Solving an Integer Linear Program (ILP)
13:30-15:00		Poster Spot 1	#2209	Resources Provisioning within Cloud Federation
13:30-15:00		Poster Spot 1	#1060	A Kind of Mouse Behavior Authentication Method on Dynamic Soft Keyboard
13:30-15:00		Poster Spot 1	#1205	Q-learning based Air Combat Target Assignment Algorithm
13:30-15:00		Poster Spot 1	#1515	A multi-level requirements modeling for sociotechnical system simulation-based checking
13:30-15:00	Poster Session I2	Poster Spot 2	#1041	A New Approach to Functional Observer Design for Linear Time-Delay Systems
13:30-15:00		Poster Spot 2	#1131	Identification and Optimal Control of Large-Scale Systems Using Selective Decentralization
13:30-15:00		Poster Spot 2	#1532	Jensen-Shannon divergence based algorithm for adaptive segmentation and labelling of household's electricity power consumption data series
13:30-15:00		Poster Spot 2	#2221	Validation discussion of an Unmanned Aerial Vehicle (UAV) using JSBSim Flight Dynamic Model compared to MATLAB/Simulink AeroSim Blockset
13:30-15:00		Poster Spot 2	#1090	Optimal State Estimation for Sampled-data Systems with Randomly Sampled and Delayed Measurements
13:30-15:00		Poster Spot 2	#1447	Optimization of a Multiversion Index on SSDs to improve System Performance
13:30-15:00		Poster Spot 2	#1027	Differential flatness properties and control of commodities price dynamics
13:30-15:00		Poster Spot 2	#1662	Multi-Physical System Variable DOF Modeling: An Investigation on Hyro-Control Device Start Process
13:30-15:00		Poster Spot 2	#1878	Identification of time-varying parameters in Gipps model for driving behavior analysis
15:30-17:00	Poster Session I3	Poster Spot 1	#1776	Nested compliant admittance control for robotic mechanical assembly of misaligned and tightly toleranced parts
15:30-17:00		Poster Spot 1	#1985	A hierarchical graph model of a two-level carbon emission conflict in China
15:30-17:00		Poster Spot 1	#1664	The Newsvendor Problem with Barter Exchange
15:30-17:00		Poster Spot 1	#2469	A Bounded Switching Approach for Identification of Switched MIMO Systems
15:30-17:00		Poster Spot 1	#1317	Multi-Level Cache Vulnerability Estimation: The First Step to Protect Memory
15:30-17:00		Poster Spot 1	#2059	Optimal Neuro-Fuzzy model configuration
15:30-17:00		Poster Spot 1	#1617	An Energy-Based Viscoelastic Model for Multi-Physical Systems: A Bond Graph Approach
15:30-17:00		Poster Spot 1	#2300	Backstepping for Set-valued Upper Control Laws and Its Application to Control Allocation Problem
15:30-17:00		Poster Spot 1	#1596	A New Mathematical Model and a League Championship Algorithm to Determine the Helicopter Routs in Offshore Gas Fields
15:30-17:00	Poster Session I4	Poster Spot 2	#1514	On robust experiment design for identifying locally affine Takagi-Sugeno models
15:30-17:00		Poster Spot 2	#1597	Shaping Procedures to deal with Complex Situations
15:30-17:00		Poster Spot 2	#1909	On-line Estimation of Inertia-related Parameter without an Accelerometer
15:30-17:00		Poster Spot 2	#1467	An Optimizing Model Based on Genetic Algorithm for Grey Interval Number
15:30-17:00		Poster Spot 2	#2290	Identification of turbine engine dynamics with the governor in the loop
15:30-17:00		Poster Spot 2	#1028	Regional Infrastructure System Function Degradation Mechanism and Recovery Strategies
15:30-17:00		Poster Spot 2	#2005	Weighing Criteria based on Fuzzy ANP for Assessing E-commerce Web Sites
15:30-17:00		Poster Spot 2	#1785	Evolutionary Dynamics for Multicriteria Games Generated by p-norm-based Pairwise Proportional Imitation
15:30-17:00		Poster Spot 2	#1950	Real-Time Implementation Of Dice Unloading Algorithm
17:00-17:30	Demo Session	Poster Spot 1	Demo Paper #1548	Eye-based Driver State Monitor of Distraction, Drowsiness, and Cognitive Load for Transitions of Control in Automated Driving
17:30-18:00		Poster Spot 1	Demo Paper #1835	ShadowRine: Accessible Game for Blind Users, and Accessible Action RPG for Visually Impaired Gamers

Sofitel Budapest Chain Bridge

Time	Session ID	Spot	Paper ID	Paper Title
13:30-15:00	Poster Session S1	Poster Spot 1	#1238	SHTM: A Neocortex-inspired Algorithm for One-shot Text Generation
13:30-15:00		Poster Spot 1	#1598	Nonlinear system modeling with deep nerual networks and autoencoders algorithm
13:30-15:00		Poster Spot 1	#2313	Modelling RNA-Seq Read Counts by Grey Relational Analysis
13:30-15:00		Poster Spot 1	#1044	A Multi-Objective Genetic Type-2 Fuzzy Extreme Learning System for the Identification of Nonlinear Dynamic Systems
13:30-15:00		Poster Spot 1	#1013	Real-time Voice Adaptation with Abstract Normalization and Sound-indexed based Search
13:30-15:00		Poster Spot 1	#1032	Manifold-based mathematical morphology for graph signal editing of colored images and meshes
13:30-15:00		Poster Spot 1	#1651	Dynamic Heuristic Planner Selection
13:30-15:00		Poster Spot 1	#1724	Combining Deep Neural Network and Traditional Image Features to Improve Survival Prediction Accuracy for Lung Cancer Patients from Diagnostic CT
13:30-15:00		Poster Spot 1	#2423	Robot Position control in pipes using Q Learning
13:30-15:00	Poster Session S2	Poster Spot 2	#1329	Regularizaed Extraction of Non-negative Latent Factors from High-dimensional Sparse Matrices
13:30-15:00		Poster Spot 2	#1342	Data Compression of Digital-Ink using B-spline Approach with Sparse Coding
13:30-15:00		Poster Spot 2	#2014	Neural Approach for Object Tracking in Complex Environment
13:30-15:00		Poster Spot 2	#2016	On the Activity Detection with Incomplete Acceleration Data using Iterative KNN Classifier
13:30-15:00		Poster Spot 2	#1064	Interval-valued Data Clustering Based on the Range City Block Metric
13:30-15:00		Poster Spot 2	#1759	K-medoids Method based on Divergence for Uncertain Data Clustering
13:30-15:00		Poster Spot 2	#1351	Application and Comparison of Possibility Measures Applied to Multi-Criteria Decision Making Method Using Intuitionistic Fuzzy Information
13:30-15:00		Poster Spot 2	#1254	Salient Corporate Performance Forecasting based on Financial and Textual Information
13:30-15:00		Poster Spot 2	#1993	Incremental Structural Model for Extracting Relevant Tokens of Entity
15:30-17:00	Poster Session S3	Poster Spot 1	#1402	Biologically-Inspired Episodic Memory Model Considering the Context Information
15:30-17:00		Poster Spot 1	#1567	Clustering Search with Estimation of Distribution
15:30-17:00		Poster Spot 1	#2279	Efficient FCM Computations Using Sparse Matrix-Vector Multiplication
15:30-17:00		Poster Spot 1	#1670	Multilevel Prediction of Missing Time Series Dam Displacements Data Based on Artificial Neural Networks Voting Evaluation
15:30-17:00		Poster Spot 1	#1016	Perceiving Stroke Information from Color-Blindness Images
15:30-17:00		Poster Spot 1	#1324	A method for acquisition of a pose matching rate using the rotation angle of the body
15:30-17:00		Poster Spot 1	#1486	Automatic Detection of Follicle in Ultrasound Images of Cattle Ovarian using MCL Method
15:30-17:00		Poster Spot 1	#2344	Mathematical Programming Formulations For Hybrid Flow Shop Scheduling With Parallel Machines At The First Stage And Two Dedicated Machines At The Second Stage
15:30-17:00			#1336	Solving Fuzzy Differential Equation with Bernstein Neural Networks
15:30-17:00	Poster Session S4	Poster Spot 2	#1890	Estimate User Meaningful Places through Low-Energy Mobile Sensing
15:30-17:00		Poster Spot 2	#2177	Applying SPEA2 to Prototype Selection for Nearest Neighbor Classification
15:30-17:00		Poster Spot 2	#1463	A Fish School Search Based Algorithm For Image Channel-Optimized Vector Quantization
15:30-17:00		Poster Spot 2	#1847	HOG Feature Human Detection System
15:30-17:00		Poster Spot 2	#2460	SVM integrated Case Based restarting GA for further improving Solar Flare Prediction
15:30-17:00		Poster Spot 2	#2159	Credibility Investigation of Newsworthy Tweets Using a Visualising Petri Net Model
15:30-17:00		Poster Spot 2	#2261	SBSTFrame: a framework to search-based software testing
15:30-17:00		Poster Spot 2	#2333	Towards a context based evaluation support system for quality in use assessment of mobile systems
15:30-17:00		Poster Spot 2	#2464	IoT-aware Context Respectful Counseling Agent

October 11 (Tuesday)

InterContinental Budapest

Time	Session ID	Spot	Paper ID	Paper Title
09:30-11:00	Poster Session I5	Poster Spot 1	#2256	Circular movement algorithm for gas tracking in indoor environment
09:30-11:00		Poster Spot 1	#2421	Integrating Data Into The Togaf Adm Phases
09:30-11:00		Poster Spot 1	#1043	Model Predictive Control Implementation on Neural Networks Using Denoising Autoencoder
09:30-11:00		Poster Spot 1	#1571	Integrating Particle Swarm Optimization with Stochastic Point Location Method in Noisy Environment
09:30-11:00		Poster Spot 1	#2204	Modeling and Verifying Self-adaptive Systems: A Refinement Approach
09:30-11:00		Poster Spot 1	#2295	Kinematic and Dynamic Modelling of UR5 Manipulator
09:30-11:00		Poster Spot 1	#1186	A new dynamic observer approach to fault detection for LTI system
09:30-11:00		Poster Spot 1	#1422	Collaborative Vehicle Routing Problem for Urban Last-mile Logistics
09:30-11:00		Poster Spot 1	#1478	Hybrid Optimization Algorithm to the Problem of Distributed Generation Power Losses
09:30-11:00	Poster Session I6	Poster Spot 2	#1264	Benefits from Model-Based Engineering in Mining and Metals
09:30-11:00		Poster Spot 2	#1578	Rapidly exploring Bur trees for Optimal Motion Planning
09:30-11:00		Poster Spot 2	#1954	Storage Services in Private Clouds: Analysis, Performance and Availability Modeling.
09:30-11:00		Poster Spot 2	#1481	Enterprise Risk Analytics: Automatic Analysis of Risk Factors from Textual Feedbacks
09:30-11:00		Poster Spot 2	#1030	Backward Path Tracking Control for Mobile Robot with Three Trailers
09:30-11:00		Poster Spot 2	#2505	Switching Control of Quadrotor with Adaptation Mechanism
09:30-11:00		Poster Spot 2	#1634	Case Study on Formally Describing the Architecture of a Software-intensive System-of-Systems with SosADL
09:30-11:00		Poster Spot 2	#1398	Dynamical analysis of simple models with flexible body for bounding in quadrupeds
09:30-11:00		Poster Spot 2	#1489	Depth Information Based Separation of Moving Speakers' Voices from Mixed Recordings
11:00-12:30	Poster Session I7	Poster Spot 1	#1755	On the design of the ROBO-PARTNER Intra-factory Logistics Autonomous Robot
11:00-12:30		Poster Spot 1	#2331	A Deterioration Hazard Model Using a Continuous Index
11:00-12:30		Poster Spot 1	#1418	Air-Writing Characters Modelling and Recognition on Modified CHMM
11:00-12:30		Poster Spot 1	#2239	Entropy-based EEG Time Interval Selection for Improving Motor Imagery Classification
11:00-12:30		Poster Spot 1	#1870	Tolerance to Complexity: Measuring Capacity of Development Teams to Handle Source Code Complexity
11:00-12:30		Poster Spot 1	#1700	Comparison of Two Techniques for Gaze Estimation System using the Direction of Eyes and Face
11:00-12:30		Poster Spot 1		
11:00-12:30		Poster Spot 1		
11:00-12:30		Poster Spot 1		

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Time	Session ID	Spot	Paper ID	Paper Title
09:30-11:00	Poster Session S5	Poster Spot 1	#1924	On Software Effort Estimation Accuracy
09:30-11:00		Poster Spot 1	#2276	Accessing Implicit Meaning: Towards Computational Ability to Reconstruct Textual Omissions
09:30-11:00		Poster Spot 1	#1078	Sparse Subspace Clustering via Closure Subgraph Based on Directed Graph
09:30-11:00		Poster Spot 1	#1136	A Learning-Based Single-Image Super-Resolution Method for Very Low Quality License Plate Images
09:30-11:00		Poster Spot 1	#1153	Identification of Nonlinear Systems with Kernel Methods
09:30-11:00		Poster Spot 1	#1908	A New Method For Mining Colossal Patterns
09:30-11:00		Poster Spot 1	#1879	Scheduling a two-stage hybrid flow shop with dedicated machines, time lags and sequence-dependent setup times
09:30-11:00		Poster Spot 1	#1914	Study of Formation Control and Obstacle Avoidance of swarm robots using Evolutionary Algorithms
09:30-11:00		Poster Spot 1	#1039	Multi-Robot Coalition Formation Problem:Task Allocation with Adapative Immigrants Based Genetic Algorithms
09:30-11:00	Poster Session S6	Poster Spot 2	#2007	Evolutionary Hierarchical Fuzzy modeling of Interval Type-2 Beta Fuzzy Systems
09:30-11:00		Poster Spot 2	#2131	Collecting Multi-View Static Object Images from an Autonomous Mobile Robot
09:30-11:00		Poster Spot 2	#2506	Optical Camouflage using RGB-D sensor and LCD display
09:30-11:00		Poster Spot 2	#2316	Face Spoofing Detection with Highlight Removal Effect and Distortions
09:30-11:00		Poster Spot 2	#1706	Similarity learning hashing embedded deep neural networks for image retrieval
09:30-11:00		Poster Spot 2	#1395	An Adaptive Sliding Mode Observer for Linear Systems under Malicious Attack
09:30-11:00		Poster Spot 2	#1552	Local Motion Planning using Forward Simulation for Autonomous Vehicle
09:30-11:00		Poster Spot 2	#2439	A Receding Horizon Scheme for Constrained Multi-vehicle Coverage Problems
09:30-11:00		Poster Spot 2	#2134	Seafloor Segmentation Using Combined Texture Features of Sidescan Sonar Images
11:00-12:30	Poster Session S7	Poster Spot 1	#1843	Deep Learning for Solar Power Forecasting – An Approach Using Autoencoder and LSTM Neural Networks
11:00-12:30		Poster Spot 1	#1992	Entropy-based Social Networks Partition Algorithm
11:00-12:30		Poster Spot 1	#2266	Learning Live Autonomous Navigation: A Model Car with Hardware Arduino Neurons
11:00-12:30		Poster Spot 1	#1535	Discovering Contextual Knowledge with Associated Information in Dimensional Structured Knowledge Bases
11:00-12:30		Poster Spot 1	#1026	A New Modeling Method of Control Systems Based on Pattern Recognition
11:00-12:30		Poster Spot 1	#1675	Data-Driven Interpretable Fuzzy Controller Design Through Mult-Objective Genetic Algorithm
11:00-12:30		Poster Spot 1		
11:00-12:30		Poster Spot 1		
11:00-12:30		Poster Spot 1		

October 12 (Wednesday)

InterContinental Budapest

Time	Session ID	Spot	Paper ID	Paper Title
09:30-11:00	**Poster Session I8**	**Poster Spot 1**	#1721	Evolution Mechanism of Project Portfolio Risk Based on Lotka-Voherra Model
09:30-11:00		**Poster Spot 1**	#1984	Semantic Annotation for the "on demand graphical representation" of variable data in Web documents
09:30-11:00		**Poster Spot 1**	#1421	Review of Fog Computing Technology
09:30-11:00		**Poster Spot 1**	#2357	Active Problem Workspace Reduction with a Fast Fuzzy Classifier for Real-Time Applications
09:30-11:00		**Poster Spot 1**	#2152	Two-Layer Hybrid Control of an Underactuated System
09:30-11:00		**Poster Spot 1**	#2294	Development and Evaluation of a Symbolic Modelling Tool for Serial Manipulators with any Number of Degrees of Freedom
09:30-11:00		**Poster Spot 1**	#1244	Improving driving efficiency for hybrid electric vehicle with suitable interface
09:30-11:00		**Poster Spot 1**	#1910	KURE: Kinematic Universal Remote intErface, A Human Centred Remote Robot Control Paradigm
09:30-11:00		**Poster Spot 1**		
09:30-11:00	**Poster Session I9**	**Poster Spot 2**	#2140	Content for Context Structure in Multidisciplinary Engineering Model
09:30-11:00		**Poster Spot 2**	#2153	Multi-temporal sequential pattern mining based improvement of alarm management systems
09:30-11:00		**Poster Spot 2**	#2503	A Probabilistic Price Mechanism Design for Online Auctions
09:30-11:00		**Poster Spot 2**	#2236	Local Load Optimization in Smart Grids With Bayesian Networks
09:30-11:00		**Poster Spot 2**	#1107	Full-order Sliding Mode Control for Deployment/Retrieval of Space Tether System
09:30-11:00		**Poster Spot 2**	#1488	Modelling Security Risk in Critical Utilities: The System at Risk as a Three Player Game and Agent Society
09:30-11:00		**Poster Spot 2**	#1526	Modeling Multimodal Biometric Modalities for Continuous User Authentication
09:30-11:00		**Poster Spot 2**	#2162	Context-Based Decision System for Human-Machine Interaction Applications
09:30-11:01		**Poster Spot 2**	#2504	Ant Supervised by PSO and 2-Opt algorithm, AS-PSO-2Opt, Applied to Traveling Salesman Problem
11:00-12:30	**Poster Session I10**	**Poster Spot 1**	#1723	Automated Locomotion Parameter Tuning for an Anguilliform-inspired Robot
11:00-12:30		**Poster Spot 1**	#1916	Development and Experiment of a Snake-like Robot Composed of Modularized Isomorphic Joints
11:00-12:30		**Poster Spot 1**	#1129	Uncalibrated Visual Predictive Control Using Broyden Estimation
11:00-12:30		**Poster Spot 1**	#1557	Optimal Placement of Solar Reflectors at the Lunar South Pole
11:00-12:30		**Poster Spot 1**	#1069	Placement-Position Search Technique for Packing Various Objects with Robot Manipulator
11:00-12:30		**Poster Spot 1**	#1327	Pre-processing unsteady flows for clutter reduction in vortex visualization
11:00-12:30		**Poster Spot 1**	#1262	In-Situ Visualization of Pedaling Forces on Cycling Training Videos
11:00-12:30		**Poster Spot 1**	#1211	On the Approximate Maximum Likelihood Estimation in Stochastic Model of SQL Injection Attacks
11:00-12:30		**Poster Spot 1**		
11:00-12:30	**Poster Session I11**	**Poster Spot 2**	#1586	Network coding enhanced browser based Peer-to-Peer streaming
11:00-12:30		**Poster Spot 2**	#1471	Cloud-based Facial Emotion Recognition for Real-Time Emotional Atmosphere Assessment during a Lecture
11:00-12:30		**Poster Spot 2**	#1752	Fast content-based image retrieval using Convolutional Neural Network and hash function
11:00-12:30		**Poster Spot 2**	#1313	Error feedback does not change response strategies in a joint force detection task
11:00-12:30		**Poster Spot 2**	#2244	Curious Partner: An Approach to Realize Common Ground in Human-Autonomy Collaboration
11:00-12:30		**Poster Spot 2**	#1795	Determination of the fault identification accuracy in LV networks using the Fuzzy method
11:00-12:30		**Poster Spot 2**	#1058	A Continuous Identity Verification Method based on Free-Text Keystroke Dynamics
11:00-12:30		**Poster Spot 2**		
11:00-12:30		**Poster Spot 2**		

Time	Session ID	Spot	Paper ID	Paper Title
14:00-15:30	Poster Session I12	Poster Spot 1	#1296	Study on the Impact of the NS in the Performance of Meta-Heuristics in the TSP
14:00-15:30		Poster Spot 1	#2031	Chance Constrained Model Predictive Controller Synthesis for Stochastic Max-Plus Linear Systems
14:00-15:30		Poster Spot 1	#2098	Hyper-redundant Robots and Bioinformatics: Modelling Loops in RNA
14:00-15:30		Poster Spot 1	#2120	Non-parametric Smoothing for Gradient Methods in Non-differentiable Optimization Problems
14:00-15:30		Poster Spot 1	#2367	Increasing ROS 1.x communication security for medical surgery robot
14:00-15:30		Poster Spot 1	#2412	Fault Diagnosis for dynamic nonlinear system based on Variable Moving Window KPCA
14:00-15:30		Poster Spot 1	#1277	Score Level Fusion Algorithm Using Differential Evolution and Proportional Conflict Redistribution Rule
14:00-15:30			#1674	State Estimations in Virus Epidemic Dynamic System on Sparse Network by using Hybrid Extended Kalman Filter
14:00-15:30				
14:00-15:30	Poster Session I13	Poster Spot 2	#1085	John von Neumann's Self-Replicating Machine – Critical Components Required
14:00-15:30		Poster Spot 2	#1330	Quality assessment of subjectively labelled training data for improving the reliability of status prediction
14:00-15:30		Poster Spot 2	#2311	Grey Relational Analysis Based on Velocity and Acceleration and its Application on Research
14:00-15:30		Poster Spot 2	#1642	Mining Mixed-initiative Dialogs
14:00-15:30		Poster Spot 2	#1335	Automatic clustering of eye gaze data for machine learning
14:00-15:30		Poster Spot 2	#2498	Mitigating distractions during online reading: an explorative study
14:00-15:30		Poster Spot 2		
14:00-15:30		Poster Spot 2		
14:00-15:30		Poster Spot 2		

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Time	Session ID	Spot	Paper ID	Paper Title
09:30-11:00	Poster Session S8	Poster Spot 1	#2175	MOPSO for Dynamic Feature Selection Problem Based Big Data Fusion
09:30-11:00		Poster Spot 1	#2340	Sentiment detection for mining altruistic behaviors in Social Web: a case study
09:30-11:00		Poster Spot 1	#2249	Privacy Free Indoor Action Detection System Using Top-View Detph Camera based on Key-poses
09:30-11:00		Poster Spot 1	#1511	Quaternion Decomposition Based Discriminant Analysis for Color Face Recognition
09:30-11:00		Poster Spot 1	#2495	Improved Reversible Data Hiding in Encrypted Images using Histogram Modification
09:30-11:00		Poster Spot 1	#1297	A Prediction Classifier Architecture to Forecast Device Status on Smart Environments
09:30-11:00		Poster Spot 1	#1893	Model Predictive Control for Urban Traffic Flows
09:30-11:00		Poster Spot 1	#2015	Local invariant representation for multi-instance toucheless palmprint identification
09:30-11:00		Poster Spot 1	#1892	Study of the conditionals possibilities effectiveness in the numerical information fusion
09:30-11:00	Poster Session S9	Poster Spot 2	#1274	Comparative Study of Logarithmic Image Processing Models for Medical Image Enhancement
09:30-11:00		Poster Spot 2	#1739	Non-Linear Model Based Control and Parameter Identification of a Hex-Rotor UAV
09:30-11:00		Poster Spot 2	#2461	Combining intrusion detection datasets using MapReduce
09:30-11:00		Poster Spot 2	#2323	Validating “Is ECC-ANN Combination Equivalent to DNN?” for Speech Emotion Recognition
09:30-11:00		Poster Spot 2	#1768	Design Functional Decomposition Based on Flow
09:30-11:00		Poster Spot 2	#1834	Comparing Single Task Assignments Control with Supervisory Control through Automated Plan Generation
09:30-11:00		Poster Spot 2		
09:30-11:00		Poster Spot 2		
09:30-11:00		Poster Spot 2		
11:00-12:30	Poster Session S10	Poster Spot 1	#1051	Activity Recognition and Sensor Positioning
11:00-12:30		Poster Spot 1	#1967	Detecting BGP Anomalies Using Machine Learning Techniques
11:00-12:30		Poster Spot 1	#2401	Ontology Traceability for the Adaptation of Services in Pervasive Environment
11:00-12:30		Poster Spot 1	#1570	Towards the development of a standardized performance evaluation framework for eye gaze estimation systems in consumer platforms
11:00-12:30		Poster Spot 1	#2246	Toward new family beta maps for chaotic image encryption
11:00-12:30		Poster Spot 1	#2312	Real-time Rotation invariant Action Recognition using Microsoft Kinect
11:00-12:30		Poster Spot 1	#1251	Actuated Green Wave Control for Grid-like Network Traffic Signal Coordination
11:00-12:30		Poster Spot 1	#2179	Agent-supported Knowledge Acquisition for Digital Humanities Research
11:00-12:30		Poster Spot 1	#1640	On Localization and Mapping with RGB-D Sensor and Hexapod Walking Robot in Rough Terrains
11:00-12:30	Poster Session S11	Poster Spot 2	#2197	Semi-asynchronous Fault Diagnosis of Discrete Event Systems
11:00-12:30		Poster Spot 2	#1210	Adaptive Probabilistic Tracking with Discriminative Feature Selection for Mobile Robot
11:00-12:30		Poster Spot 2	#2501	Virtual Reality Social Training for Adolescents with High-Functioning Autism
11:00-12:30		Poster Spot 2	#1255	Grey Dominance-based Rough Set Approach to Decision System with Three-parameter Interval Grey Number
11:00-12:30		Poster Spot 2	#2265	A Stochastic Learning Approach for Construction of Brick Structures with a Ground Robot
11:00-12:30		Poster Spot 2		
11:00-12:30		Poster Spot 2		
11:00-12:30		Poster Spot 2		
11:00-12:30		Poster Spot 2		

#1684 A New Stable Election-based Routing Algorithm to Preserve Aliveness and Energy in Fog-supported Wireless Sensor Networks

Mohammad Shojafar (IT), Paola G. Vinueza Naranjo (IT), Ajith Abraham (US), Enzo Baccarelli (IT)

One of the current key challenges in wireless sensor networks is the development of routing protocols that provide stable cluster-head election, while prolonging network lifetime by saving energy. In this contribution, a new Stable Election Protocol(SEP), namedNew-SEP (N-SEP), is presented to prolong the stable period of Fog-supported sensor networks by maintaining balanced energy consumption. N-SEP takes into account some features of sensor nodes (e.g., distance from base station, network heterogeneity ratio, residual/consumed energy, distance between cluster heads (CHs)) in order to elect the best CHs. For this purpose, it exploits heterogeneous energy thresholds, in order to select CHs and prolong the time interval of the system. Simulation results support the capability of the proposed algorithm to maximize the network lifetime and preserve more energy as compared to the results obtained by using current heuristics, such as, Low Energy Adaptive Clustering Hierarchy (LEACH) and SEP protocols. Additionally, we found that N-SEP outperforms LEACH and SEP in prolonging the stability period of the network by 50% and 25%, respectively.

#2397 Optimal Design and Scheduling of Cellular Manufacturing Systems: An Experimental Study

Sherif Adel Fahmy (KW)

Designing and controlling cellular manufacturing systems (CMS) constitute tactical and operational decisions that include cell formation (CF), group layout (GL), and group scheduling (GS). Taking these three decisions simultaneously into consideration when modeling the problem, can improve both the design and operational performance of the system. In a previous paper, a mixed integer linear programming (MILP) model was proposed for the combined CF, GL and GS problem. The model can be solved to optimality for small and fairly medium-sized problems. Because of the complexity of the problem, in this paper, a Genetic Algorithm (GA) is used to solve it, where the GA chromosome is designed to represent the three decisions, simultaneously. Crossover and mutation operators are utilized to explore different schedules for the same cell formations and layouts, and vice versa. The performance of the GA is compared to that of the MILP model in an experimental study by solving a number of randomly generated problems. The GA obtained the optimal solutions for small problems and better solutions than the best feasible solutions obtained by the MILP model for medium and large problems.

#2408 On-Line Detection and Diagnosis of Stuck-at Faults in Channels of NoC-based Systems

Biswajit Bhowmik (IN), Jatindra Kumar Deka (IN), Santosh Biswas (IN), Bhargab B. Bhattacharya (IN)

This paper presents a distributed on-line test mechanism that detects stuck-at faults (SAFs) in the channels as well as identifies the faulty channel-wires in an on-chip network (NoC). The proposed test mechanism improves yield and reliability of NoCs at the cost of few test clocks and small performance degradation. Additionally, the mechanism is scalable to large-scale NoCs. We study the impact of channel stuck-at faults on various performance metrics and simulation results establish 100% coverage metrics and the effectiveness of the proposed test mechanism.

#1120 Viable diagnosis of complex active systems

Gianfranco Lamperti (IT), Xiangfu Zhao (CN)

An active system (AS) is a network of communicating automata. A complex active system (CAS) is a hierarchy of communicating active systems. By inspiration of biological systems, organized in a hierarchy of subsystems, the interaction between automata in an AS gives rise to an emergent behavior at a superior AS, which is unpredictable from a knowledge of the behavior of the communicating automata only. Real systems can be conveniently modeled as CAS's, in order to be monitored and diagnosed by automated techniques. A diagnosis method for CAS's is presented, with viability being a major requirement: despite the complexity of the system, diagnosis shall be performed efficiently. This is supported by lazy techniques, which allow for the sound and complete solution of the diagnosis problem.

#1439 Optimization of Tire Noise by Solving an Integer Linear Program (ILP)

Matthias Becker (DE), Nicolas Ginoux (FR), Zsuzsanna Roka (FR), Sebastien Martin (FR)

One important aim in tire industry when finalizing a tire design is the modeling of the noise characteristics as received by the passengers of the car. The noise perceived inside the car should convey properties of the car; low and unobtrusive tire sound emphases a car's appearance of quality. Most of the literature concerning the optimizing of tire noise use heuristic optimization algorithms, since the problem mathematically takes place in an exponential search space of the order around four to the power of 70, so that an exact or exhaustive search for the optimal tire design is not viable. Nevertheless, there are many restrictions in the degrees of freedom in tire design. While constraints often hamper heuristic optimization algorithms, because the generation of a new possible solution to be explored takes more time when constraints have to be obeyed; the application of linear integer programming algorithms profit from constraints: more constraints mean less possible search candidates, thus the expectation to find the optimum in a given amount of time rises, if there are many constraints restricting the overall number of solutions to be explored. Since efficient solvers for linear integer programming problems exist, the optimization of tire sound might be solved if the problem can properly be formulated in that context.Our study shows that the integer linear programming approach shows significant improvement of the found tire designs, however it has to be improved further to meet the calculation time restrictions for real world problem size.

#2209 Resources Provisioning within Cloud Federation

Raouia Bouabdallah (TN), Soufiene Lajmi (TN), Ghedira Khaled (TN)

A cloud provider provides, on-demand, physical computing resources to clients. It enables clients to improve their computing resources delivered in virtual machines. However, the cloud provider faces major problems impacting its correct operation. One problem is that a cloud provider cannot deliver more resources when it has not enough resources during peak hours. Another problem related to providers is their inability to satisfy all client's requirements. In order to increase the reliability and the availability of cloud providers resources, we propose a distributed approach based on Contract Net Protocol (CNP) to overcome the limited resources problem. We propose also an extension for Open Virtualization Format (OVF) standard to describe resources provisioning in cloud federation. This extension includes more information about the client, the provider identification and the quality of service. To prove the efficiency and the effectiveness of our approach, we suggest a real case study illustrating how a client can interact with our approach for the provision of two-tier web application. In addition, we implement a prototype to evaluate the key idea presented in this paper through a set of experiments.

#1060 A Kind of Mouse Behavior Authentication Method on Dynamic Soft Keyboard

Lei Ma (CN), Chungang Yan (CN), Zhao Peihai (CN), Wang Mimi (CN)

Existing researches on user mouse authentication mostly focus on fixed tracks, which leads to the lack of practicability. This paper is not restricted to fixed tracks and models the non-fixed mouse behavior pattern. By simulating scenarios of dynamic soft keyboard, mouse behavior data in relatively free tracks is collected. New mouse characteristics are proposed based on the behavioral trait. Mouse behavior feature vector is obtained by using a combination of Cumulative Distribution Function (CDF) and Plus-L Minus-R Selection (LRS). The Support Vector Machine (SVM) algorithm is adopted to build patterns, and the majority voting method is used for user authentication. Experimental results demonstrate the efficacy of the proposed method with a classification accuracy of 96.3%, which achieves a FAR of 1.98%, and a FRR of 2.10%. The proposed method can be adopted in non-fixed traces, which can be used as an assistant method for password authentication mechanism in real-world dynamic soft keyboard scenarios.

#1205 Q-learning based Air Combat Target Assignment Algorithm

Peng-Cheng Luo (CN), Jun-Jie Xie (CN), Wang-Fang Che (CN)

Target assignment is an important yet difficult problem in air combat. Previous methods, e.g., neural network, genetic algorithm, particle swarm optimization and ant colony algorithm for target assignment have been proved to be either too slow or not stable as far as converging to the global optimum is concerned. In this paper, Q-learning is verified to be an appropriate reinforcement learning algorithm for air combat target assignment. Firstly, the air combat Agents are modeled in term of their attributes, structure and actions; secondly, the criteria of state-action pairs are defined and the Q-learning based algorithm for target assignment is provided; in addition, the compromise between the exploration and exploitation of the algorithm is also discussed. Case analysis shows that the presented algorithm avoids relying on prior knowledge and performs well in getting out of local optimum.

#1515 A multi-level requirements modeling for sociotechnical system simulation-based checking

Sophie Prat (FR), Philippe Rauffet (FR), Pascal Berruet (FR), Alain Bignon (FR)

To improve the design of reconfigurable sociotechnical systems,it is necessary to ensure that the control/monitoring system meets the end-user needs and requirements, as early as possible in the project. Simulation techniques help to conduct functional/behavioral checks from early design stages. However, this involves modeling the requirements in context, according to the sociotechnical and reconfigurable features of the system. Therefore, we propose a multi-level requirements modeling and discuss its use, in the case of the design of a ship auxiliary fluid management system.

Poster Session I2

October 10 (Monday), 13:30-15:00, InterContinental Budapest, Poster Spot 2
Chair: Saeid Nahavandi, Co-Chair: Snehasis Mukhopadhyay

#1041 A New Approach to Functional Observer Design for Linear Time-Delay Systems

Reza Mohajerpoor (AU), Hamid Abdi (AU), Saeid Nahavandi (AU)

Designing functional observers for time-delay systems is an important practical research topic. However, the performance regulation of those observers and their robustness against the delays upper-bounds, have been fairly overlooked. In this brief, the problem of minimum order multi-functional observer design for Linear-Time-Invariant (LTI) systems with single state delay is revisited. Lyapunov Krasovskii approach is used to design the observer parameters in conjunction with the solution of some interconnected equations. A new methodology based on the descriptor transformation is proposed to construct less conservative criteria compared with some other existing methods in designing delay-dependent functional observers. In addition, the exponential convergence of the observer with a specified convergence rate, is guaranteed. A numerical example shows the performance and the efficacy of the proposed design scheme.

#1131 Identification and Optimal Control of Large-Scale Systems Using Selective Decentralization

Thanh Minh Nguyen (US), Snehasis Mukhopadhyay (US)

In this paper, we explore the capability of selective decentralization in improving the control performance for unknown large-scale systems using model-based approaches. In selective decentralization, we explore all of the possible communication policies among subsystems and show that with the appropriate switching among the resulting multiple identification models (with corresponding communication policies), such selective decentralization significantly outperforms a centralized identification model when the system is weakly interconnected, and performs at least equivalent to the centralized model when the system is strongly interconnected. To derive the sub-optimal control, our control design include two phases. First, we apply system identification to train the approximation model for the unknown system. Second, we find the suboptimal solution of the Halminton-Jacobi-Bellman (HJB) equation to derive the suboptimal control. In linear systems, the HJB equation transforms to the well-solved Riccati equation with closed-form solution. In nonlinear systems, we discretize the approximation model in order to acquire the control unit by using dynamic programming methods for the resulting Markov Decision Process (MDP). We compare the performance among the selective decentralization, the complete decentralization and the centralization in our two-phase control design. Our results show that selective decentralization outperforms the complete decentralization and the centralization approaches when the systems are completely decoupled or strongly interconnected.

#1532 Jensen-Shannon divergence based algorithm for adaptive segmentation and labelling of household's electricity power consumption data series

István Pintér (HU)

The increasing presence of renewable energy sources and the novel consumption types will obviously cause the increase of the fluctuation of electrical power in households. In order to better manage the electrical power consumption and production the integration of information and communication technologies and power grid is necessary, which is obviously a recent research topic. The availability of large amount of measurement data provided by household's smart meter(s) offers new possibilities in analyzing the internal structure of power consumption data series. One of them is discovering typical power consumption patterns with their duration-distributions. Our recent achievements in this direction are presented in the paper, namely a novel on-line, Jensen-Shannon divergence-based adaptive and automatic segmentation algorithm, the segment descriptors and the results of clustering using Kohonen's self-organizing map.

#2221 Validation discussion of an Unmanned Aerial Vehicle (UAV) using JSBSim Flight Dynamic Model compared to MATLAB/Simulink AeroSim Blockset

Oihane Cereceda Cantarelo (CA), Luc Rolland (CA), Siu O'Young (CA)

A JSBSim Flight Dynamics Model (FDM) for a UAV has been developed to be used in current simulations and projects under software such as FlightGear and Robot Operating System (ROS). The importance of designing an accurate and high-fidelity FDM for certain applications could be fundamental to obtain good results on the field; specific conditions can be created and simulated before a real flight mission. UAV real flight tests are limited by the aerospace regulations, especially due to safety concerns. Simulators allow developers to test hazardous situations and recreate conditions, such as winds among other environmental settings. An example is found in Sense and Avoid strategies, where the near midair collision (NMAC) conditions have to be simulated before any real test. Due to the importance of the simulation's role, a FDM validation process is presented in this paper in a particular case for a Giant Big Stik R/C UAV under JSBSim. The purpose is, first, define the validation as a process composed by several steps and, secondly, support the use of JSBSim FDM for small fixed-wing aircrafts. This paper covers the validation related to the simulation part, leaving optional real tests for the creation of an even more accurate FDM. Therefore, this paper could be also considered as a simple guide for a developer to model a high accurate UAV computer model in the absence of flight test.

#1090 Optimal State Estimation for Sampled-data Systems with Randomly Sampled and Delayed Measurements

Wufan Wang (CN), Xiaming Yuan (CN), Jihong Zhu (CN)

The optimal state estimation problem for sampled-data systems with randomly sampled and delayed measurements is addressed in this paper. An optimal filter is presented first for the sampled-data system with randomly sampled and delay-free measurements from multiple sensors. The filter, which has been proved to be optimal in the sense of minimum estimation variance, updates the state estimation once new measurements are available. The result is applicable to a wide range of sampling cases of which the corresponding state estimation procedures are formulated separately. Discrete-time equivalent of the filter is also derived rigorously which makes it feasible for computer implementation. Further more, we extend the optimal filter and develop a sliding time window estimator through the measurement reorganization technique to deal with the situation of delayed measurements. Monte-Carlo simulations are carried out to demonstrate the effectiveness of the proposed approach.

#1447 Optimization of a Multiversion Index on SSDs to improve System Performance

Wongi Choi (KR), Mincheol Shin (KR), Doogie Lee (KR), Sanghyun Park (KR), Hyunjun Park (US)

In this paper, we propose a multiversion index utilizing key features of SSDs (solid state drives). SSDs have many advantages, e.g., fast read/write performance, high energy efficiency, and non-volatility. Thus, SSDs have been considered for several years as a promising alternative to HDDs (hard disk drives). Many studies have made progress in optimizing and modifying HDD-based database management system (DBMS) to suit SSDs. In the case of multiversion databases, which manage not only keys and but also versions, research optimizing SSD query processing has been ignored in comparison with single versioned databases. Generally, the multiversion databases manage evolving data which is processed in cyber physical system or accounting system. Therefore, the data is large and the index structure requires frequent rearrangement of its structure to maximize efficiency, which is called structure modification operation. The multiversion index based on HDDs utilizes random writes to conduct the structure modification operation. This feature can introduce crucial performance problems on SSDs, because the speed of random writes on SSDs is much slower than the speed of sequential writes. We propose a Bulk Split multiversion tree (BSMVBT) index that utilizes sequential pattern I/O and out-of-place updates of SSDs. Experimental results showed that it is 10% – 30% faster than the compared version.

#1027 Differential flatness properties and control of commodities price dynamics

Gerasimos Rigatos (GR), Pierluigi Siano (IT), Patrice Wira (FR), Nikolaos Zervos (GR)

The PDE model of the commodities price dynamics is shown to be equivalent to a multi-asset Black-Scholes PDE. Actually it is a diffusion process evolving in a 2D assets space, where the first asset is the commodity's spot price and the second asset is the convenience yield. By applying semi-discretization and a finite differences scheme this multi-asset PDE is transformed into a state-space model consisting of ordinary nonlinear differential equations. For the local subsystems, into which the commodities PDE is decomposed, it becomes possible to apply boundary-based feedback control. The controller design proceeds by showing that the state-space model of the commodities PDE stands for a differentially flat system. Next, for each subsystem which is related to a nonlinear ODE, a virtual control input is computed, that can invert the subsystem's dynamics and can eliminate the subsystem's tracking error. From the last row of the state-space description, the control input (boundary condition) that is actually applied to the multi-factor commodities' PDE system is found. This control input contains recursively all virtual control inputs which were computed for the individual ODE subsystems associated with the previous rows of the state-space equation. Thus, by tracing the rows of the state-space model backwards, at each iteration of the control algorithm, one can finally obtain the control input that should be applied to the commodities PDE system so as to assure that all its state variables will converge to the desirable setpoints.

#1662 Multi-Physical System Variable DOF Modeling: An Investigation on Hyro-Control Device Start Process

Amir Zanj (AU), Fangpo He (AU)

In this paper, a feasibility study on modeling the multi-physical dynamic behaviors of the start period of hydro-mechanical control devices is presented. Using a novel multi-model Bond graph approach, a non-linear, variable degree-of-freedom, state-space model is developed for a typical pressure regulator during its start period. Simulation studies demonstrate the essential physical behavior of the regulator during the transient, and confirm the integrity of the resulting non-linear model of the system.

#1878 Identification of time-varying parameters in Gipps model for driving behavior analysis

Thomas James Alexandre Wilhelem (JP), Hiroyuki Okuda (JP), Akihiko Kawashima (JP), Tatsuya Suzuki (JP)

This paper proposes a new method to analyze driver behavior. Analysis of the behavior is done through the observation of the time-evolution of parameters of simple driver models. The behavior analysis is decomposed in two steps. First the driver model have to be selected or designed to represent the average behavior of a large sample of drivers. Then personal driver’s behavior evolution can be analyzed over the time. To be able to identify time-varying non-linear hybrid model parameters, an iterative metaheuristic method based on particle optimization and moving average filtering has been created. This method enables to identify parameters of any model type while filtering the parameter time-variation based on the possible parameter dynamics. This methods also enables to interpolate parameters values while model output values are occluded. Demonstration of the identification algorithm efficiency with Gipps car-following driver model is done based on theoretical examples, and time-evolution of parameter are identified from real-world measured data.

Poster Session I3

October 10 (Monday), 15:30-17:00, InterContinental Budapest, Poster Spot 1
Chair: Abdollah Homaifar, Co-Chair: Guowei Hua

#1776 Nested compliant admittance control for robotic mechanical assembly of misaligned and tightly toleranced parts

Nicky Mol (NL), Jan Smisek (NL), Babuska (NL), Andre Schiele (NL)

In this paper, we propose a closed-loop force sensor based nested admittance/impedance control strategy to actively estimate and minimize effects of geometric misalignment that naturally occurs during assembly tasks with compliant robots. The method allows the robot to be used with a stiff impedance control setting, which is beneficial for free air motion performance, yet allows to adjust for large misalignment errors between parts that need be assembled. First, the stability bounds on the control parameters of the new method are established through numerical simulation, after which they are compared with the experimentally determined parameters. Trial peg-in-hole insertion experiments are performed with a 6-DOF KUKA LWR-4+ robot under various degrees of rotational misalignment, where metal pegs are being inserted into metal holes under tight tolerances. The proposed method allows successful peg insertions even under large rotational misalignments of up to 20 degrees (13 fold increase compared to 1.5 degrees we achieved with traditional impedance control alone) without the need to adjust the position trajectories with complex models on the fly. Moreover, it provided a 5 fold reduction of the average forces exerted on the environment compared with using impedance control alone.

#1985 A hierarchical graph model of a two-level carbon emission conflict in China

Shawei He (CN), Keith W. Hipel (CA), D. Marc Kilgour (CA)

A two-level carbon emission conflict is investigated using Graph Model for Conflict Resolution. Chinese central government has conflict with local authorities at provincial levels regarding the implementation of new carbon emission reduction policy. As the conflict takes place in multiple regions, the governments at a higher level should form strategies to interact with governments at the lower level. The resolution of this conflict obtained by calculating the stabilities in the corresponding graph model can be used as guidance of actions for each decision maker to follow. The stabilities indicate that the central government should form distinct strategies to deal with provinces with different levels of economic development. Hierarchical graph model can provide decision makers a comprehensive understanding of the carbon emission conflict taking place at different locations.

#1664 The Newsvendor Problem with Barter Exchange

Guowei Hua (CN)

Barter exchange, as an alternative to move distressed inventory, has become increasingly popular in business. Many companies barter their unsold goods for the goods they need via barter exchange platforms at full prices. In this paper we consider the newsvendor problem with the barter exchange option. A retailer (the newsvendor) facing stochastic demand not only sells its goods, but also buys other goods that it needs from the market. It either trades its unsold goods for the goods it needs on a barter platform or disposes of its unsold goods at discounted prices at the end of the selling season like in the classical newsvendor model. We derive the retailer's optimal order quantity, and analytically and numerically examine the impacts of barter on the retailer's inventory decisions and profit. We find that barter exchange induces the retailer to order more goods and is beneficial to the retailer. The lower the commission of the barter platform charges, the more goods the retailer will order and the more profit it will make. The higher the values of the goods that the retailer needs, the more goods it will order and the less profit it will make. The larger the demand variance is, the more goods the retailer should order, the less profit it will make, and the more barter can improve its profit.

#2469 A Bounded Switching Approach for Identification of Switched MIMO Systems

Mohammad Gorji Sefidmazgi (US), Mina Moradi Kordmahalleh (US), Abdollah Homaifar (US), Ali Karimoddini (US), Edward Tunstel (US)

This study considers offline identification of switched linear MIMO systems using measurements from their inputs and outputs. This is a class of non-convex optimization and ill-posed problems. To convert this optimization into a binary integer programming problem, the proposed approach assumes that the number of switches among the subsystems is upper-bounded. The state-space realization of each subsystem is found by the subspace identification. The proposed approach does not need the tuning of the moving window size or any penalization factor. The algorithm efficiency is evaluated through numerical simulations. The results indicate that the error of identification is small and the eigenvalues of subsystems are estimated successfully.

#1317 Multi-Level Cache Vulnerability Estimation: The First Step to Protect Memory

Yohan Ko (KR), Kyoungwoo Lee (KR)

Cache memory is one of the most susceptible microarchitectural components against soft errors since cache memory not only takes up the majority of chip area but also is frequently accessed by other microarchitectural components. Several protection techniques have been proposed in order to improve the cache reliability. These cache protections can significantly affect the overall performance of the entire processor. Thus, it is extremely important to quantify the reliability of cache memory with and without protections in order to choose appropriate protection techniques. In this paper, we model the vulnerability estimation with considering generally used protection techniques, such as parity and error correction code, on multi-level cache memory. In common processors, level 1 and 2 caches are protected by parity and error correction code, respectively, but our experimental results reveal several interesting results. First off, parity protection for level 1 instruction cache can be good way to decrease the vulnerability, but it is inefficient for level 1 data cache. In special cases, parity protection for level 1 data cache can worsen the reliability as compared to unprotected cache. Secondly, parity protection for level 2 cache can decrease the vulnerability almost by half with the comparable overheads. For some benchmarks, parity protection for level 2 cache can be as reliable as error correcting code with much less overheads.

#2059 Optimal Neuro-Fuzzy model configuration

Zsolt János Viharos (HU), Krisztián Balázs Kis (HU)

The paper is aimed to present how Neuro-Fuzzy Systems can be applied for identifying a general system model of a given problem defined by a set of variables. Neuro-Fuzzy Systems are favored in many application fields because they provide fair accuracy and their inner computational model can be interpreted through the fuzzy rules they encapsulate. The proposed input-output search algorithm is able to find optimal system configuration of an arbitrary set of variables. By placing the algorithm on a Neuro-Fuzzy basis the resulted system model became more interpretable through the inner rules of the Neuro-Fuzzy model. This makes the algorithm more interpretable by revealing more information about the inner connections between the variables of a specific problem.

#1617 An Energy-Based Viscoelastic Model for Multi-Physical Systems: A Bond Graph Approach

Amir Zanj (AU), Fangpo He (AU), Peter C. Breedveld (NL)

Understanding the true nature of viscoelastic behaviors in multi-physical systems has always been a challenging issue in the system dynamic investigations, as each existing physical subdomain of the system may follow a different attenuation pattern during the dynamic process. In this study, to generate a viscoelastic model suitable for multi-physical domain dynamic investigations, a physical combined viscoelastic model is proposed. To this aim, by means of the Bond graph approach, the physical model of the embedded dispersive mechanisms of the conventional viscoelastic models is first generated. An energy-based combined viscoelastic model is then proposed by including the obtained dissipative mechanisms into the relative subdomains of an elastic domain. The obtained results indicate that the proposed energy-based viscoelastic model is able to capture a variety of viscoelastic behaviors in the system with respect to the true physical nature of the system.

#2300 Backstepping for Set-valued Upper Control Laws and Its Application to Control Allocation Problem

Daiki Suzuki (JP), Yuh Yamashita (JP), Koichi Kobayashi (JP)

In this paper, we propose a new control allocation framework of an over-actuated system for static optimization of inputs via dynamical extension and potential approach. The approximate static optimization of the control allocation is performed in real-time by varying the input according to the potential. To ensure asymptotic stability of the controlled system, we extended the backstepping method to allow more flexible additional potential. Under the conditions of the minimizer set, the growth rate around the set, and the unimodality of the additional potential with some auxiliary assumptions, the extended potential function becomes a control Lyapunov function of the augmented system. The effectiveness of the proposed method is demonstrated by simulations.

#1596 A New Mathematical Model and a League Championship Algorithm to Determine the Helicopter Routs in Offshore Gas Fields

Ali Husseinzadeh Kashan (IR), Amin Abbasi-Pooya (IR), Sommayeh Karimiyan (IR)

Crew members must be transported daily to offshore platforms to regulate the production of oil and gas. The preferred means of transportation is helicopter which imposes high costs on oil and gas companies. Therefore, daily helicopter flight schedule must be planned in such a way that minimizes the cost (or equivalently the flight time) while taking account of all operational rules related to helicopter's passenger and weight capacity, origin-destination itinerary, flight endurance, and arrival time of crew members to airport. To this aim, this paper proposes a novel mathematical model that has the objective of minimizing the finish time of the final tour of the helicopter while taking the above-mentioned rules into account. The model is solved for problems with up to 11 jackets, which gives optimal solution in a satisfactory amount of time. For problems of larger sizes for which the computational effort for finding exact solution is not affordable, a metaheuristic algorithm, namely League Championship Algorithm (LCA), is proposed. Computational experiments show that the algorithm can produce good solutions in an acceptable amount of time, so it may be efficiently used for large-size problems of helicopter routing.

Poster Session I4

October 10 (Monday), 15:30-17:00, InterContinental Budapest, Poster Spot 2
Chair: Andreas Kroll, Co-Chair: Takafumi Kanazawa

#1514 On robust experiment design for identifying locally affine Takagi-Sugeno models

Axel Dürrbaum (DE), Andreas Kroll (DE)

Optimal experiment design (OED) is a well-devel-oped concept for linear regression and linear dynamical modeling problems. In case of nonlinear models, the dilemma is that in order to evaluate the Fisher Information Matrix (FIM) for experiment design, the parameters to be estimated are required to evaluate the FIM. In case of locally affine Takagi-Sugeno (TS) models and D-optimal designs, even a 'robust' sequential OED may not be sufficiently robust against wrong assumptions on partition parameters. As remedy, a two stage experiment design is proposed: It uses a space-filling design to estimate good initial TS model parameters. These are used to initialize a robust sequential FIM-based OED. The method is demonstrated for a nonlinear regression problem.

#1597 Shaping Procedures to deal with Complex Situations

Bruna Diirr (BR), Marcos Borges (BR)

Handling dynamically-evolving environments, where unpredictable scenarios, incomplete information and pressure for quick decisions are commonplace, might bring great complexity for teams during treatment. Variables considered for undertaking recommended procedures may yield a great number of decision alternatives. Additionally, expectations regarding the response to treatment may not match those actually observed. Thus, recommended procedures usually require adjustments to meet needs and reactions of the ongoing situation. This paper deals with the challenges to diagnosing and adjusting procedures when handling complex situations, specifically during patients' care in emergency rooms. We propose an approach to support physicians' decision-making while shaping medical procedures to emergency cases. It allows physicians identify when observed evolution does not match the procedures described. From this, they can diagnose adequacy of recommended procedures for handling the case faced and, if necessary, adjust these procedures to patient's proper treatment. A case study in labor in poor communities illustrates approach application.

#1909 On-line Estimation of Inertia-related Parameter without an Accelerometer

Yuting Chai (HK), Lilong Cai (HK)

This paper presents an on-line estimator to evaluate the inertia-related parameters for a class of quasi-linear mechanical systems. The proposed estimator is established on the designed virtual acceleration error signal, and only the measurements for velocity and position are needed, therefore the usage of an accelerometer is avoided. The performance of the proposed estimator is verified on the numerical simulation of two mechanical systems. The simulation results of the linear spring-mass-damper system show that the proposed estimator could evaluate the constant mass well, even when the initial estimation contains large error values. And also another simulation conducted on a two-link planar robotic arm shows the proposed estimator can follow the time-varying inertia matrix with large initial estimation error.

#1467 An Optimizing Model Based on Genetic Algorithm for Grey Interval Number

Yingjian Qi (CN)

Interval grey number sequence can be converted into a real number sequence for prediction which is proposed by Bo Zeng etc. We proposed a mean variable weight method here instead of using the non-bias mean weight. In order to realize this method, we introduce a parameter. The average relative error function with the parameter for prediction is chose as a object function. We try to find the optimal parameter of the object function through genetic algorithm. We build the GM (1,1) model for the new interval grey number. A simulation example shows the improvement on average relative error by selected parameter.

#2290 Identification of turbine engine dynamics with the governor in the loop

Huanyu Li (CN), Linfeng Wu (CN), Yingjie Li (CN), Chunwen Li (CN)

Precise gas turbine engine control for dynamic processes is of great importance in industry. To be able to preciously control the turbine engine an accurate model, which can predict the engine dynamic responses is required. This work focuses on developing a new prediction model for turbine engine rotor speed in a dynamic situation (time-varying rotor speed command). In this new method, the governor model is included, and the influence of governor can be characterized by introducing rotor speed feedback in the model. The model is tested by comparing the long time prediction results with experiment measurements. A close agreement is achieved and the results are significantly more accurate than the model neglecting the governor. We also provide detailed discussion regarding the mathematical form for the reduced model which provides an insight of the governing mechanism. It shows that the governor output can be approximated as multiplication product of the speed error signal and the proportional gain at an operating point.

#1028 Regional Infrastructure System Function Degradation Mechanism and Recovery Strategies

Zhiguo Shao (CN)

Attributing to the existence of natural disasters, man-made destruction and natural aging, structural damage and functional degradation of regional infrastructure are of frequent occurrence. Thus, in this paper, the theory and methods of system science and restoration ecology are used to analyze the hierarchy and function degradation mechanism of the regional infrastructure system. Besides, this paper aims to investigate the degradation process of the regional infrastructure system coupled with feedback, structure and function disturbance response model, and recovery directions. Additionally, reconstructing individuals, enlarging the support population scale and strengthening the population contact are all conducive to the regional infrastructure system function recovery. At last, an instance of the infrastructure system recovery of Chongming Island is introduced.

#2005 Weighing Criteria based on Fuzzy ANP for Assessing E-commerce Web Sites

Rim Rekik (TN), Ilhem Kallel (TN), Adel M. Alimi (TN)

Assessing E-commerce web sites quality is essential not only to have recommendations for improvement but also to make comparisons with competitors. In this paper, the aim is to know the best criteria for the evaluation and obtain a weight for them using fuzzy Analytic Network Process (fuzzy ANP). The subjective judgments of the decision maker are expressed by fuzzy numbers. The decision making problem is solved by making fuzzy pairwise comparisons and a feedback between the criteria.

#1785 Evolutionary Dynamics for Multicriteria Games Generated by p-norm-based Pairwise Proportional Imitation

Kosuke Iewaki (JP), Takafumi Kanazawa (JP)

Multicriteria evolutionary games model interactions among many players who make decisions on the basis of multiple criteria. In single-criterion games, imitative behaviors of the players are described by revision protocols. The pairwise proportional imitation is one of the revision protocols. The evolutionary dynamics derived from the protocol is well-known as replicator dynamics. In multicriteria games, however, there are few studies on the evolutionary dynamics. In this paper, we consider the evolutionary dynamics in multicriteria games. We extend the pairwise proportional imitation to the multicriteria games and derive the evolutionary dynamics. We also show the relationships between the stability of equilibrium points of the proposed dynamics, and the equilibrium and evolutionary stability concepts of multicriteria games.

#1950 Real-Time Implementation Of Dice Unloading Algorithm

Artem Vassilyev (FI), Jussi Parviainen (FI), Jussi Collin (FI), Jarmo Takala (FI)

This paper shows the potential of using a physical model of dice as an input device for multimedia applications. We present a real-rime method for simulating fair 6-sided dice on the base of loaded model of foam-rubber dice equipped with inertial measurement unit. The method allows avoiding the negative influence that biased dice produces on the final game result. The technique is based on filtering out duplicated rolls and building a fair result by accumulating 3 single, unique rolls. The measurements were done using inertial measurement unit that transmits data to the mobile device with Android application. The application processes the data and shows final result on the screen in real time. Both theoretical and practical sides of the implementation, including the set of experiments, are shown in this paper. A full technical description of method and technology that was used during the implementation is also presented.

Demo Session

October 10 (Monday), 17:00-18:00, InterContinental Budapest, Poster Spot 1
Chair: Yo-Ping Huang

Demo Paper #1548 Eye-based Driver State Monitor of Distraction, Drowsiness, and Cognitive Load for Transitions of Control in Automated Driving

Christopher D Cabrall (NL), Nico Janssen (NL), Joel Goncalves (DE), Alberto Morando (SE), Matthew Sassman (FR), Joost de Winter (NL)

Automated driving vehicles of the future will most likely include multiple modes and levels of operation and thus include various transitions of control (ToC) between human and machine. Traditional activation devices (e.g., knobs, switches, buttons, and touchscreens) may be confused by operators among other system setting manipulators and also susceptible to inappropriate usage. Non-intrusive eye-tracking measures may assess driver states (i.e., distraction, drowsiness, and cognitive overload) automatically to trigger manual-to-automation ToC and serve as a driver readiness verification during automation-to-manual ToC. Our integrated driver state monitor is overviewed here within the scope of this brief system description/demonstration paper. It combines gaze position, gaze variability, eyelid opening, as well as external environmental complexity from the driving scene to facilitate ToC in automated driving. As both driver facing and forward facing cameras become increasingly commonplace and even legally mandated within various automated driving vehicles, our integrated system helps inform relevant future research and development towards improved human-computer interaction and driving safety.

Demo Paper #1835 ShadowRine: Accessible Game for Blind Users, and Accessible Action RPG for Visually Impaired Gamers

Masaki Matsuo (JP), Takahiro Miura (JP), Junji Onishi (JP), Masatsugu Sakajiri (JP)

Though some games for visually impaired persons have been developed, most of games that use only auditory information present challenges for sighted persons. Moreover, unfortunately, it is still difficult for visually impaired persons to play the same game with sighted persons and for sighted and visually impaired persons to share a common subject. Thus, we developed a barrier-free game that both sighted and visually impaired persons can play using their dominant senses including visual, auditory and tactile senses.

Poster Session S1

October 10 (Monday), 13:30-15:00, Sofitel Budapest Chain Bridge, Poster Spot 1
Chair: Yi Zeng, Co-Chair: Yuji Sato

#1238 SHTM: A Neocortex-inspired Algorithm for One-shot Text Generation

Yuwei Wang (CN), Yi Zeng (CN)

Text generation is a kind of nature language processing task which is the basis of machine translation and question answering systems. Deep learning techniques can get good performance with huge number of parameters and mass of data to train. However, human beings do not learn in this way.People combine knowledge learned before and something new with only few samples. This is called one-shot learning. In this paper, we focus on one-shot text generation task fromthe perspective of neocortex based model—Hierachical Temporal Memory. We propose Semantic Hierachical Temporal Memory model to do one-shot text generation. We set LSTM as the contrast model and do experiments on three public datasets. Results shows that SHTM performs much better than LSTM on the measures of mean precision and BLEU score. What's more, we utilize SHTM model to do question answering in the fashion of text generation and verifying its superiority.

#1598 Nonlinear system modeling with deep nerual networks and autoencoders algorithm

Wen Yu (MX), Erick De la Rosa (MX), Xiaoou Li (MX)

Deep learning techniques have been successfully used for pattern classification. These advantage methods are still not applied in nonlinear systems identification. In this paper, the neural model has deep architecture which is obtained by a random search method. The initial weights of this deep neural model is obtained from the denoising autoencoders model. We propose special unsupervised learning methods for this deep learning model with input data. The normal supervised learning is used to train the weights with the output data. The deep learning identification algorithms are validated with three benchmark examples.

#2313 Modelling RNA-Seq Read Counts by Grey Relational Analysis

Thanh Nguyen (AU), Saeid Nahavandi (AU)

This paper proposes a feature selection approach for RNA-seq read counts modelling based on grey relational analysis (GRA). Read counts are transformed to microarray-like data to facilitate normal-based statistical methods. GRA is designed to select differentially expressed genes by integrating outcomes of five individual feature selection methods including two-sample t-test, entropy test, Bhattacharyya distance, Wilcoxon test and receiver operating characteristic curve. GRA performs as an aggregate filter method through combining advantages of the individual methods to produce significant feature subsets that are then fed into classifiers for evaluation. The proposed approach is verified by using two benchmark real datasets and the five-fold cross-validation method. Experimental results show the performance dominance of the GRA-based feature selection method against its competing methods. This implies that the proposed method can be implemented effectively in real practice for medical applications such as disease diagnosis using RNA-seq data analysis.

#1044 A Multi-Objective Genetic Type-2 Fuzzy Extreme Learning System for the Identification of Nonlinear Dynamic Systems

Saima Hassan (MY), Mojtaba Ahmadieh Khanesar (IR), Jafreezal Jaafar (MY), Abbas Khosravi (AU)

The major challenge in the design of Interval type-2 fuzzy logic system (IT2FLS) is to determine the optimal parameters for their antecedent and consequent parts. The most frequently used objective function for the design of IT2FLSs is root mean squared error (RMSE). However, other than RMSE, the maximum absolute error (MAE) for each of identification samples is very important. This paper propose a novel hybrid learning algorithm for the design of IT2FLS. The proposed algorithm benefits from the combination of extreme learning machine (ELM) and non-dominated sorting genetic algorithm (NSGAII) to tune the parameters of the consequent and antecedent parts of the IT2FLS, respectively. The proposed method is used for the forecasting of nonlinear dynamic systems. It is shown that not only the proposed method results in low RMSE, MAE achieved is also satisfactory.

#1013 Real-time Voice Adaptation with Abstract Normalization and Sound-indexed based Search

Mads Alexander Midtlyng (JP), Yuji Sato (JP)

This paper proposes a two-step based real-time voice adaptation system in the field of speech processing. Step one combines recording and pre-processing to construct a voice profile. Secondly is the real-time raw input of the voice's adaptation to a target voice. The fact that individual voices' structure are habitually varying, we suggest a method for converting into a comparable format. The new method is called abstract normalization which cuts the voice data into smaller sounds and generate an abstracted, simplified version of the data using a level of abstraction along with parameter fitting. The normalized data is used to generate a sound-index which is a sequence hash that represents the data in a simpler fashion. The indices are used to compare different sounds/voices for adaptation. This effectively transforms the speech-related challenges into a search problem rather than a biometric one. To assess the approach, voice profile data are compared against each other as a method to verify the sound-index. Ultimately, a real-time voice input using alternating levels of abstraction is run against a Norwegian voice profile. The degree of adaptation success is measured in percentage, and experimental results show that while accuracy is not yet excellent, the concept was validated.

#1032 Manifold-based mathematical morphology for graph signal editing of colored images and meshes

Olivier Lezoray (FR)

This paper presents a framework for morphological processing of graph signals and investigates its usage for colored images and meshes editing tasks. The proposed method enables, with the help of the construction of a manifold-based ordering of color vectors, to define a new representation of graph signals in the form of an ordering of vectors and an index. The ordering relies on three steps: dictionary learning, manifold learning, and out of sample extension. This enables to formulate morphological operators for graphs signals and we demonstrate the performance of the proposed method on various colored image and mesh editing applications (simplification, abstraction, enhancement).

#1651 Dynamic Heuristic Planner Selection

Brian Cook (US), Manfred Huber (US)

Heuristic search is considered state-of-the-art for classical planning. However, the performance of search heuristics varies significantly from problem to problem and no single heuristic is superior to all others. As a result, it is highly desirable to identify and utilize the best available heuristic for a particular planning problem. This paper presents a novel approach for planning that monitors the search dynamics of a heuristic planner over time in order to recognize whether the planner is making progress toward a solution. It then dynamically selects from a set of heuristic planners during the planning process so that planners that appear to be making progress are allocated more processor time. Experimental results show this approach is more effective than static approaches of dividing processor time equally between planners or selecting any one planner a priori.

#1724 Combining Deep Neural Network and Traditional Image Features to Improve Survival Prediction Accuracy for Lung Cancer Patients from Diagnostic CT

Rahul Paul (US), Samuel Hawkins (US), Lawrence Hall (US), Dmitry Goldgof (US), Robert Gillies (US)

Lung cancer is caused by abnormal and uncontrolled growth of cells in the lungs and the mortality rate of lung cancer is the highest among all types of cancer. It can be identified and treated with the help of computed tomography (CT) images. For an automated classifier, identifying good features from an image is a key concern. Deep feature extraction using pre-trained convolutional neural networks has been successful for some image domains recently. In our study, we apply a pre-trained convolutional neural network (CNN) to extract deep features from lung cancer CT images and then train classifiers to predict short and long term survivors. The best accuracy of 77.5% was with a cropping approach using a decision tree classifier in a leave one out cross validation with ten features chosen using symmetric uncertainty feature ranking. We mixed extracted deep neural network features along with quantitative (traditional image) features and obtained the best accuracy of 82.5% with a nearest neighbor classifier in a leave one out cross validation using the symmetric uncertainty feature ranking algorithm.

#2423 Robot Position control in pipes using Q Learning

Danilo Sulino Silveira Pinto (BR), Karina Rocha Gomes da Silva (BR)

In the most critical hydro crisis in Brazil, 37% of the whole amount of treated water is wasted before reaching consumers. A robot with a position control to travel inside a pipe is an important step in the pursuit of an autonomous solution to detect and correct pipes failures. This paper shows a Q Learning controller algorithm implemented using a microcontroller in a mechanical body of a commercial pipe inspection robot. Using only the measurements of a gyroscope, and controlling the wheels' motors on the left and right sides, the controller learned the best set of movements to ride inside a 300mm sewer pipe, in the tested conditions. Real tests in a 300mm pipe were performed using the developed algorithm and it was compared to a random movement and to a straight forward movement.

Poster Session S2

October 10 (Monday), 13:30-15:00, Sofitel Budapest Chain Bridge, Poster Spot 2
Chair: Jeng-Shyang Pan, Co-Chair: Te-Min Chang

#1329 Regularizaed Extraction of Non-negative Latent Factors from High-dimensional Sparse Matrices

Xin Luo (CN), Shuai Li (CN), Mengchu Zhou (US)

Owing to the rapid progress of the World Wide Web and information technologies, more and more entities are involved in various online applications, e.g., recommender systems and social network services. In such context, high-dimensional sparse matrices describing the relationships among them are frequently encountered. It is thus important to develop efficient non-negative latent factor (NLF) models to reveal missing relationships because of a) their ability to extract useful knowledge from them; b) their fulfillment of non-negativity constraints for representing non-negative industrial data; and c) their high computational and storage efficiency for such high-dimensional sparse matrices. However, due to the imbalanced distribution of known data in such matrices, it is necessary to investigate the regularization effect in NLF models. After a brief review of NLF models, we propose to integrate the frequency-weight on each involved entity into its Tikhonov regularization terms to represent imbalanced data from a high-dimensional sparse matrix. Experimental results on industrial-size sparse matrices indicate that the proposed scheme is effective in improving the model's performance in missing-data-estimation.

#1342 Data Compression of Digital-Ink using B-spline Approach with Sparse Coding

Hiroyuki Fujioka (JP), Hiroyuki Kano (JP)

This paper considers a problem of highly compressing the data called "Digital-Ink" which is a sequence of position data sampled from the traced curve at a sampling rate. We here suppose that a set of digital-ink is measured and stored as two-dimensional position data by electronic device (e.g. smart-phone and pen-tablet PC, etc.). Then, we develop a method of digital-ink compression using B-spline approach with sparse coding. Such a compression method consists of two steps: (i) approximating by B-splines and (ii) sparse coding. By the step (i), the digital-ink is compressed as a control point vector which is a sequence of B-spline's control points. Then, in the step (ii), such a control point vector is shrunk to a sparse vector. In particular, employing a method of dictionary learning called 'K-SVD algorithm', we create the best dictionary so that the control point vector can be represented sparsely. We demonstrate the performance by some experimental studies.

#2014 Neural Approach for Object Tracking in Complex Environment

Ajoy Mondal (IN)

In this article, we present an algorithm to track objects in complex environments like, large variations in scale and orientation, background clutters, illumination changes, pose variation and occlusion. A multilayer perceptron based discriminative appearance model is constructed to distinguish the objects from their cluttered backgrounds. Moments of the binary image are used to estimate scale and orientation of the detected object. The target in the current frame is tracked by maximizing the Bhattacharyya coefficient between the distributions of object in the target and target candidate models. Two different heuristics based on support value and relative confidence score calculated from detection result are used to reduce drift problem and to handle occlusion. We show a realization of the proposed method and demonstrate its performance with respect to state-of-the-art techniques on several challenging video sequences. Analysis of the results concludes that the proposed method can track objects in a better way compare to the existing ones.

#2016 On the Activity Detection with Incomplete Acceleration Data using Iterative KNN Classifier

Gamze Uslu (TR), Sebnem Baydere (TR)

In real time continuous activity recognition systems, utilization of data segmentation stage increases the dependency of success on the size of activity set as well as activity type, duration and sensor sampling rate. In this study, considering an accelerometer based hand oriented activity recognition system, we analyzed wheather iterative K-Nearest Neighbour based knowledge discovery can substitute for the segmentation stage to reduce these dependencies. To this end, we utilized peak frequency and wavelet entropy feature extraction schemes for the recognition of open-pill-box, put-pill-in-mouth, drink and put-glass-back actions which constitute as a whole "medication intake" activity. We evaluated the performance of these schemes on incomplete data, resulting from the iterative process. According to our findings, peak frequency outperforms wavelet entropy for adaptation to variation in activity type with incompleteness mitigation problem, scoring higher in Intra-Class-Correlation (ICC) metric. Our work points out that a more proficient iterative classification algorithm is required for attaining higher adaptability to the diversification of actions that stem from the incompleteness problem.

#1064 Interval-valued Data Clustering Based on the Range City Block Metric

Sérgio Mário Lins Galdino (BR)

This paper introduces a new approach to Data Clustering on interval-valued data. Nowadays dissimilarity measures for interval-valued data uses representative point distance. It was defined the Range City Block metric. Interval-valued input distance matrix is used to process hierarchical clustering by single linkage with partial ordering. The new method based on the Range City Block Metric can allows for a better analysis of the clustering results on interval-valued data.

#1759 K-medoids Method based on Divergence for Uncertain Data Clustering

Jin Zhou (CN)

Uncertain data clustering is an essential task in the research of data mining. Lots of traditional clustering methods are extended with new similarity measurements to tackle this issue. Different from certain data clustering, uncertain data clustering focus more on the evaluation of distribution similarity between uncertain data objects. In this paper, based on the KL-divergence and the JS-divergence, we propose a novel K-medoids method for clustering uncertain data, named UK-medoids. Good performance of the proposed algorithm is shown in experiments on synthetic datasets.

#1351 Application and Comparison of Possibility Measures Applied to Multi-Criteria Decision Making Method Using Intuitionistic Fuzzy Information

Fatma Dammak (TN), leila Baccour (TN), Adel M. Alimi (TN)

This work is interested to show the importance of possibility theory in multi-criteria decision making (MCDM). Thus, we apply some intuitionistic fuzzy possibility measures from literature to the MCDM method using intuitionistic fuzzy sets (IFSs). These measures are applied to a decision matrix after being transformed with intuitionistic aggregation operators. The results are compared to previous one and concluding remarks are drawn.

#1254 Salient Corporate Performance Forecasting based on Financial and Textual Information

Hsu Ming-Fu (TW), Chang Te-Min (TW), Hu Guo-Hsin (TW), Lin Keng-Pei (TW)

The financial media news reports have helped market participants to know about the strength and weakness of corporate future development, they still encounter a new challenge when analyzing businesses, because of their velocity, volume, variety, and veracity (4V). In comparison with the numerical ratios derived from financial reports, we believe textual information derived from financial media news reports provides much more essential and valuable cues pertaining to the existence of corporate financial difficulties, because the preparations of financial reports have to satisfy some selective accounting principle or estimation method determination. How to effectively and efficiently handle a large amount of textual content is an important in this explosive information period of big data analytics. To deal with the aforementioned challenge, this study implements a latent topic modelling technique and text mining technique to construct the “Intensity of Performance-Corpus Index” (IPCI), which can compress tremendous amounts of textual information into more manageable essential synthesized parts and then use them to forecast corporate operating performance. To our knowledge, current research has not yet constructed a forecasting model for corporate operating performance that simultaneously integrates numerical and textual information content. To fill the gap in the literature, this study combines numerical and textual information contents and uses them to construct a novel forecasting mechanism. With superior forecasting performance that is supported by real cases, the introduced mechanism can assist both market participants (such as bankers, investors, and creditors) and public sectors (such as Financial Supervisory Commission and Ministry of Economic Affairs) in allocating economic resources to form their own judgement as well as to promote the proper media circulation of business events.

#1993 Incremental Structural Model for Extracting Relevant Tokens of Entity

Najoua Rahal (TN), Mohamed Benjlaiel (TN), Adel M. Alimi (TN)

This paper describes a method for extracting relevant tokens of entity from semi-structured administrative documents. This method is used for mislabeling correction by employing the entity tokens physically close in a document. Firstly, the entities are labeled. Secondly, each entity is modeled by a tokens structure graph in which the nodes represent the tokens and the arcs represent the distances. A clustering algorithm is then applied to incrementally concatenate the relevant tokens of entities and ignore the noisy parts. The obtained results with a dataset of real invoices are reported in experimental section.

#1402 Biologically-Inspired Episodic Memory Model Considering the Context Information

Park Gyeong-Moon (KR), Sanghyun Cho (KR), Kim Jong-Hwan (KR)

Episodic memory can store time sequential events and retrieve them anytime with specific cues. However, if the episodic memory only stores events comprised of actions and objects, execution of episodes may fail if current situation is different from the settings it learned in. As a solution, we propose Deep C-ART (Context-Adaptive Resonance Theory) which considers not only time sequential events but also their contexts. In addition to the learning process of Deep ART, Deep C-ART stores context information such as situation of objects, states of robots, place, and time of episodes. Since context changes over each event in an episode, Deep C-ART forms an episode with an event sequence and a context sequence. During retrieval and execution of episode, it compares the current situation with the learned one to verify that it is executable or in an anomaly situation. The effectiveness of Deep C-ART is demonstrated through computer simulations.

#1567 Clustering Search with Estimation of Distribution

Marcelo Branco do Nascimento (BR), Alexandre César Muniz Oliveira (BR)

Clustering Search (CS) is a hybrid optimization method which assists the discovery of promising search areas by dividing the search space. The search process is guided by a grouping mechanism that indicates where to perform local search. This paper proposes the use of estimation distribution to assist both the clustering and local search processes in order to reduce the computational effort to optimize combinatorial problems. The computational experiments and theoretical analyzes are used to validate the proposal.

#2279 Efficient FCM Computations Using Sparse Matrix-Vector Multiplication

Michal Puheim (SK), Ján Vaščák (SK), Kristina Machova (SK)

Fuzzy cognitive maps (FCM) are often represented and implemented using matrix-vector multiplication (MxV). Since the multiplication operation is critical to the performance of the FCM computations, it is important to secure its efficient implementation. Considering the connection matrix used to represent the FCM is often static and since it often contains only several nonzero elements, it is viable to transform it into another particular representation suitable to perform sparse matrix-vector multiplication (SpMxV). This paper shows a performance benchmark for the most common SpMxV representations, namely the CRS and CCS. It also examines the sparsity threshold at which it is more efficient to use naïve dense MxV.

#1670 Multilevel Prediction of Missing Time Series Dam Displacements Data Based on Artificial Neural Networks Voting Evaluation

Adis Hamzić (BA), Zikrija Avdagić (BA)

The dams are very important objects (production of electric energy, flood management, drought control, etc.) but they are also a great danger for areas downstream because there is always risk of dam failure. To prevent dam failure it is important to perform regular dam monitoring. Precise geodetic surveying of a number of discrete points, which accurately depict the characteristics of the dam, is a common monitoring method. It is not uncommon that some discrete points can't be monitored because of different obstacles or equipment limitations but it is possible to interpolate those dam displacements using prediction. In this research a non conventional approach for interpolation of missing dam displacements data using artificial neural networks (ANNs) is presented. This approach combines spatial and temporal aspects of data to its benefits to give good results using ANNs. Three ANN types (Feed Forward Back Propagation, Cascade Forward Back Propagation and Layer Recurrent Back Propagation) were used for dam displacements prediction. Additionally, a voting system with four functions (“minimum”, “maximum”, “mean of the closest two” and “mean of three”) is introduced to improve prediction results. The research showed that ANNs in combination with the voting system can provide precise prediction for missing dam displacements.

#1016 Perceiving Stroke Information from Color-Blindness Images

Yung-Sheng Chen (TW), Chao-Yan Zhou (CN), Long-Yun Li (CN)

Dichromats (a human with red-green color blindness considered in this paper) cannot always perceive meaningful visual information due to their deficiencies in eye cells. Stroke information extraction from a color-blindness image (CBI) is presented in order to deliver direct and effective information to dichromats. A CBI is first transformed into the pattern-highlighted image by means of color component analysis, pattern attention as well as thresholding. Then the maximal effective information in the highlighted image is computed to form a gray image. Based on the assistance of gray thinning algorithm, the useful stroke information in CBI is obtained. Experimental results on the often-used Ishihara test plates confirm that the perceived stroke information agrees with the normal perception.

#1324 A method for acquisition of a pose matching rate using the rotation angle of the body

Hun Beom Hyeon (KR), Song Suho (KR), Hyun Lee (KR), Ji-Heon Hong (KR)

In recent, some researches are being developed in medical applications to improve the accuracy of the pose and the joint of the patient. One of the famous existed methods for measuring the matching rate of the pose is by using the rotation angle of the joint. However, there is a problem that the rotational direction is missing when we only consider the rotation angle of the joint. Thus, we propose the method that can improve the accuracy of the matching rate of the pose and the joint by using the integration of the rotation angle of the joint and the sensor of the body. To show the improvement of the proposed method, we compare the proposed method with the existed method.

#1486 Automatic Detection of Follicle in Ultrasound Images of Cattle Ovarian using MCL Method

Liu Jun (CN), Chen Hao (CN)

This paper proposed a new full automated detection algorithm for ultrasound follicle images. The proposed algorithm uses multiple concentric layers (MCL) technology, which is based on the presence of concentric layers surrounding a focal area in the follicle region. The algorithm experiment is based on three processes, which include image preprocessing, detection of focal areas and multiple concentric layers criterion. The results are compared with the edge based method and demonstrate that the proposed algorithm is more effective in follicle detection.

#2344 Mathematical Programming Formulations For Hybrid Flow Shop Scheduling With Parallel Machines At The First Stage And Two Dedicated Machines At The Second Stage

Zouhour Nabli (TN), Ouajdi Korbaa (TN), Soulef Khalfallah (TN)

In this article two mathematical models and lower bounds are presented for the hybrid flow shop scheduling problem noted HFS. We consider me parallel machines at the first stage and two dedicated machines at the second stage. We showed that the performance depends on the choice of the decision variable types.

#1336 Solving Fuzzy Differential Equation with Bernstein Neural Networks

Wen Yu (MX), Raheleh Jafari (MX), Xiaoou Li (MX)

With fuzzy set theory, the uncertainty nonlinear systems can be modeled with fuzzy equations or fuzzy differential equations (FDEs). The solutions of them are applied to analyze many engineering problems. However, it is very difficult to obtain solutions of FDEs. In this paper, the solutions of FDEs are approximated by two type of Bernstein neural networks. We first transform the FDE into four ordinary differential equation (ODEs) with Hukuhara differentiability. Then we construct neural models with the structure of ODEs. With modified backpropagation method for fuzzy variables, the neural networks are trained. The theory analysis and simulation results show that these new models, Bernstein neural networks, are effective to estimate the solutions of FDEs.

Poster Session S4

October 10 (Monday), 15:30-17:00, Sofitel Budapest Chain Bridge, Poster Spot 2
Chair: Genoveffa Tortora, Co-Chair: Ferat Sahin

#1890 Estimate User Meaningful Places through Low-Energy Mobile Sensing

Teodoro Montanaro (IT), Fulvio Corno (IT), Luigi De Russis (IT)

Due to the increasing spread of location-aware applications, developers interest in user location estimation has grown in recent years. As users spend the majority of their time in few meaningful places (i.e., groups of near locations that can be considered as a unique place, such as home, school or the workplace), this paper presents a new energy efficient method to estimate user presence in a meaningful place. Specifically, instead of using commonly used but energy hungry methods such as GPS and network positioning techniques, the proposed method applies a Machine Learning algorithm based on Decision Trees, to predict the user presence in a meaningful place by collecting and analyzing: a) user activity, b) information from received notifications (receipt time, generating service, sender-receiver relationship), and c) device status (battery level and ringtone mode). The results demonstrate that, using 20 days of training data and testing the system with data coming from 14 persons, the accuracy (percentage of correct predictions) is 89.40% (standard deviation: 8.27%) with a precision of 89.04% and a recall of 89.40%. Furthermore, the paper analyzes the importance of each considered feature, by comparing the prediction accuracy obtained with different combinations of features.

#2177 Applying SPEA2 to Prototype Selection for Nearest Neighbor Classification

Autilia Vitiello (IT), Giovanni Acampora (GB), Genoveffa Tortora (IT)

The k-nearest neighbor (k-NN) algorithm is one of the most well-known supervised classifiers due to its ease of use and good performance. However, in spite of its popularity, k-NN suffers from some drawbacks such as high computational complexity, high storage requirements, and low noise tolerance. Prototype selection is a successful technique aimed at addressing aforementioned issues by reducing the size of training datasets without deprecating, but improving, the classification accuracy. Recently, evolutionary algorithms have been successfully applied to the optimisation of accuracy and size of reduction of prototype selection because of their innate exploration and exploitation capabilities in visiting the space of solutions of a problem. However, so far, all the evolutionary approaches for prototype selection are based on a so-called multi-objective “a priori” technique, where multiple objectives are aggregated together into a single objective through a weighted combination. This paper proposes to apply, for the first time, an “a posteriori” algorithm, namely SPEA2, to prototype selection problem in order to explicitly deal with both objectives and offer a better trade-off between classification and reduction performance. As shown in the experimental section, the application of SPEA2 allows to hold high accuracy in nearest neighbour classification with a significant reduction of training data thanks to the discovery of higher quality solutions than those detected by a conventional “a priori” approach.

#1463 A Fish School Search Based Algorithm For Image Channel-Optimized Vector Quantization

Felipe Alberto Barbosa Simão Ferreira (BR), Francisco Madeiro (BR)

Channel-Optimized Vector Quantization (COVQ) is an alternative to Vector Quantization (VQ) in the scenario of transmission over noisy channels. The codebook design is an optimization problem in which a set of vectors must be optimized to represent the signals to be quantized. This paper presents a new approach to COVQ codebook design, which is a challenging optimization problem. The proposed technique embeds the Fish School Search (FSS) as a Swarm Clustering Algorithm to COVQ. Simulation results concerning a Binary Symmetric Channel (BSC) reveal the superiority of the proposed technique over conventional COVQ codebook design in terms of the quality of reconstructed images.

#1847 HOG Feature Human Detection System

Matt Davis (US), Ferat Sahin (US)

Human detection systems are becoming more important as more automatic and robotic systems are being used in the world. RGB, depth, and thermal images can be used together to produce a better detection system that works in situations where one of the sensors might not produce valuable data. HOG features can provide valuable information for detecting humans in an image and that data can be used to train an SVM classifier to detect humans in a scene. The combination of sensor modalities in conjunction with the training of various body parts can create a human detection system that can detect partially obscured humans. Preliminary results obtained using a threshold of 80 to 100 degrees Fahrenheit and HOG features from thermal images produce a robust test set accuracy of 88.92% using SVM with a linear kernel. The results for the training set accuracy using the linear kernel was 96.13%. The result for the validation set accuracy using the linear kernel was 93.313%.

#2460 SVM integrated Case Based restarting GA for further improving Solar Flare Prediction

Yukiko Yamamoto (JP), Daichi Itoh (JP), Setsuo Tsuruta (JP), Takayuki Muranushi (JP), Yuko Hada-Muranushi (JP), Syoji Kobashi (JP), Yoshiyuki Mizuno (JP), Rainer Knauf (DE)

Solar activity has various influences on the global environment. Specifically, it may have serious impacts on the Earth such as satellite damage, etc. and power plant failures causing more serious disaster. For a precise forecast of larger scale solar flares causing serious disaster, it is important to improve the space weather forecast, a daily forecast of the solar flare. In our work so far, a machine-learning algorithm called Support Vector Machine (SVM) was used. We extended this technology by integrating Case Based Genetic Algorithm (CBGA) for a more precise forecast. It was shown experimentally that triple mutation rate on the slowdown of evolution in our CBGA improves considerably (e.g. another 5%) more than original mutation rate in the True Skill Statistics TSS. For further obtaining the optimality towards more imbalanced data analysis applicable to the recognition of serious disaster or medical disease, Restart CBGA is proposed with its expected effect. Here GA integrating SVM is restarted using highly optimized but diversified solutions in the case base as initial individuals. Further this restart CBGA is repetitively and evolutionary performed, evolving and maintaining the case base by the result of each (restarted) GA.

#2159 Credibility Investigation of Newsworthy Tweets Using a Visualising Petri Net Model

Mohamed Torky (EG), Ramadan Baberse (EG), Ragial Ibrahim (EG), Ella Hassanien (EG), Gerald Schaefer (GB), Iakov Korovin (RU), Shao Ying Zhu (GB)

Investigating information credibility is an important problem in online social networks such as Twitter. Since misleading information can get easily propagated in Twitter, ranking tweets according to their credibility can help to detect rumors and identify misinformation. In this paper, we propose a Petri net model to visualise tweet credibility in Twitter. We consider the uniform resource locator (URL) as an effective feature in evaluating tweet credibility since it is used to identify the source of tweets, especially for newsworthy tweets. We perform an experimental evaluation on about 1000 tweets, and show that the proposed model is effective for assigning tweets to two classes: credible and incredible tweets, which each class being further divided into two sub-classes (credible" and "seem credible" and "doubtful" and "incredible" tweets, respectively) based on appropriate features.

#2261 SBSTFrame: a framework to search-based software testing

Bruno Nunes Machado (BR), Cássio Leonardo Rodrigues (BR), Celso Gonçalves Camilo Junior (BR), Eduardo Horst Díaz Quijano (BR)

The software testing is an important component of software development life cycle, that directly affects quality of software products. Some problems in software testing phase can't be optimized only with traditional Software Engineering techniques. It is possible to do the mathematical modelling of those problems in an attempt to optimize them through the search techniques. This study presents a framework for search-based software testing (SBST). The proposed framework works as a top-level layer over generic optimization frameworks and testing software tools, it's target is supporting software testers that are not able to use optimization frameworks during a testing activity due to short deadlines and limited resources or skills, also supporting expert or beginners users from optimization area that need or want to compare their metaheuristics with ones from literature and offered by the proposed framework. The framework was evaluated in a case study of software testing scenario. This scenario was modeled as test case selection problem in which, experiments were executed with different metaheuristics. The results indicate it's capability to support the SBST area. The framework was evaluated and compared with other SBST framework in terms of quality metrics, that indicated it's extensibility and flexibility as framework.

#2333 Towards a context based evaluation support system for quality in use assessment of mobile systems

Emna Ben Ayed (TN), Rim Magdich (TN), Christophe Kolski (FR), Houcine Ezzedine (FR)

Mobile applications, which introduce a new style of interaction between the final user and the mobile systems, are used in different contexts of use. So, a context based evaluation of the Quality in Use (QinU) of such systems becomes well required. In this work, we conduct a method towards supporting evaluators to assess QinU of mobile systems. We propose a context model that defines a set of contextual attributes for considering the mobility aspect during the evaluation. Also, we provide an evaluation support system that allows a quantitative measurement of criteria defined by ISO/IEC 25010 QinU model. We have clearly shown that the continuous change of the context affects the use of a mobile system by presenting a series of evaluation results drawing on 6 user profiles.

#2464 IoT-aware Context Respectful Counseling Agent

Yukiko Yamamoto (JP), Tetsuo Shinozaki (JP), Setsuo Tsuruta (JP), Kentarou Kurashige (JP), Rainer Knauf (DE)

Many IT workers suffer from stress in doing their work despite a few counselors to help them. To cope with this, a context respectful counseling agent, CRECA is proposed. For example, CRECA extracts emotional words from clients' utterances to detect their changes and provides clients with dialogue summary. To continue the conversation towards clients' further reflection, CRECA is extended. Using self-disclosure type prompts or questions, CRECA restricts or relates client's wishes or goals with eventual and emotional words in dialogue sentences, focusing on emotional backgrounded eventual word. Moreover, CRECA is equipped with a voice generation tool for Japanese language called OpenJtalk. Further, this is enhanced to display an avatar mimicking the natural Japanese conversation behavior called nodding ("unazuki") expressing entire approval necessary for our original CRECA modeling called Rogers counseling, the agent nods at appropriate times during the dialog. Integrating all these features with an Internet connected robot and multiple sensors, this paper totally introduces a concept of IoT-aware Context Respectful Counseling Agent (IoT-aware CRECA), which enables the robot extremely human-counselor-like.

Poster Session I5

October 11 (Tuesday), 09:30-11:00, InterContinental Budapest, Poster Spot 1
Chair: Aurona Gerber, Co-Chair: Mengchu Zhou

#2256 Circular movement algorithm for gas tracking in indoor environment

Jiyoon Lee (US), Seongha Park (US), Eric T Matson (US)

This paper introduces the design and experiments of a gas tracking algorithm, named a circular movement algorithm, which is for natural indoor environment without a strong and constant wind. A graph of gas concentration shows tumultuous flow under the condition [8]. To solve the turbulent gas concentration problem, we defined cumulative-gas concentration (CGC) value to compute gradient of gas concentration and compare gas concentration values. Using the circular movement algorithm, the robot performs circular movement and collects gas concentration data to determine directions of gas source. The algorithm makes the robot able to track the directions of the gas source. This paper also introduces a tracking method using relative coordinate system for the tracking robot in the gas leaking circumstances which can calculate the location of the gas leakage without an absolute coordinate of a room or a building. As a result of experiments, the robot was able to detect a location of possible gas source by using the proposed circular movement algorithm and the relative coordinate system.

#2421 Integrating Data Into The Togaf Adm Phases

Aurona Gerber (ZA)

This paper investigates how Data as a disruptive technology could be integrated into TOGAF. Given the recent attention of Big Data and Data Science as disruptors, this paper investigates what the impact on the enterprise could be and how Enterprise Architecture (EA) should accommodate data to enable data-driven EA. There is no model currently available that investigates how Big Data can be incorporated into data-driven EA solutions. This study specifically focuses on how the TOGAF ADM could support a data-driven enterprise. Through document analysis and a systematic literature review, a specific adaption of the TOGAF ADM is proposed that indicates the influence that Data and Big Data has on each phase within the ADM.

#1043 Model Predictive Control Implementation on Neural Networks Using Denoising Autoencoder

Daiki Ushida (JP), Eiji Konaka (JP)

Model Predictive Control (MPC) is an effective control method for nonlinear control systems including quantized control systems; however, the optimization process requires huge computation for such cases and is therefore hard to realize. In this study, a controller design method based on a machine learning technique, in particular a neural network with denoising autoencoder (DAE), is proposed. The simulation results show that the neural controller emulates the behaviors of MPC. The mean and standard deviation of the control result are improved by applying DAE, compared to simple neural network. The proposed method requires short computation time, shorter than 1[ms], therefore it can be applied to fast mechanical control systems with nonlinear characteristics where MPC requires 100[ms] or longer.

#1571 Integrating Particle Swarm Optimization with Stochastic Point Location Method in Noisy Environment

Zhang JunQi (CN), SiYu Lu (CN), Di Zang (CN), Mengchu Zhou (US)

Particle Swarm Optimization (PSO) deteriorates when facing a high-noise environment. To address this issue, one popular mechanism is the resampling method that is based on re-evaluations to find the true fitness value. However, the budget for re-evaluations in PSO is limited. In this paper, we intend to integrate a Stochastic Point Location (SPL) method into PSO to alleviate the impacts of noise on the evaluation of true fitness. SPL deals with the problem of a learning mechanism locating a target point on the line in noisy environment. Up to now, Adaptive Step Searching is the fastest algorithm in solving the SPL problem and shows great anti-noise performance. This paper investigates two effective hybrid PSO approaches, by integrating PSO and PSO-Equal Resampling with Adaptive Step Searching. The simulation results and comparisons on 20 largescale benchmark optimization functions in noisy environments demonstrate the superiority of the proposed approaches in terms of optimization accuracy and convergence rate.

#2204 Modeling and Verifying Self-adaptive Systems: A Refinement Approach

Marwa Hachicha (TN), Riadh Ben Halima (TN), Ahmed Hadj Kacem (TN)

Self-adaptive systems are able to modify their behavior and/or structure to deal with their continuously changing environment and internal dynamics. MAPE control loops, based on these four steps: Monitoring, Analysis, Planning, and Execution, have been identified as crucial elements in realizing selfadaptation of software systems. Adaptive systems are generally more difficult to design, specify and verify due to their high complexity. Ensuring the correctness of the system's adaptation logic is very crucial. In this paper, we propose a refinement approach that aims first to model step-by-step self-adaptive systems based on MAPE control loop. Second, our approach aims to formally specify self-adaptive systems at a high level of abstraction using the Event-B method. This formal specification provides a way to verify several properties for self-adaptive systems such as safety, reachability and temporal constraints. We illustrate our approach by verifying the fire detection system that exhibits a self-adaptive behavior.

#2295 Kinematic and Dynamic Modelling of UR5 Manipulator

Parham Mohsenzadeh Kebria (AU), Saba Al-Wais (AU), Hamid Abdi (AU), Saeid Nahavandi (AU)

UR robotic arms are from a series of lightweight, fast, easy to program, flexible, and safe robotic arms with 6 degrees of freedom. The fairly open control structure and low level programming access with high control bandwidth have made them of interest for many researchers. This paper presents a complete set of mathematical kinematic and dynamic, Matlab, and Simmechanics models for the UR5 robot. The accuracy of the developed mathematical models are demonstrated through kinematic and dynamic analysis. The Simmechanics model is developed based on these models to provide high quality visualisation of this robot for simulation of it in Matlab environment. The models are developed for public access and readily usable in Matlab environment. A position control system has been developed to demonstrate the use of the models and for cross validation purpose.

#1186 A new dynamic observer approach to fault detection for LTI system

Zhaoke Ning (CN), Jinyong Yu (CN)

This paper investigates the observer-based approach to the fault detection for the linear time-invariant system (LTI).The main idea of this technology is designing a constant observer gain to guarantee that the dynamic residual system is asymptotically stable and it has the desired property simultaneously. In this paper, a new dynamic observer approach is designed by regarding the observer gain as the measuring output of the plant and the estimation output of the observer. With the extra adding design degrees of freedom, the new structure provides sufficient and necessary conditions for the solution of the fault detection and estimation at the same time. The new observer-based fault detection problem is formulated as a H_∞ optimization problem which can be solved by linear matrix inequalities (LMI) technique. A simulation example is provided to illustrate the design procedures.

#1422 Collaborative Vehicle Routing Problem for Urban Last-mile Logistics

Quoc Chinh Nguyen (SG)

Collaboration between logistics service providers (LSPs) becomes increasingly crucial in urban last-mile logistics as it not only helps LSPs to reduce the transportation costs and increase the truck load factor but also improve customer service levels. However, LSPs are usually against sharing of customer data and delivery orders with their competitors. This makes most existing collaboration strategies in literature impractical in reality. To deal with this issue, we proposed a new collaboration strategy that requires less coordination efforts between the LSPs involved. In addition, we carried out a numerical experiment with the data collected from the local LSPs in Singapore to illustrate our proposed strategy. The results and the analysis highlighted shows that the proposed collaboration strategy is not only more practical than other conventional strategies, it also helps to reduce the total transportation costs and increase truckload in overall.

#1478 Hybrid Optimization Algorithm to the Problem of Distributed Generation Power Losses

Ahmed Yusuf Ali (ZA)

In this paper it presents a methodology that aims to deliver a near optimal Distributed Generation (DG) in the process of allocation DG units by using a hybrid genetic algorithm, Hence, the main aim is to minimize power losses in DG. The proposed algorithm in this paper involves two main parts of algorithms an artificial neural network (ANN) that found to evaluate the fitness function in the generation of the best DG distribution and a local search procedure that allows the algorithm to search a massive range of neighbours units.

Poster Session I6

October 11 (Tuesday), 09:30-11:00, InterContinental Budapest, Poster Spot 2
Chair: Tirthankar Dasgupta, Co-Chair: Vesna Ojleska Latkoska

#1264 Benefits from Model-Based Engineering in Mining and Metals

Laszlo Tikasz (CA), Robert I. McCulloch (CA)

Projects in mining and metals are costly, huge - and unique by their nature. Similar plants or expansions differ significantly from previous ones due to advancements in technology, to different geographical location, climate, local regulations and hosting social/cultural environment. In all phases of the works (design, construction, early operation), the Project could benefit from the model based engineering approach. Examples, selected from recent (copper and aluminium) projects, are introduced on comparing design variants, addressing ad-hoc construction problems, providing managerial decision support and training construction crew.

#1578 Rapidly exploring Bur trees for Optimal Motion Planning

Dinko Osmankovic (BA), Bakir Lacevic (BA)

This paper presents a new approach to C-space exploration and optimal path planning for robotic manipulators and planar scenarios using the structure named bur of free C-space. This structure builds upon the so-called bubble, which is a local volume of free C-space, easily computed using the distance information in the workspace. It is previously shown how burs can be used to form a rapidly exploring bur tree (RBT): a space-filling tree that resembles RRT. Now, we exploit the burs of free C-space approach to develop a new algorithm called RBT*, which is, like RRT* algorithm, provably asymptotically optimal, i.e., such that the cost of the returned solution converges almost surely to the optimum. Burs of free space offer better performance and faster convergence because it enables faster exploration of free space.

#1954 Storage Services in Private Clouds: Analysis, Performance and Availability Modeling

Elton Bezerra Torres (BR)

Cloud computing brings new technologies and concepts that favor communication services and data storage. Services like OneDrive, Google Drive and DropBox increase data availability and provide new features as synchronization and collaboration. This article aims to assess the availability and performance of private cloud storage service. A set of models that use a hierarchical strategy is proposed to evaluate both availability and performance through the composition of reliability block diagrams (RBD) and stochastic Petri net (SPN) models. A case study is presented to illustrate the applicability of the proposed models through a cloud storage service hosted on the Eucalyptus platform.

#1481 Enterprise Risk Analytics: Automatic Analysis of Risk Factors from Textual Feedbacks

Tirthankar Dasgupta (IN)

Textual data are an important information source for risk management for business enterprises. To effectively identify, extract, and analyze risk-related statements in textual data, these processes need to be automated. In this paper, we have exploited computational linguistics and natural language processing research to develop a risk analytics framework that processes human-reported risk statements to analyzes the enterprise risk description texts to classify them into valid and invalid risk categories, and perform analytics to extract information from the text pertaining to the different categories of risks and their possible cause and impacts. A manual annotation study from management experts using risk descriptions collected for a specific organization was conducted to evaluate the framework. The evaluation showed promising results for automated risk analysis and identification.

#1030 Backward Path Tracking Control for Mobile Robot with Three Trailers

Jin Cheng (CN)

The path tracking control problem of a mobile robot with three trailers in backward motion is addressed in this paper. Based on the proposed feedback control law, which can stabilize the orientations of the tractor and trailers on the desired reference angle, a fuzzy controller is designed to track given path. The controller is applicable to line segment path and is stable in backward motion. Numerical simulation experiments are implemented and the results show that the designed controller has excellent performance in backward tracking of line path.

#2505 Switching Control of Quadrotor with Adaptation Mechanism

Bara Jamal Emran (CA), Homayoun Najjaran (CA)

A switching nonlinear control system consisting of multiple Lyapunov functions and an adaptive mechanism is considered for small quadrotors. A typical quadrotor has only four actuators and six degrees of freedom (DOF) which makes it an under-actuated system. Underactuation adds constraints to the control input and complicates designing the control system. In addition, quadrotor control systems suffer from the presence of parameter uncertainty. In this work, the quadrotor's parameters are considered to be unknown but bounded. The proposed control algorithm combines a switching technique with an adaptation mechanism to overcome the difficulties associated with underactuation and uncertainty. Specifically, the switching controller is designed based on multiple Lyapunov functions to deal with the underactuation problem; and the adaptive mechanism is used to overcome the parametric uncertainties. The stability of the combined controller is proven within the region of interest, and simulation with real UAV model parameters was used to show that the proposed controller allows the system to follow a designed path closely.

#1634 Case Study on Formally Describing the Architecture of a Software-intensive System-of-Systems with SosADL

Flavio Oquendo (FR)

Software architecture description has been the subject of intensive research in the last two decades resulting in different formal Architecture Description Languages (ADLs) applied for describing static and dynamic software architectures of (often large) single systems. However, none of these ADLs has the expressive power for formally describing the evolutionary architecture of a System-of-Systems (SoS). Recently, a novel ADL, called SosADL, was specially conceived for formally describing the software architecture of SoSs. This paper presents a case study demonstrating how SosADL can be applied to formally describe the architecture of a critical Software-intensive SoS, the Urban River Monitoring SoS deployed in the Monjolinho river crossing the city of Sao Carlos.

#1398 Dynamical analysis of simple models with flexible body for bounding in quadrupeds

Tomoya Kamimura (JP)

The observation of quadruped animals has suggested that the body flexibility is important for the bounding gait. In particular, the body flexibility is assumed to be crucial for determining the ground reaction force (GRF). In this paper, we investigated the dynamic effect of the body flexibility on the GRF in quadruped bounding with simple physical models by focusing on the vertical motion. More specifically, we first showed that the body flexibility reduces the GRF using a simple two legged model in sagittal plane. Next, to clarify the GRF reduction mechanism, we further simplified the model, which has only one leg. This allowed us to analytically obtain periodic solutions. Based on the solutions, we investigated the mechanism that the body flexibility reduces the GRF during quadrupedal bounding.

#1489 Depth Information Based Separation of Moving Speakers' Voices from Mixed Recordings

Takahiro Kigawa (JP)

This paper proposes a method for separating the voice of a signal person from the voices of multiple speakers' in a mixed recording. When the sounds of multiple speakers are present when a voice recognition system is operating, the quality of speech recognition decreases. The proposed method separates the sound of multiple speakers using signal processing techniques and a microphone array. The position of the speaker is also required; however, the microphone array cannot be used for this purpose. Consequently, the position of the speaker was determined using the Kinect V2 depth image sensor. An experiment was performed to separate a signal voice from many voices. The results of the experiment show that, it is possible to separate two voices using the proposed technique.

Poster Session I7

October 11 (Tuesday), 11:00-12:30, InterContinental Budapest, Poster Spot 1
Chair: Francisco Marques, Co-Chair: Kiyoyuki Kaito

#1755 On the design of the ROBO-PARTNER Intra-factory Logistics Autonomous Robot

André Filipe Lourenço (PT), Francisco Marques (PT), Ricardo Mendonça (PT), Eduardo Pinto (PT), Jose Barata (PT)

The trends of manufacturing have now begun to call for a more adaptive and dynamic shop floor in the automation industry. The advancements in mobile robotics of recent decades have inspired and cemented a belief that multiple autonomous mobile robotic agents, often cooperatively sharing the workspace with humans, will significantly contribute to a truly flexible shop floor of the future. This article reports on the design specifications for one such robotic agent, the Intra-factory Mobile Assistant Unit (IMAU), able to carry material boxes between supermarkets and assembly stations, dynamically avoiding obstacles, throughout the shop floor. The solution will make shop floor logistics more flexible, reduce the allocated space for buffers, and, also, ease the human workload. The article will cover the sensing, actuation, communication, software architecture, and the seamless integration into the plant's execution system, which shape the autonomous logistics robot to be deployed into a working automotive shop floor during the ROBO-PARTNER project.

#2331 A Deterioration Hazard Model Using a Continuous Index

Yohei Ninomiya (JP), Daijiro Mizutani (JP), Kiyoyuki Kaito (JP)

In this study, the authors develop a deterioration prediction model with respect to deterioration management indicators by using continuous variables. Quite a few deterioration management indicators of infrastructure are observed as continuous values. It is possible to discretize these continuous values and predict deterioration with a Markov chain model, but in order to obtain more precise deterioration prediction results, it is desirable to develop a direct model of the time variation in continuous values. In this study, the authors formulate a continuous deterioration hazard model including characteristic variables that vary according to the structural characteristics and environmental conditions of infrastructure. Furthermore, the authors attempt to empirically analyze the applicability of the methodology proposed in this study.

#1418 Air-Writing Characters Modelling and Recognition on Modified CHMM

Songbin Xu (CN)

Air-writing refers to writing characters or words in the air using hand-held devices with inertial sensors. Unlike conventional hand-writing with visual and haptic feedbacks, air-writing only have stochastic and less straightforward sensor signals keeping track of hand movements and orientations. In this paper, a modified continuous Hidden Markov Model is proposed for stochastic motion characters modeling. To evaluate the effects of limitations of writing area and stroke orders on recognition performance, we address air-writing recognition on three databases. The DB1 of 10 characters was collected by 40 subjects without writing constraints, while DB2 of 36 characters was collected by 49 participants in constrained stroke orders. DB3 is a public database collected under limitations of both writing area and stroke orders. Results show that our system can realize real-time use and achieve high accuracy in both the mixed-user and the user-independent style.

#2239 Entropy-based EEG Time Interval Selection for Improving Motor Imagery Classification

Arvaneh Mahnaz (GB), Rahim Soleymanpour (IR)

Classification of different motor imagery tasks using electroencephalogram (EEG) signals is challenging, since EEG presents individualized temporal and spatial characteristics that are contaminated by noise, artifacts and irrelevant mental activities. In most applications, the EEG time interval on which feature extraction algorithms operate is fixed for all subjects, whereas the start time and the duration of motor imagery-based brain activities can vary from subject to subject. To improve the classification accuracy, this paper proposes a novel entropy-based algorithm to accurately identify the interval that motor imagery has been performed. The proposed algorithm searches through different time intervals across trials and finds the one with minimum irregularity. The hypothesis behind the proposed algorithm is that when motor imagery is performed, the activities of the neurons in the motor cortex tend to become more synchronized and less irregular. We evaluate our proposed algorithm using a publicly available motor imagery-based BCI dataset. The experimental results show that the proposed algorithm selects the EEG intervals leading to superior BCI performance compared to the fixed EEG intervals that are commonly used for all subjects.

#1870 Tolerance to Complexity: Measuring Capacity of Development Teams to Handle Source Code Complexity

Marcos Alvares (BR), Fernando Buarque de Lima Neto (BR), Tshilidzi Marwala (ZA)

A well defined testing strategy is essential for any software development project. Testing efforts need to be carefully planed and executed in order to ensure effectiveness. Program- ming failures can represent a high risk for business. In order to mitigate such risk, companies have been increasingly investing more resources on software testing. In despite of massive investments on software testing and extensive collection of static analysis techniques and tools, there are still few conclusive explanations for what causes human programming failures on software. The hypothesis investigated in this paper is that a metric based on development teams characteristics can be more effective to predict defective source code than metrics purely focused on information about source code, alone. Aiming to assist software engineers during testing initiatives, this article presents a new approach to systematically measure capacity of development teams to handle source code complexity. The proposed metric can be effective for raising information and comparing multiple development teams, planning training initiatives and prioritising testing efforts. Experiments were carried out with the entire source code base of device drivers for Linux Operating System. Our approach was able to predict, with 80% of accuracy rate, which development teams introduced more issues from 2010 to 2014.

#1700 Comparison of Two Techniques for Gaze Estimation System using the Direction of Eyes and Face

Keiko Sakurai (JP), Mingmin Yan Yan (JP), Hiroki Tamura (JP), Koichi Tanno (JP)

Binocular eye-gaze tracking can be used to estimate gaze of a subject in space using the vergence of the eyes. We analyze eye movement and head movement. As for the eye movement, we used the TalkEye which is eye tracking device. The head angle determined by template matching using a camera attached to TalkEye. A purpose of this study is to compare the proposal method using TalkEye with the conventional method to perform a high-precision gaze estimate. Conventional method is a method of using the Electrooculogram (EOG) signal and RGB-D sensor. Experiments were performed in both indoor and outdoor. The subjects could move eyes and a head freely in wide space. As a result, we show the result because 30 degrees, 60 degrees, -30 degrees, eyes estimate of -60 degrees were possible with high precision. In addition, we compared proposal technique and the conventional technique using a regression analysis and considered the effectiveness.

Poster Session S5

October 11 (Tuesday), 09:30-10:00, Sofitel Budapest Chain Bridge, Poster Spot 1
Chair: Behrouz H. Far, Co-Chair: Helio Pedrini

#1924 On Software Effort Estimation Accuracy

Hamdy Abdelhameed Ibrahim (CA), Behrouz H. Far (CA)

For decades, artificial neural network (ANN) has been used as an effective method to improve the accuracy of estimation techniques. Despite the significant contribution of accurate effort estimation in the success of software development projects, it is usually associated with challenges because of the nature of software products and dynamics in software industry and development environment. This paper investigates the impact of (1) increasing number of hidden layers and number of neurons in these hidden layers, (2) using different sets of the most influential effort multipliers as input to the ANN model on the estimation accuracy. A number of experiments are conducted to determine the influence of changing these factors on the estimation accuracy. In the experiments (1) an effort estimation technique developed using clustering and ANN ensembles and (2) a dataset of 216 projects are used. Mean Magnitude Relative Error (MMRE) is used to measure the estimation accuracy of different ANN topologies used in the experiments. MMRE also used to compare between different sets of the most influential effort multipliers which are used as input to ANN model. The experimental results show that one hidden layer was enough to better model the dataset and using more than one hidden layer significantly decreases the estimation accuracy. It also shows that increasing number of neurons up to 6 in the hidden layer improves the estimation accuracy. However, using more than 6 neurons in the hidden layer decreases the estimation accuracy. Finally, the estimation accuracy of using the most influential effort multipliers as input to the ANN model almost equals to the estimation accuracy of using the 16 effort multipliers.

#2276 Accessing Implicit Meaning: Towards Computational Ability to Reconstruct Textual Omissions

Julia M Taylor (US), Victor Raskin (US), Louis Hickman (US)

This paper describes an early step in approaching implicit meaning computationally. It outlines various types of implicit meanings and then presents a method of finding the so called defaults – omissions that are universally reconstructable and, of course, interpretible without much additional reasoning. The defaults are analyzed on the example of the 1000 instances of TerminateLife events, and a small illustrative experiment is described, where defaults of the event and its children are computationally recovered.

#1078 Sparse Subspace Clustering via Closure Subgraph Based on Directed Graph

Yuefeng Ma (CN), Xun Liang (CN)

Sparse subspace clustering has attracted much attention in the fields of signal processing, image processing, computer vision, and pattern recognition. We propose an algorithm, sparse subspace clustering via closure subgraph (SSC-CG), to accomplish subspace clustering without the number of subspaces as prior information. In SSC-CG, we use a directed graph to describe the relations in data instead of an undirected graph like most methods. Through finding all strongly connected components with closure property, we discovery all subspaces in the given dataset. Based on expressive relations, we assign data to subspaces or treat them as noise data. Experiments demonstrate that SSC-CG has an exciting performance in most conditions.

#1136 A Learning-Based Single-Image Super-Resolution Method for Very Low Quality License Plate Images

Alexandre Natã Vicente (BR), Helio Pedrini (BR)

Spatial resolution enhancement of license plate images in real scenarios plays an important role in the fields of criminal investigation and forensic science. This paper presents a learning-based single-image super-resolution method that uses a priori knowledge of the input as the plate images captured at poor quality and very low resolution. The proposed method employs a decision tree to classify the input image and the classification results are used to weight the image patches in the reconstruction step. Additionally, a histogram equalization is performed to improve the performance of the classifier. Experiments conducted on synthetic and real-world images demonstrate that the proposed method is capable of producing satisfactory results.

#1153 Identification of Nonlinear Systems with Kernel Methods

Hamza Nejib (TN), Okba Taouali (TN), Nasreddine Bouguila (TN)

This paper present a nonlinear system identification based kernel methods, such as regularization networks, support vector regression and kernel principal component analysis. In this case, black-box models are used in a particular space named reproducing kernel Hilbert space (RKHS) which only considered the input/output signals of the nonlinear system. In this particular space, the model is a linear combination of kernel functions applied to transform the observed data from the input space to a high dimensional feature space of vectors, this idea known as the kernel trick. To prove the performances of the kernel methods, identification examples are illustrated with three single-input single-output (SISO) benchmark models.

#1908 A New Method For Mining Colossal Patterns

Vo Bay (VN), Nguyen Thanh-Long (VN), Nguyen Loan (VN)

Sohrabi and Barforoush proposed BVBUC algorithm for mining colossal patterns based on bottom up scheme. It, however, spends more time to check subsets and supersets because it generates a lot of candidates and consumes more memory usage to store candidates. In this paper, we propose a new method for mining colossal patterns. Firstly, CP (Colossal Pattern)-tree is designed. Next, we develop two theorems to fast compute patterns of nodes and prune nodes. Based on CP-tree and these theorems, an algorithm (named CP-Miner) is proposed to solve the problem of mining colossal patterns. Experimental results show that CP-Miner is efficient than BVBUC in both the mining time and search space.

#1879 Scheduling a two-stage hybrid flow shop with dedicated machines, time lags and sequence-dependent setup times

Houda Harbaoui (FR), Odile Bellenguez-Morineau (FR), Soulef Khalfallah (TN)

This article concerns the resolution of a hybrid flow shop with dedicated machines, sequence dependent setup and time lags. Such a configuration is encountered in the pasta production industry. The objective is to minimize the maximum completion time of all the jobs (makespan). We first propose a mathematical model for the problem. Given the complexity of the problem, we also developed an upper bound using genetic algorithm and a lower bound in order to evaluate the GA. Computational experiments are applied to a number of randomly generated test problems. The results show that the proposed algorithm can produce results that are very close to optimal schedules if they are known or very close to the lower bounds.

#1914 Study of Formation Control and Obstacle Avoidance of swarm robots using Evolutionary Algorithms

Dibyendu Roy (IN), Madhubanti Maitra (IN)

Swarm robots cooperating in a group offer plentiful benefits and can accomplish several jobs that could be otherwise challenging either for human beings or for a single robot. Here we have studied two evolutionary based control algorithms, namely Bacterial Foraging (BFOA) and Particle swarm optimization (PSO), for flocking of a swarm to a predefine target along an optimum path while avoiding obstacles. During the movement of the swarm, attraction, repulsion and formation coefficients of all agents are evaluated using the above stated algorithms based on some fitness function as described. The evaluated coefficients can plan the path with obstacle avoidance efficiently throughout the journey. It is shown that PSO is responsible for proficient and fast path selection whereas BFOA maintains formation throughout the trajectory. Simulation results illustrate that two competing algorithms produce robust solution in different aspects.

#1039 Multi-Robot Coalition Formation Problem: Task Allocation with Adapative Immigrants Based Genetic Algorithms

Amit Rauniyar (IN), Pranab Kumar Muhuri (IN)

Multi-robot coalition formation (MRCF) problem deals with the formation of subsets of robotic to handle a particular task. In such a system, every task is executed by multiple robots. Thus, cooperation and coordination among the robots is very important. One of the key issues to be investigated for smooth operation of a multi-robot systems is finding an optimal task allocation among the suitably formed robot groups (sub sets). Considering the complete execution of available tasks, the problem of assigning available resources (robot features) to the tasks is computationally complex, which may further increase as number of tasks increases. Genetic algorithms (GA) have been found quite efficient in solving such complex computational problems. There are several algorithms based on GA to solve MRCF problems but none of them have considered the dynamic variants. Thus we apply immigrants based GAs viz. RIGA (random immigrants genetic algorithm) and EIGA (elitism based immigrants genetic algorithm) to optimal task allocation in MRCF problem. Comparative performance evaluation has been made with respect to SGA (standard genetic algorithm). Finally, we report a novel use of these algorithms making them adaptive with certain modification in their traditional attributes by adaptively choosing the parameters of genetic operators. We name them as aRIGA (adaptive RIGA) and aEIGA (adaptive EIGA). Simulations experiments have demonstrated that RIGA and EIGA produces better solutions then SGA in both the cases (with fixed and adaptive genetic operators). Among them, EIGA and aEIGA outperforms RIGA and aRIGA respectively.

Poster Session S6

October 11 (Tuesday), 09:30-10:00, Sofitel Budapest Chain Bridge, Poster Spot 2
Chair: Ajith Abraham, Co-Chair:Adnan Tahirovic

#2007 Evolutionary Hierarchical Fuzzy modeling of Interval Type-2 Beta Fuzzy Systems

Yosra Jarraya (TN), Souhir Bouaziz (TN), Adel M. Alimi (TN), Ajith Abraham (US)

The automated evolutionary design of an optimal hierarchical fuzzy system combined with the use of Interval Type-2 Fuzzy Systems and the Beta basis function is considered in this study. The resulted proposed system is named the Hierarchical interval Type-2 Beta Fuzzy System (HT2BFS). For the learning process, two main optimizations steps are considered. The first one executes the structure learning of the HT2BFS by the Extended Genetic Programming (EGP) algorithm allowing the generation of an optimal architecture. In the second step, the Opposite-based Particle Swarm Optimization (OPSO) algorithm is employed for the adjustment of parameters existing in the best obtained architecture. The two optimization algorithms are interleaved until an optimal HT2BFS is generated. Experiments on some time-series forecasting problems were performed and prove the effectiveness of the proposed system.

#2131 Collecting Multi-View Static Object Images from an Autonomous Mobile Robot

Daichi Morimoto (JP), Yoko Sasaki (JP), Hiroshi Mizoguchi (JP)

A method is presented for collecting images of static objects from various directions using a mobile robot equipped with a LIDAR unit and an omni-directional camera. A system using this method collects an image sequence for each object along with its geometric information (3D shape and position). The robot estimates its position while moving and detects static objects by using LIDAR. At each time frame, it extracts a part of the object (the surface element, or “surfel”) in the view range.' The object images are extracted from the time-series of camera images as surfel existing frames. The collected information is automatically collected from the robot. Experimental evaluation demonstrated that this method can be used to continuously collect images and geometric information of static objects in the robot periphery as it is moving.

#2506 Optical Camouflage using RGB-D sensor and LCD display

Ahmed Siddek (EG), Ahmed Siddek (EG), Islam Eshrah (EG)

Optical Camouflage is a type of Camouflage techniques, for concealing objects in visual spectrum range. This paper proposes a technique uses RGB-D camera, a Kinect for Windows v2 sensor (released in July 2014), for depth sensing of background scene, and observer’s eyes and skeleton tracking. The 2D camouflaged images is processed images of background scene which should be seen from the viewpoint of the observer rather than the back camera’s viewpoint. It depends on 3D points of tracked observer in real world and displayed on the occluded display.

#2316 Face Spoofing Detection with Highlight Removal Effect and Distortions

Inhan Kim (KR), Juhyun Ahn (KR), Daijin Kim (KR)

With rapid development of face recognition and detection techniques, the face has been frequently used as a biometric to find illegitimate access. It relates to a security issues of system directly, and hence, the face spoofing detection is an important issue. However, correctly classifying spoofing or genuine faces is challenging due to diverse environment conditions such as brightness and color of a face skin. Therefore we propose a novel approach to robustly find the spoofing faces using the highlight removal effect, which is based on the reflection information. Because spoofing face image is recaptured by a camera, it has additional light information. It means that spoofing image could have much more highlighted areas and abnormal reflection information. By extracting these differences, we are able to generate features for robust face spoofing detection. In addition, the spoofing face image and genuine face image have distinct textures because of surface material of medium. The skin and spoofing medium are expected to have different texture, and some genuine image characteristics are distorted such as color distribution. We achieve state-of-the-art performance by concatenating these features. It significantly outperforms especially for the error rate.

#1706 Similarity learning hashing embedded deep neural networks for image retrieval

Siying Zhu (KR), Bongnam Kang (KR), Daijin Kim (KR)

Learning valid similarities is a vital problem in hashing methods, especially in large-scale image search. Similarity pertained hashing method is widely used in image retrieval for its high quality compact binary code mapping. The hashing scheme of most existing hashing methods is that the input data is encoded as a vector of visual features and hashed into binary codes via projection functions or quantization methods afterward. However, this separated pipeline may prone to lose accurate similarities between images, since the limited compatible domain between visual feature vector generation and binary code mapping process. Encouraged by the extraordinary image representations learning ability of deep neural networks in classification, we propose a structure that merges binary code generation process within deep neural networks for efficient image retrieval. The proposed architecture contains two fundamental blocks. Three multilayer perceptrons from Network In Network to compute efficacious intermediate image representations and an embedded latent layer with sigmoid activation functions to learn binary codes simultaneously. Experiments show that the proposed method gains improvement over several state-of-the-art hashing methods. Besides, conducting applicable surgery to deep neural networks for simultaneous features leaning and hash codes mapping reveals an interesting link between image classification and image retrieval.

#1395 An Adaptive Sliding Mode Observer for Linear Systems under Malicious Attack

Niloofar Jahanshahi (IR), Nader Meskin (QA), Farzaneh Abdollahi (IR), Wassim Haddad (US)

Recent years have witnessed extensive research activities in the development of control law architectures for cyber-physical systems consisting of sensing, computing and communication modules working together to control physical systems. One of the main challenges in cyber-physical systems is the vulnerability to adversarial attacks. As the important module in cyber physical systems, sensor measurements are prone to malicious attacks due to the use of open computation and communication architectures. This paper proposes an adaptive sliding mode observer for state estimation of systems subjected to adversarial attacks. The novelty of the method considered here lies in the use of the equivalent control concept to explicitly reconstruct attack signals and consequently the system state. A design procedure is described and simulation results are presented to demonstrate the effectiveness of the proposed approach.

#1552 Local Motion Planning using Forward Simulation for Autonomous Vehicle

Byungjae Park (KR)

This paper proposes a motion planning method for an autonomous vehicle in an urban environment. The proposed method generates trajectories using the closed-loop forward simulation (CLFS), which can consider various properties of an autonomous vehicle. The safeties of the generated trajectories are evaluated using an occupancy grid map. Using the proposed method, smooth and safe trajectories can be generated. The experiment in a real urban environment was conducted to verify the performance of the proposed method.

#2439 A Receding Horizon Scheme for Constrained Multi-vehicle Coverage Problems

Adnan Tahirovic (BA)

This paper proposes a receding horizon optimization framework (RHC) for finding an approximate solution to different constrained multi-vehicle coverage problems. The optimization is based on the algorithm we have already developed for unconstrained multi-vehicle coverage problem, which inherently possessed some nice properties for dealing with unconstrained coverage problem setups. Although it was shown that the algorithm had preferred to choose obstacle-free areas during the task execution, it was not possible to guarantee collision free paths. The proposed RHC is, however, capable of handling constraints that might be present within a coverage problem, such as those imposed by the presence of obstacles and/or by different time limitations imposed on the duration of the vehicles' missions.

#2134 Seafloor Segmentation Using Combined Texture Features of Sidescan Sonar Images

Guanying Huo (CN)

In this paper, an unsupervised seafloor segmentation method using combined texture features of sidescan sonar images is proposed. Two sets of features are considered in the proposed algorithm. One calculates the statistics from the gray-level co-occurrence matrix (GLCM), and the other obtains the statistics in the nonsubsampled contourlet transform domain (NSCT). The two sets of features are combined to produce a multi-dimensional feature vector for each pixel. Principal component analysis (PCA) is used to reduce the dimensionality of each feature vector. The Silhouette index is adopted to automatically estimate the number of seafloor types in sonar images. The segmentation is achieved using k-means clustering based on the compact feature vectors. Experimental results show that the proposed method can improve the seafloor segmentation accuracy.

Poster Session S7

October 11 (Tuesday), 11:00-12:30, Sofitel Budapest Chain Bridge, Poster Spot 1
Chair: Chia-Feng Juang, Co-Chair: Janosch Henze

#1843 Deep Learning for Solar Power Forecasting – An Approach Using Autoencoder and LSTM Neural Networks

Andre Gensler (DE), Janosch Henze (DE), Bernhard Sick (DE), Nils Raabe (DE)

Power forecasting of renewable energy power plants is a very active research field, as reliable information about the future power generation allow for a safe operation of the power grid and helps to minimize the operational costs of these energy sources. Deep Learning algorithms have shown to be very powerful in forecasting tasks, such as economic time series or speech recognition. Up to now, Deep Learning algorithms have only been applied sparsely for forecasting renewable energy power plants. By using different Deep Learning and Artificial Neural Network algorithms, such as Deep Belief Networks, AutoEncoder, and LSTM, we introduce these powerful algorithms in the field of renewable energy power forecasting. In our experiments, we used combinations of these algorithms to show their forecast strength compared to a standard MLP and a physical forecasting model in the forecasting the energy output of 21 solar power plants. Our results using Deep Learning algorithms show a superior forecasting performance compared to Artificial Neural Networks as well as other reference models such as physical models.

#1992 Entropy-based Social Networks Partition Algorithm

Shusen Zhang (CN), Xun Liang (CN)

The emergence of human communication needs as well as many online social network applications, a variety of social relations have been established between people, and gradually form a variety of social networks. It is an important core issue in social networks to divide community or group structure, which can help analyze and understand social networks topology, predict networks evolution trend, control networks development, and respond to networks abnormal group events. Currently, the network node is the mainstream of community division algorithm as the processing object to divide the network. This paper introduces entropy theory into social networks partition on the basic of studying the concept of entropy and social networks partition algorithm, proposed an entropy-based link partition algorithm, which is the social network links as the processing object. The similarity between two objects is also properly defined and improved, which thus is more close to the real situation of the network. Experimentation on two real-world networks, obtained results of community division and compared with other community partition algorithms to verify the effectiveness of the proposed algorithm. Additionally, this algorithm has a higher accuracy, and communities are more realistic than those generated by either of the link clustering algorithm (LC) or the classical Clique percolation method (CMP).

#2266 Learning Live Autonomous Navigation: A Model Car with Hardware Arduino Neurons

Mohammad Owais Khan (US), Gary B Parker (US)

Previously we developed an implementation for an easily expandable hardware Artificial Neural Network (ANN) capable of learning using inexpensive, off-the-shelf Arduino Pro Mini microprocessors. This ANN system is unique, general use, unspecialized, and inexpensive. The implementation involves a one neuron per microchip representation, a ratio which allows for computational parallelism and ANN architecture flexibility inherent to biological neural networks. Learning happens completely on hardware via backpropagation without the need for communication with a computer. Tests showed successful, dynamic learning of the logical operations OR, AND, XOR, and XNOR. In this paper, we demonstrate the usage and strength of this implementation by applying the same framework to learn live obstacle avoidance and autonomous navigation for a 1:24 scale model car equipped with ultrasonic distance sensors. This test of the application involved a user who supervised the learning and a method to easily transition between testing and training the ANN on the car via Bluetooth. Results show that the hardware ANN consistently learns to navigate the car through an obstacle course from entrance to exit and vice versa with no collisions.

#1535 Discovering Contextual Knowledge with Associated Information in Dimensional Structured Knowledge Bases

Johannes Zenkert (DE), Alexander Holland (DE), Madjid Fathi (DE)

The visualization and simplification of complex semantically-related knowledge is one of the main challenges in knowledge discovery. In this regard, the knowledge map is a good visualization instrument to represent and provide suitable information with analysis potential. Multidimensional knowledge bases aim to support this objective and store automatically extracted facts and their dimensional relations from textual knowledge resources. In this paper, a dynamic layout structure for knowledge maps based on dimensional information is introduced. The Concept of the Imitation of the

Mental Ability of Word Association (CIMAWA) is applied in this approach to create a graphical structure as arrangement of associated information on different levels of textual information.

#1026 A New Modeling Method of Control Systems Based on Pattern Recognition

Mushu Wang (CN)

For many industrial production processes obeying certain statistical laws, a new method of establishing a SISO control model is put forward based on pattern recognition technology. Firstly, k-means clustering algorithm is used to partition input and output data collected into several classes respectively. Secondly, the distance between two classes is described by the distance of the two class centers. Then the mapping relationship between input and output of the control model is established based on pattern classification technology. And input and output orders of the model are identified by conditional entropy. Lastly experimental results illustrate the feasibility of the modeling method using the data collected from an actual industrial process.

#1675 Data-Driven Interpretable Fuzzy Controller Design Through Mult-Objective Genetic Algorithm

Chia-Feng Juang (TW), Yu-Cheng Chang (TW)

This paper considers the problem of data-driven fuzzy controller (FC) design with the objectives of not only high control accuracy but also high interpretability in the control rules. Because the tradeoff between the two objectives, a multi-objective genetic algorithm is employed to find a set of Pareto-optimal FCs. The optimization is based on an initial FC structure online generated through clustering of input data with the input space flexibly partitioned. A constrained objective function is defined to measure fuzzy set transparency and optimization of which improves FC interpretability. Since the dimension of each FC in the parameter solution population changes with the generation of a new rule, a new solution update method is proposed in this paper. The data-driven interpretable fuzzy control approach is applied to control a nonlinear plant in simulation to verify its performance.

Poster Session I8

October 12 (Wednesday), 09:30-10:00, InterContinental Budapest, Poster Spot 1
Chair: Mina Hoorfar, Co-Chair: Annamária Várkonyi-Kóczy

#1721 Evolution Mechanism of Project Portfolio Risk Based on Lotka-Voherra Model

Ning Guo (CN), Peng Guo (CN)

This paper studies the evolution mechanism of project portfolio risk and reveals the internal dynamic resources based on the risk analysis of different types of project portfolio. The risk evolution of three typical project portfolios is analyzed respectively with Lotka-Volterra model. Furthermore, this paper derives the equilibrium point of risk evolution through studying mutualistic project portfolio. Research shows, the main drive of project portfolio risk evolution is project interactions, the trend of risk evolution depends on the state of projects competition and cooperation, and there is a stable-node in the project portfolio risk evolution in the presence of certain conditions. This research will benefit to the analysis of project portfolio risk problems.

#1984 Semantic Annotation for the "on demand graphical representation" of variable data in Web documents

Nour ElHouda Ben Chaabene (TN), Ramzi Guetari (TN)

Visualization is the process of representing data graphically and interacting with these representations in order to gain insight into the data and to assist human information processing by reducing demands on attention, working memory, and long-term memory. The graphical representation of data is also used in the Web as a mean which carries visual and easy to understand information. However, graphics used to be static images that are not always up-to-date compared to the data it should represent. It therefore seems obvious that the best way to be faithful to reality is to build the graphical representation of the dynamically and on demand. In this paper we present an approach allowing generate graphical representation of data in Web documents dynamically and on demand. The annotation, based on the Resource Description Framework, allows end users to ask for a graphical representation any time they want. This representation is built according to the data existing in the document. This is very convenient, especially if the Web document is a forum in which users express opinions; or any other Web document containing variable data and where the data changes very often.

#1421 Review of Fog Computing Technology

Firas Qais Al-Doghman (AU), Zenon Chaczko (AU), Alina Rakhi Ajayan (AU), Ryszard Klempous (US)

There is a lot of confusion of what Fog Computing is and what is its role and position.The Internet of Things (IOT) needs a real time response in many applications and services which makes Fog Computing a suitable platform for achieving this goal. This paper try to justify the interest, rational on approaches, methodologies and concepts of Fog Computing. It describes the need for Fog Computing, investigate its characteristics and models, illustrate some scenarios to implement it and deduce the importance of its presence in the IoT network.

#2357 Active Problem Workspace Reduction with a Fast Fuzzy Classifier for Real-Time Applications

Balazs Tusor (HU), Annamária Várkonyi-Kóczy (HU), Janos Toth (SK)

In this paper, a Sequential Fuzzy Indexing Tables classifier is proposed for problems that require fast online operation. Its base idea comes from fuzzy hypermatrices (which are specialized versions of fuzzy look-up tables) that realize nearest-neighbor classification in order to recognize patterns similar to known ones. It is done by mapping the problem space into the memory in form of multidimensional matrices, so the class of the input data can be gained instantly in the evaluation phase. The downside of the base method is that the memory requirements scale exponentially with the number of attributes and the size of the attribute domains. The proposed classifier solves this issue for problems with large, but sparse workspaces by storing only a part of the problem domain. Thus instead of using a single multidimensional matrix, the classifier consists of a layered structure, breaking the multi-dimensional problem to a sequential combination of 2D fuzzy matrices.

#2152 Two-Layer Hybrid Control of an Underactuated System

Seyed Reza Larimi (CA), Omair Iqbal (CA), Jamieson Garbowski (CA), Mina Hoorfar (CA), Homayoun Najjaran (CA)

This paper demonstrates a new approach for model-based hybrid control of an underactuated system. The balancing of an underactuated inverted pendulum system is achieved using a reaction wheel. Specifically, a two-layer hybrid controller is proposed with control algorithms implemented into prioritized states from the calculated dynamic equations. The first layer controller uses the reaction wheel with feedback linearization to control the first priority parameter at the non-actuated joint. The second layer controller then governs the first layer controller to guide the actuated joint to reach the set point. The effectiveness of the hybrid controller on the underactuated dynamic nonlinear system is illustrated by simulations in MATLAB.

#2294 Development and Evaluation of a Symbolic Modelling Tool for Serial Manipulators with any Number of Degrees of Freedom

Parham Mohsenzadeh Kebria (AU), Hamid Abdi (AU), Saeid Nahavandi (AU)

Kinematics and dynamics modelling of manipulators are essential for analysis, optimisation, control system design, and motion planning of the manipulators. Deriving these models is a time consuming task and it involves tedious mathematical calculations specifically for manipulators with more than two degrees of freedom. In this paper, development and evaluation of a symbolic modelling tool for the kinematic and dynamic equations of serial manipulators with revolute and prismatic joints are presented. The tool allows a quick access to the full kinematics and dynamics equations of the manipulators. The user only requires to provide the DH parameters for obtaining the kinematic model and the centre of the gravity, mass parameters and momentum of inertia matrices of the links to be able to obtain the dynamic model. The tool is shared for public access and it is aimed to benefit researchers or graduate students in the area of robotics. Evaluation of the models generated by the tool is demonstrated through its accuracy for control design of PUMA 560.

#1244 Improving driving efficiency for hybrid electric vehicle with suitable interface

Jiao Wang (DE), Dirk Soeffker (DE)

In driver-vehicle systems, the Human-Machine Interface (HMI) plays an important role to assist the drivers in understanding the status of the vehicle and also serves as an input device. The HMI is an essential part in different levels of autonomous driving. As long as the interaction between the driver and vehicle remains, the outputs from the assistance system should be displayed to the driver. Studying the state of the art of the displays in vehicles, it can be stated that most of the displays show the current state of the vehicle well and detailed. To drive efficiently or to make a right decision in time, the human driver has to be assisted more specifically. Increasing driving efficiency, namely decreasing fuel consumption is one of the issues in modern automotive technology. Based on the proposed concept, actions relevant to the predefined or given goals can be displayed based on Augmented Reality (AR) in a suitable manner. In such way, the driver-vehicle-loop is closed by the interface. In this contribution, three proposed interfaces sharing the same optimal strategy behind are proposed to increase the fuel efficiency. A driving simulator is used to test the proposed interfaces. It is connected to a HiL (Hardware in Loop) test rig, which simulates the powertrain of a hybrid electric vehicle (HEV). Experiments were done to validate these three interfaces. Results show that the fuel efficiency is increased by using the proposed interfaces. Furthermore, results show also that more economic driving requires more cognitive workload.

#1910 KURE: Kinematic Universal Remote intErface, A Human Centred Remote Robot Control Paradigm

Christos Melidis (GB), Davide Marocco (IT)

In this paper we present a novel approach to human-robot control. Taking inspiration from Behaviour Based robotics and self-organisation principles, we present an interfacing mechanism, named KURE in this paper, with the ability to adapt both towards the user and the robotic morphology. The aim is for a transparent mechanism connecting user and robot, allowing for a seamless integration of control signals and robot behaviours. Starting from a tabula rasa basis, KURE is able to identify control patterns (behaviours) for the given robotic morphology and successfully merge them with control signals from the user, regardless of the input device used. The structural components of the interface are presented and assessed both individually and as a whole.

Poster Session I9

October 12 (Wednesday), 09:30-10:00, InterContinental Budapest, Poster Spot 2
Chair: Fei-Yue Wang, Co-Chair: László Horváth

#2140 Content for Context Structure in Multidisciplinary Engineering Model

László Horváth (HU)

Representation of cooperating systems in recent products and collecting organized engineering knowledge in organizational intellectual property are currently actual issues on the long way of engineering model integration. Engineering model with those representations inherently includes components from various discipline areas in a single structure and recently uses requirements, functional, logical, and physical (RFLP) structure from systems engineering. Laboratory of Intelligent Engineering Systems at the Óbuda University was founded for research in high abstraction based modeling and published five leveled abstraction and its application in the initiatives, behavior, context, and action (IBCA) contextual content structure. IBCA structure was developed among others for content based driving of components and elements in RFLP structure. In this paper, recent research results are introduced in consideration of intellectual property and system level product representation at restructuring of the IBCA structure. After placing the proposed modeling in its environment, the formerly proposed abstraction and content driving structures are discussed. Following this, new content conform intelligent property view is proposed and the restructured IBCA structure is introduced and discussed. Finally, concept of future implementation in a host industrial professional engineering system with RFLP structured product model is outlined.

#2153 Multi-temporal sequential pattern mining based improvement of alarm management systems

Janos Abonyi (HU)

Even in a case of a simple failure, modern process control systems can cause a vast number of alarms. Due to the overload of the operators these alarm floods may result in tragedical accidents. Alarm management systems can suppress correlated and predictable alarms to reduce the workload of the operators. Since the process units of complex production systems are strongly interconnected, the signals defined on different process variables generate complex multi-temporal patterns. We propose a multi-temporal sequence mining based approach to extract these patterns and form alarm suppression rules. We demonstrate the applicability of the concept in a vinyl-acetate production technology. The results illustrate the multi-temporal analysis of events defined on process variables can detect causes of alarm, and prevent alarm floods by pro-actively suppressing alarms based on the extracted sequences of events.

#2503 A Probabilistic Price Mechanism Design for Online Auctions

Jie Zhang (CN), Linjing Li (CN), Fei-Yue Wang (CN)

Recently, there is a rapid growth of the online auctions in e-commerce platforms, in which small and mediumsized enterprises (SMEs) heavily depend on the advertising systems. We need to design flexible price mechanisms to reduce the competition of SMEs without affecting competitive large companies. In this paper, a probabilistic price mechanism design approach is investigated for online auctions. Utilizing this approach, we first introduce simple mechanisms as a tool for designing new mechanisms. Based on a simple and a classical mechanism probabilistic price mechanisms are designed for online auctions and their properties are analysed. Furthermore, two mechanism design algorithms are suggested for different online auction scenarios. Experiments are presented to demonstrate the flexibility and the effictiveness of the proposed probabilistic mechanism design approach.

#2236 Local Load Optimization in Smart Grids With Bayesian Networks

Stanislav Chren (CZ), Barbora Buhnova (CZ)

One of the main goals of the utilities is to provide stable supply of the power load. The growing popularity of smart grids, a power grids enhanced with modern ICT, opened new possibilities to make the grid more efficient, secure and reliable. However, by introducing new elements into the infrastructure, such as small-scale photovoltaic power plants, the management of power load is becoming more challenging. In the paper, we address the issue of prevalent load management methods, which often lack sufficient flexibility to match growing complexity of the grid. We developed a local load management component as an alternative to the still widely used ripple control technology. Our component is capable of individual water heating control by utilising customized TOU tariff schedules. The component uses Bayesian network model to incorporate uncertainties caused by inconsistent or incomplete information collected from smart meters. Our solution was deployed by a major energy distribution company in Czech Republic in a real smart grid infrastructure consisting of more than 300 consumption points. In the case study, we confirmed viability of our approach as well as pointed out potential challenges remaining to be solved.

#1107 Full-order Sliding Mode Control for Deployment/Retrieval of Space Tether System

Zhiqiang Ma (CN), Guanghui Sun (CN)

A novel full-order sliding mode tension control scheme for the deployment/retrieval of the space tether system is proposed. The deployment/retrieval dynamics of the space tether system are derived by using Lagrangian mechanics theory. The ideal full-order sliding mode surfaces of the deployment/retrieval dynamics are design using KTC and the second method of Lyapunov, and the designed control technologies can guarantee the asymptotic stability of the full-order sliding mode dynamics. The continuous input is applied to ensure that the system states can reach the ideal surfaces in finite time and keep stable in the subsequent time. The positive tension limit is taken into consideration with choosing appropriate parameters or gains in the design of the full-order sliding mode controller. The numerical results valid the effectiveness of the proposed methods.

#1488 Modelling Security Risk in Critical Utilities: The System at Risk as a Three Player Game and Agent Society

Jeremy Busby (GB), Antonios Gouglidis (GB), Stefan Rass (AT), Sandra König (AT)

It becomes essential when reasoning about the security risks to critical utilities such electrical power and water distribution to recognize that the interests of producers and consumers do not fully coincide. They may have incentives to behave strategically towards each other, as well as toward some third party adversary. We therefore argue for the need to extend the prior literature, which has concentrated on the strategic, adaptive game between adversary and defender, towards 3-player games. But it becomes hard to justify modelling a population of consumers as a single, decision making actor. So we also show how we can model consumers as a group of mutually-influencing, yet not centrally co-ordinated, heterogeneous agents. And we suggest how this representation can be integrated into a game-theoretic framework. This requires a framework in which payoffs are known by the players only stochastically. We present some basic models and demonstrate the nature of the modelling commitments that need to be made in order to reason about utilities' security risk.

#1526 Modeling Multimodal Biometric Modalities for Continuous User Authentication

Chao Shen (CN), He Zhang (CN), Zhenyu Yang (CN), Xiaohong Guan (CN)

Continuous authentication offers the ability to continuously verify users' identity for accessing to the protected resource. Although current explorations such as face and fingerprint verification have seen varying rates of success, three main problems may limit their applicability in the context of information protection and access control: they can be of low availability in some practical scenarios, they can be intrusive, and they commonly require costly equipment. This paper presents a multimodal biometrics authentication system that can continuously verify the presence of a logged-in user. Three passive biometric modalities are currently used – keystroke (i.e., behavioral biometric), face (i.e., physiological biometric), and skin color (i.e., soft biometric) – but our approach can also be readily extended to include more modalities. By fusing these three passive biometrics, the continuous authentication system combines both temporal and modality information holistically, and can keep verifying who is using the computing system, without troubling users' routine activities. Based on real data resulting from our implementation, we find the results to be very promising with a false-acceptance rate of 0% and a false-rejection rate of 0.72%. Additional experiment on the size of observation window is provided to further examine the applicability of the proposed approach.

#2162 Context-Based Decision System for Human-Machine Interaction Applications

João Quintas (PT), Paulo Menezes (PT), Jorge Dias (PT)

This paper aims to contribute to the field of Human-Machine Interaction by proposing an innovative approach that integrates contextual information in the decision processes that orchestrate the behaviours of an interactive system (i.e. perception and actuation features involved during interaction). Classical approaches focus on designing and implementing algorithms that take into account several environment features (e.g. light, pose, etc.) to adapt its performance obtaining accurate results. An advantage of these approaches is to concentrate complexity in one algorithm leading to simple system architectures. In the other hand, a disadvantage of such approaches is their limitation to adapt to conditions under different scenarios, which typically requires manual adjustments to compensate changes of environment features. Our hypothesis is that, we can improve the overall performance of human-machine interaction process if a decision process is introduced, which is responsible for selecting the most adequate actions/algorithms, with maximum performance, that achieve a certain goal under a given context. The results from exploratory simulations validate the proposed approach to be more effective in attaining specific goals in the interaction process, resorting to algorithms with low complexity.

#2504 Ant Supervised by PSO and 2-Opt algorithm, AS-PSO-2Opt, Applied to Traveling Salesman Problem

Sonia Kefi (TN), Nizar Rokbani (TN), Adel M. Alimi (TN)

AS-PSO-2Opt is a new enhancement of the AS-PSO method. In the classical AS-PSO, the Ant heuristic is used to optimize the tour length of a Traveling Salesman Problem, TSP, and PSO is applied to optimize three parameters of ACO, (α, β, ρ). The AS-PSO-2Opt consider a post processing resuming path redundancy, helping to improve local solutions and to decrease the probability of falling in local minimum. Applied to TSP, the method allowed retrieving a valuable path solution and a set of fitted parameters for ACO. The performance of the AS-PSO-2Opt is tested on nine different TSP test benches. Experimental results based on a statistical analysis showed that the new proposal performs better than key state of art methods using Genetic algorithm, Neural Network and ACO algorithm. The AS-PSO-2Opt performs better than close related methods such as PSO-ACO-3Opt [9] and ACO with ABC [19] for various test benches.

Poster Session I10

October 12 (Wednesday), 11:00-12:30, InterContinental Budapest, Poster Spot 1
Chair: Yaoping Hu, Co-Chair: Adrian Stoica

#1723 Automated Locomotion Parameter Tuning for an Anguilliform-inspired Robot

Aditi Raj (IN), Amarjeet Kumar (IN), Atul Thakur (IN)

Effectiveness of the locomotion of an Anguilliform-inspired robot depends upon the selection of various controller parameters such as amplitude, frequency, offset and low level controller gains. Manual tuning of the aforementioned parameters can be cumbersome. Automated controller parameter tuning requires repetitive experimental tests with non-optimal parameters leading to a rapid wear and tear of the robot. Use of dynamics simulator instead of a robot may alleviate this issue to some extent. However, reality gap may exist between a physical system and corresponding simulator. This paper reports an optimization based approach for determining environment parameters (added mass, added inertia and drag) from physical experiments followed by an optimization based automated parameter tuning utilizing the determined environment parameters via developed dynamics simulator. We report numerical simulations of waypoint following on different test paths using the identified environment parameters and optimized controller parameters determined using the developed approach. We found a reduction of up to 36% in travel time in our experiments. The developed approach can lead to a match between dynamics simulation and physical experiments and thereby can help in automated parameter tuning. In future, we would like to improve the performance of the optimization and to incorporate the sensing noise and environmental disturbance like current into the dynamics simulator.

#1916 Development and Experiment of a Snake-like Robot Composed of Modularized Isomorphic Joints

Tianliang Liu (CN), Wenfu Xu (CN)

A snake-like robot is a hyper-redundant robot. It has flexible movement ability and high stability with low center of gravity. It is very suitable for environment detection in the rugged road or narrow space. This paper develops a snake-like robot with 10 degrees of freedoms (DOFs). Its joints are arranged as the structure of “Roll-Pitch-Roll-Pitch-….”, where “Roll” and “Pitch” respectively denote a Roll and Pitch joint. Each joint is designed as the same modularized unit, which can be used as a “Roll” or “Pitch” joint. Such design decreases the cost of development and enhances the flexibility of applications. Furthermore, the kinematics equation of this robot is derived and the movement ability is analyzed. Inspired by the biological behavior of a real snake, we plan several typical gaits for the snake-like robot, including peristalsis, rolling and Serpenoid curve gaits. We also develop the embedded controller based on the ARM processor and uc/os-ii real-time operation system. The gait planning algorithms are programmed using C language and realized in the embedded processor. At last, typical cases are experimented. The experiment results show that the developed robot has high mobility and flexibility.

#1129 Uncalibrated Visual Predictive Control Using Broyden Estimation

Guoqiang Ye (CN), Weiguang Li (CN), Hao Wan (CN)

In order to increase the flexibility and intelligence of robotics visual control system, Broyden estimation of composite Jacobian is combined with nonlinear model predictive control in robotics visual servoing. This method does not require the knowledge of robot model, camera model and object model, while visibility constraints, limitations of joint angles and joint velocities are all considered. Robotics control is achieved by solving the constrained optimization problem over a predictive horizon at each step, corresponding predictive model is designed with estimated composite Jacobian. Finally, simulation results are provided to demonstrate the validity of proposed method.

#1557 Optimal Placement of Solar Reflectors at the Lunar South Pole

James V Henrickson (US), Adrian Stoica (US)

A recent NASA Innovative Advanced Concepts study suggests that several reflectors placed around the perimeter of Shackleton Crater may be capable of redirecting uninterrupted solar energy to a region within the crater year-round---effectively creating an energy oasis in the otherwise dark and cold extreme environment. This work further explores this concept by identifying sets of reflector placement locations around the perimeter of Shackleton Crater that maximize the amount of time in which at least one reflector in the set has access to sunlight. Using LRO LOLA data, a 3D model of Shackleton Crater and the surrounding terrain is created. Using a ray-tracing algorithm, synthetic imagery of this region is then generated using ephemeris data for the year 2020, from which an illumination model is generated. A placement optimization search algorithm is then developed, and results are shown for cases of 1, 2, and 3 reflectors over a search space focused on the western ridge of the crater. Results indicate that three reflectors strategically placed around the perimeter of the crater would be capable of providing energy to an area within the crater for at least 92.5% of the year if placed at surface level, or at least 96.8% if placed 100 meters above the surface.

#1069 Placement-Position Search Technique for Packing Various Objects with Robot Manipulator

Kanako Esaki (JP), Nobutaka Kimura (JP), Kiyoto Ito (JP)

In this study, a placement-position search technique for robot-executable, space-efficient packing of various objects with a robot manipulator has been developed. The technique is used to enable placing objects in order from the corner of a container, fulfilling the following conditions: (A) the corner is within the reach of a robot manipulator, and (B) the robot manipulator does not collide with surrounding obstacles when it moves an object to the corner. The technique is as follows: a robot manipulator holding an object alternates between motions in a straight line and random reflections from a surface of either a container or already-packed objects in a simulation of robot movement. The motions and reflections are under physical constraints such as the reach of the robot manipulator and collisions between the robot and surrounding obstacles. The technique was evaluated with numerical examples based on the CAD data of an actual industrial-robot-manipulator using five types of objects, and the robot-packable corner for each object was determined. We therefore concluded that the technique is essential for the packing of various objects with a robot manipulator. The technique is expected to be used for packing with a robot manipulator in warehouses and factories.

#1327 Pre-processing unsteady flows for clutter reduction in vortex visualization

Kavya Bellur Padmesh (CA), Simon W. Ferrari (CA), Yaoping Hu (CA), Robert Martinuzzi (CA)

Visualization of flow features, such as vortices, aids in analyzing complex unsteady (turbulent) flows and thus facilitate human cognition of flow phenomena. Typical data of unsteady flows are vector fields of velocity in four spatiotemporal dimensions (4D). Often empirical data of unsteady flows suffer from unknown measurement errors (i.e., undesired vectors). The undesired vectors lead to clutter in visualization. The clutter degrades information content and obstructs user interaction for analyses. As a feasibility study, this paper presents adaptive nonparametric approach (ANPA) to pre-process three-dimensional (3D) flow data at individual time frames. The pre-processing aimed to eliminate undesired vectors in the data. Tested on 4 empirical datasets with different intensities of vortex shedding, ANPA reduced undesired vectors, and thereby visual clutter, from the flow data without distorting vortices. The reduction was quantifiable by the decreased number of false positives in vortex identification. These observations indicate a potential to extend ANPA to pre-process 4D flow data for vortex visualization.

#1262 In-Situ Visualization of Pedaling Forces on Cycling Training Videos

Oral Kaplan (JP), Goshiro Yamamoto (JP), Yasuhide Yoshitake (JP), Takafumi Taketomi (JP), Christian Sandor (JP), Hirokazu Kato (JP)

Over the last decades, visual representations of data has been a commonly used medium to bolster human cognition in performance evaluation of professional athletes. However, the current approaches to these visualizations still build upon the paper based principles of initial designs with solid backgrounds. Due to this situation, same visualizations usually fail to provide explicit information about the physical characteristics of the scenario that the data was captured, such as the form of athletes. In this work, we present a data visualization method which combines visual representations of cyclist's pedaling with corre- lated frames of indoor training videos. We designed a prototype system which allows us to superimpose various pedaling visual- izations onto simultaneously captured training videos of cyclists (Figure 1). The results of user studies we conducted with twelve professional cyclists confirmed their interest in new possibilities emerging from intuitive data visualizations. We also received valuable feedback about the feasible benefits of our approach over traditional approaches, such as reduced cognitive overload in understanding visualizations. We conclude by discussing the future implementations and application areas of our approach and further need of adjusting it to distinct training scenarios.

#1211 On the Approximate Maximum Likelihood Estimation in Stochastic Model of SQL Injection Attacks

Michio Sonoda (JP), Takeshi Matsuda (JP), Daiki Koizumi (JP)

SQL injection is one of vulnerabilities of web application and there is a risk of an unauthorized access if web application has this vulnerability. A lot of prevention and detection methods concerning SQL injection have been developed before now. However, it is hard to find the essential solution of this problem. In this paper, an approximate maximum likelihood estimation of parameter of a stochastic model which imitates the property of SQL injection attacks would be proposed. Furthermore, its effectiveness would be considered by investigating relationships between our proposed method and linear classification methods such as soft confidence weighted learning (SCW) and support vector machine (SVM).

Poster Session I11

October 12 (Wednesday), 11:00-12:30, InterContinental Budapest, Poster Spot 2
Chair: Fitzek Frank, Co-Chair: Peter Sincak

#1586 Network coding enhanced browser based Peer-to-Peer streaming

Patrik János Braun (HU), Péter Ekler (HU), Fitzek Frank (DE)

Peer-to-Peer network topology is well known for its beneficial characteristic, like good scalability high robustness. In spite of this, web browsers are still using the standard server-client topology for data download. In this paper we investigate the methods of implementing Peer-to-Peer data streaming in web browsers, using only JavaScript, without the need of any third party plugin. We are using WebRTC to establish direct browser to browser connections. With its help, we are designing two efficient protocols for browser based Peer-to-Peer streaming. The first protocol is an efficient content sharing Peer-to-Peer protocol. The second one a network coding enhanced Peer-to-Peer protocol. In order to demonstrate the characteristics of the solution and prove the advantages of it we have established a testbed. In this testbed we run several measurements to analyze the behavior and the throughput of our protocols. Through our results, we show that modern browsers are capable of maintaining Peer-to-Peer connections and carrying out complex network coding calculations. We show that employing our protocols for data streaming, average data download speed can be significantly increased and server load can be decreased up to 80%. This research can be considered as a pioneer work in the field of Peer-to-Peer solutions with network coding, based purely on web technologies.

#1471 Cloud-based Facial Emotion Recognition for Real-Time Emotional Atmosphere Assessment during a Lecture

Peter Takáč (SK), Marián Mach (SK), Peter Sincak (SK)

In this paper we introduce a cloud-based solution of facial emotion recognition for real-time emotional atmosphere assessment during a lecture. The role of this assessment is to help a lecturer or presenter track the facial emotions and attention of the audience for being able to accordingly change aspects of his presentation in order to achieve higher responsiveness or better mood. Furthermore, we offer a verification experiment carried out using the Microsoft Emotion API, which offers near real-time facial emotion recognition. The partial goal of this verification experiment was to prove the significance of cloud-based solutions in the emotion recognition field.

#1752 Fast content-based image retrieval using Convolutional Neural Network and hash function

Domonkos Varga (HU), Tamas Sziranyi (HU)

Due to the explosive increase of online images, content-based image retrieval has gained a lot of attention. The success of deep learning techniques such as convolutional neural networks have motivated us to explore its applications in our context. The main contribution of our work is a novel end-to-end supervised learning framework that learns probability-based semantic-level similarity and feature-level similarity simultaneously. The main advantage of our novel hashing scheme that it is able to reduce the computational cost of retrieval significantly at the state-of-the-art efficiency level. We report on comprehensive experiments using public available datasets such as Oxford, Holidays and ImageNet 2012 retrieval datasets.

#1313 Error feedback does not change response strategies in a joint force detection task

Fabio Tatti (IT), Gabriel Baud-Bovy (IT)

When two partners perform a joint physical task, each of them experiences a force that sums together a component generated by the partner and another generated from the environment. To investigate whether subjects are able to distinguish these two components, we created a force perception task in which two partners indicate the direction of an external force applied to a rigid bar that they grasp from opposite ends. In a previous study we showed that dyads adopt different response strategies and that many do not split the external force in a manner that allows both subjects to experience a meaningful interaction force. Here, we investigated whether a visual feedback on the partner's and correct response let dyads learn how to best split the external force. We show that this is not the case and that the dyads' force sharing and response strategies were comparable to those of the previous experiment.

#2244 Curious Partner: An Approach to Realize Common Ground in Human-Autonomy Collaboration

Siddhartha S Mehta (US), Chau T Ton (US), Emily Doucette (US), Jess Willard Curtis (US)

A dialog-based human-autonomy interaction approach, called curious partner, is presented for a class of systems where the role of autonomy is to assist humans in decision making tasks. Even if the human and the autonomy share the environment and receive identical information, they may have inconsistencies in the representation of the environment due to difference in their perception and expert knowledge. The curious partner interaction framework is presented to resolve model-level differences between the human and the autonomy to establish common ground. The knowledge base of the autonomy is modeled using a Bayesian engine. The autonomy's dialog with the human acts as a feedback mechanism to resolve any differences either by suggesting maximally probable actions to human based on the state of its Bayesian model or by updating its model to achieve analogous world representation.

#1795 Determination of the fault identification accuracy in LV networks using the Fuzzy method

Judith Pálfi (HU), Péter Holcsik (HU), Marta Takacs (HU), Zsolt Mitrik (HU)

The on-line detection of the faults in low-voltage (LV) distribution networks has become possible by the implementation of the smart meters (SM's). Due to technical and economic reasons SM's will not be installed in each households. For an efficient and accurate fault identification, it is necessary to determine the optimal ratio of SM's in relation to the number of consumers. This is achieved by using the Fuzzy method. In this paper, the influence of the number of SM's on the accuracy of the fault identification is presented.

#1058 A Continuous Identity Verification Method based on Free-Text Keystroke Dynamics

Xiaoshuang Song (CN), Zhao Peihai (CN), Wang Mimi (CN)

Currently, existing continuous identity verification methods mostly need to analyze a lot of keystroke data to ensure the authentication credibility.To achieve certification results with less data, in the paper, a new continuous verification method is proposed. This method, based on free-text keystroke dynamics, excavates the nearest character sequences of the users from their typing patterns, then builds Gaussian model based on the users' nearest character sequences, and at last grades the attempts to verify identity of the users based on Gaussian probability density function. Experimental results demonstrate that efficacy of the proposed method with accuracy of 90.5%, which achieve a false-alarm-rate of 5.3% under thirty characters. In the field of continuous identity verification, our method can be applied to reduce the verification cycle and ensure the reliability of the verification.

Poster Session I12

October 12 (Wednesday), 14:00-15:30, InterContinental Budapest, Poster Spot 1
Chair: Bart De Schutter, Co-Chair: Ana Madureira

#1296 Study on the Impact of the NS in the Performance of Meta-Heuristics in the TSP

André Serra e Santos (PT), Ana Madureira (PT), Leonilde Rocha Varela (PT)

Meta-heuristics have been applied for a long time to the Travelling Salesman Problem (TSP) but information is still lacking in the determination of the parameters with the best performance. This paper examines the impact of the Simulated Annealing (SA) and Discrete Artificial Bee Colony (DABC) parameters in the TSP. One special consideration of this paper is how the Neighborhood Structure (NS) interact with the other parameters and impacts the performance of the meta-heuristics. NS performance has been the topic of much research, with NS proposed for the best-known problems, which seem to imply that the NS influences the performance of meta-heuristics, more that other parameters. Moreover, a comparative analysis of distinct meta-heuristics is carried out to demonstrate a non-proportional increase in the performance of the NS.

#2031 Chance Constrained Model Predictive Controller Synthesis for Stochastic Max-Plus Linear Systems

Vahab Rostampour Samarin (NL), Dieky Adzkiya (ID), Sadegh Esmaeil Zadeh Soudjani (GB), Bart De Schutter (NL), Tamas Keviczky (NL)

This paper presents a stochastic model predictive control problem for a class of discrete event systems, namely stochastic max-plus linear systems, which are of wide practical interest as they appear in many application domains for timing and synchronization studies. The objective of the control problem is to minimize a cost function under constraints on states, inputs and outputs of such a system in a receding horizon fashion. In contrast to the pessimistic view of the robust approach on uncertainty, the stochastic approach interprets the constraints probabilistically, allowing for a sufficiently small violation probability level. In order to address the resulting nonconvex chance-constrained optimization problem, we present two ideas in this paper. First, we employ a scenario-based approach to approximate the problem solution, which optimizes the control inputs over a receding horizon, subject to the constraint satisfaction under a finite number of scenarios of the uncertain parameters. Second, we show that this approximate optimization problem is convex with respect to the decision variables and we provide a-priori probabilistic guarantees for the desired level of constraint fulfillment. The proposed scheme improves the results in the literature in two distinct directions: we do not require any assumption on the underlying probability distribution of the system parameters; and the scheme is applicable to high dimensional problems, which makes it suitable for real industrial applications. The proposed framework is demonstrated on a two-dimensional production system and it is also applied to a subset of the Dutch railway network in order to show its scalability and study its limitations.

#2098 Hyper-redundant Robots and Bioinformatics: Modelling Loops in RNA

Mahendra Gohil (IN), Arindam Chakraborty (IN), Bhaskar Dasgupta (IN)

Nucleic acid structures, like DNA and RNA, primarily involve hydrogen bonded, base-paired stretches interspersed with loops of various geometric shapes. Theoretical modelling and simulation of these loop structures has been an analytical challenge (with the exception of proteins) and most methods used are based on heuristics. The objectives of this research are to model loops in nucleic acid structures by developing an algorithm using the inverse kinematics for hyper-redundant manipulators and develop a database of theoretical models for corresponding experimental models in Protein Data Bank (PDB). First, a volumetric representation of the loops in nucleic acids is sought from a hyper-redundant manipulator schema with torsion angle as joint variables. Based on it, steric clashes, as a function of loop configuration, in side chains are predicted; acknowledging that a stable configuration should have minimal infringement. It is further shown that loop modelling is essentially a process of constrained energy optimization for redundant structures which, at its background, requires kinematic approximation of the loop and estimation of infringement. Simulated theoretical prediction of structure, of some such loops in specific RNA molecules and non-Watson-Crick duplex or quadruplex (along with statistical parameters), illustrate the validity of this approach to modelling. Predicted structures (with multiple possibilities) are considered for selection only if certain statistical criteria (indicating proximity) are satisfied when compared to their experimental counterparts.

#2120 Non-parametric Smoothing for Gradient Methods in Non-differentiable Optimization Problems

Arindam Chakraborty (IN), Arunjyoti Sinha Roy (IN), Bhaskar Dasgupta (IN)

In this article, a method has been established, for optimizing multi-variable nonlinear discontinuous cost functions having multiple simple kinks in their domains of definition, by applying simple non-parametric inverse trigonometric functions and combinations thereof as smoothing agents. The original function is locally replaced by these smoothing agents at the points of jump discontinuity, while retaining the global structure of the original objective function. The non-parametric smoothing function is exact and devoid of complicated special functions or integral approximations and hence, the resulting optimization algorithm is relatively simpler and faster. The absence of the parameter ensures little ill-conditioning effects in subsequent calculations. Relevant properties of the smoothing function are developed analytically and the shape of the resulting modified objective functions are illustrated with appropriate numerical simulations. Conjugate gradient and Broyden family of methods (DFP/BFGS) were employed to minimize the modified functions; although Levenberg–Marquardt and gradient descent methods were also used occasionally to confirm the universal applicability of the proposed method. Over fifty problems were successfully minimized (maximized) and results for some of them are tabulated before the concluding remarks of the article. Constrained optimization of discontinuous functions with such smoothing agents is an active research within the working group.

#2367 Increasing ROS 1.x communication security for medical surgery robot

Roland Doczi (HU), Ferenc Kis (HU), Balazs Suto (HU), Valeria Poser (HU), Gernot Kronreif (AT), Eszter Jósvai (AT), Miklos Kozlovszky (HU)

Robot systems based on ROS are growing in popularity. While they are vulnerable from a cybersecurity perspective, they still provide a solid framework for many research projects. The components can easily communicate with each other, share information and send control commands freely and without major restrictions. In special fields (medical, military, etc.) such freedom is dangerous and not acceptable. To foster the application of ROS in medical research field we are hardening its internal architecture and elevate the software security. In this paper we propose an application layer solution for the dataflow control and protection between the nodes.

#2412 Fault Diagnosis for dynamic nonlinear system based on Variable Moving Window KPCA

Fezai Radhia (TN), Okba Taouali (TN)

Kernel Principal Component Analysis (KPCA) is a noteworthy nonlinear extension of the most popular dimensionality reduction methods, Principal Component Analysis (PCA). It has been extensively used for process monitoring. The time varying property of industrial processs require the adaptive ability of KPCA. The Variable Moving Window KPCA (VMWKPCA) is developed to monitor the dynamic processes. This new method is based on the variation of the size of the moving window depending on the normal change of the system. For fault diagnosis a set of structured partial VMWKPCA were used. The fault detection and diagnosis with the proposed VMWKPCA are tested using the CSTR process. The simulation results proved that the new method is effective for fault detection and diagnosis.

#1277 Score Level Fusion Algorithm Using Differential Evolution and Proportional Conflict Redistribution Rule

Mezai Lamia (DZ), Fella Hachouf (DZ)

In this paper, a new score level fusion approach is proposed. It is based on Differential Evolution (DE) technique and Proportional Conflict Redistribution fusion rule. DE technique is used to find the best confidence factors of the belief assignments of the different modalities. The fusion of the weighted belief assignments is then performed by Proportional Conflict Redistribution combination rule. Experiments are conducted on the scores of BANCA multimodal dataset. A comparative study is achieved using our method, Proportional Conflict Redistribution combination rule and the SVM based fusion. The experimental results show that the proposed approach improves significantly the performance compared to the well established methods.

#1674 State Estimations in Virus Epidemic Dynamic System on Sparse Network by using Hybrid Extended Kalman Filter

Ruting Jia (US), Chengwei Lei (US)

This paper considers the problem of state estimations in virus/ worm epidemic dynamic system with time-dependent parameters in arbitrary sparse networks by using continuous-discrete Extended Kalman Filter (so-called Hybrid Extended Kalman Filter [1]). The virus spreading dynamic model has unmeasurable states and with highly nonlinearities which makes the state estimation complicated and not straightforward. Because of the continuous-time dynamic and discretetime measurement, in this paper, a Hybrid Extended Kalman Filter to estimate states has been introduced. To move one step further, the homogeneity assumption in Kephart and White [2], [3] has been removed and a model that accommodate realistic scenarios where the model parameters may change with respect to time has been introduced. Simulations are taken to demonstrate, via a small sparse network of constant number of nodes, that the Hybrid Kalman Filter still gives a fast and accurate estimation. Of course, there are subtle issues that must be tackled before the problem can be fully addressed.

Poster Session I13

October 12 (Wednesday), 14:00-15:30, InterContinental Budapest, Poster Spot 2
Chair: Jorge Dias, Co-Chair: Adel M. Alimi

#1085 John von Neumann's Self-Replicating Machine – Critical Components Required

Alex Ellery (CA)

This paper introduces the concept of a physical self-replicating machine for deployment on the Moon utilizing raw material available on the Moon. A detailed but selective review is given in order to highlight clearly the novel aspects of the concept presented. In particular, it is hypothesized that if critical components - electric motors and vacuum tubes - can be 3D printed from the limited repertoire of lunar materials, 3D printing constitutes an effective universal construction mechanism. This follows from the observation that mechatronic components are the core constituent parts of all robotic mechanisms and that the robot is the key to von Neumann's universal constructor. Steps toward 3D printing of electric motors in particular and strategies toward the same regarding electronics is presented.

#1330 Quality assessment of subjectively labelled training data for improving the reliability of status prediction

Ying Dai (JP)

In order to improve the reliability of the status perception, this paper defines a metric QoSTD to measure the quality of the subjectively labelled training data used with K-means clustering. On the basis of QoSTD, we propose a method that utilizes a support vector support (SVM) model to predict the specified states of an individual's status. We also present a way to determine a threshold for QoSTD so that it rejects states that cannot be predicted with sufficient certainty. A high positive correlation between the QoSTD and the quality of the perception of the status is verified by experimental results with predictions based on traditional Chinese medicine (TCM) Zhengs.

#2311 Grey Relational Analysis Based on Velocity and Acceleration and its Application on Research

Xuemei Li (CN), Xiaotong Yuan (CN), Kedong Yin (CN)

Based on existing grey relational degree models, in order to investigate the dynamic similarity of trends between sequences, we propose the grey relational model based on velocity and acceleration which measures the closeness of the rate of change. And then we discuss the nature of the rate of change of gray relational degree. This model can reflect the similarity of the relative change trend of time series. It has the characters of symmetry, uniqueness, comparability, and normativity, etc. Applied to the analysis of the correlation between consumer price index (CPI) and Economic Policy Uncertainty (EPU), and between the exchange rate and Economic Policy Uncertainty (EPU). The empirical results show that the correlation between the exchange rate and Economic Policy Uncertainty (EPU) is stronger, so we consider that the exchange rate has a great influence on EPU index, that means the exchange rate has more impact of actual macroeconomic variables.

#1642 Mining Mixed-initiative Dialogs

Saverio Perugini (US)

Human-computer dialogs are an important vehicle through which to produce a rich and compelling form of human-computer interaction. We view the specification of a human-computer dialog as a set of sequences of progressive interactions between a user and a computer system, and mine partially ordered sets, which correspond to mixing dialog initiative, embedded in these sets of sequences – a process we refer to as dialog mining – because partially ordered sets can be advantageously exploited to reduce the control complexity of a dialog implementation. Our mining losslessly compresses the specification of a dialog. We describe our mining algorithm and report the results of a simulation-oriented evaluation. Our algorithm is sound, and our results indicate that it can compress nearly all dialog specifications, and some to a high degree. This work is part of broader research on the specification and implementation of mixed-initiative dialogs.

#1335 Automatic clustering of eye gaze data for machine learning

Khushnood Zahoor Naqshbandi (AU), Tom Gedeon (AU), Umran Azziz Abdulla (AU)

Eye gaze patterns or scanpaths of subjects looking at art while answering questions related to the art have been used to decode those tasks with the use of certain classifiers and machine learning techniques. Some of these techniques require the artwork to be divided into several Areas or Regions of Interest. In this paper, two ways of clustering the static visual stimuli - k-means and the density based clustering algorithm called OPTICS - were used for this purpose. These algorithms were used to cluster the gaze points before classification. The classification success rates were then compared. While it was observed that both k-means and OPTICS gave better success rates than manual clustering, which is itself higher than chance level, OPTICS consistently gave higher success rates than k-means given the right parameter settings. OPTICS also formed clusters that look more intuitive and consistent with the heat map readings than k-means, which formed clusters that look unintuitive and less consistent with the heat map.

#2498 Mitigating distractions during online reading: an explorative study

Leana Copeland (AU), Tom Gedeon (AU), Sabrina Caldwell (AU)

Reading online can be difficult due to the distractions of digital environments. In this paper we present a user study in which participants' eye gazes were recorded as they read text in a visually distracting environment. We explore two mitigation signals using real-time eye gaze data to investigate whether the effects help reduce and recovery after distractions. These effects involved altering the last word read before a distraction occurred to signal to the reader where they were up to before distraction. We compared these experimental conditions on both first English language (L1) and second language (L2) readers. We found no significant difference in the distraction rates between the easy and the hard text or between L1 and L2 readers. However, the results demonstrate the mitigation signals helped to recover from a distraction by drawing participants' attention back to the text as well as indicating from where to recommence reading.

Poster Session S8

October 12 (Wednesday), 09:30-10:00, Sofitel Budapest Chain Bridge, Poster Spot 1
Chair: Elena Anatolievna Sofronova, Co-Chair: Cody H. Fleming

#2175 MOPSO for Dynamic Feature Selection Problem Based Big Data Fusion

Ahlem Aboud (TN), Raja Fdhila (TN), Adel M. Alimi (TN)

Optimization process occurs in many aspects and areas of everyday life. However, the big use of the internet in recent years caused a complex management of large quantities of data that are stored in many different data sources and optimization attend the domain of big data to optimize multi and dynamic data that stored in a complex dataset including all types of transactions in the data sources. So, the diversity of data stored in different data sources caused a complexity to access the information and user find a problem to present the same real world object from different sources in a clear and complementary one representation. Therefore, the high complexity of the representation of a target concept object" that provided from different data sources, the dynamic feature selection problem based big data fusion present as a solution and a novel approach that will be applicable to solve a dynamic multi-objective optimization feature selection problem (MOOP) based on Multi-Objective Particle Swarm Optimization (MOPSO). This paper carried out on the state-of-the-art of the research done to present an overview of static and dynamic optimization in literature approach, then to define an overview of big data and to present an idea about the future work that will be able to solve the dynamic feature selection based on big data fusion with MOPSO.

#2340 Sentiment detection for mining altruistic behaviors in Social Web: a case study

Sabrina Senatore (IT), Jacek Filipczuk (IT), Emanuele Pesce (IT)

With the advent of Social Web, the user has become an active consumer which shares information and participates in social networks, online communities, blogs, wikis, feeds and chats. The volunteer person-power is a valuable resource which creates innovative content and helps other users to make right decisions with his own opinions, suggestions, advice. Opinions and suggestions have an amazing impact on the online user community: they may unexpectedly influence decision-making activities starting from simply buying or not a smartphone until to social events, political actions, and even marketing strategies. This paper aims at studying the role played by the sentiments in influencing the user actions. Particularly, it analyzes how sentiments expressed in the text can move the reader to do altruistic actions. The idea is from RAOP community where users write posts asking or offering a free pizza. Our work achieves a comparative analysis of machine learning methods on a ROAP dataset, that collects original posts where users asked for a free pizza. The goal is to extract the sentiments expressed in natural language, in the textual requests, in order to predict which user request will be satisfied (getting a free pizza). Finally, a posteriori “affective” analysis shows the predominant emotions expressed in the satisfied requests, that move the readers to have an altruistic behavior.

#2249 Privacy Free Indoor Action Detection System Using Top-View Detph Camera based on Key-poses

Tang-Wei Hsu (TW), Yu-Huan Yang (TW), Tso-Hsin Yeh (TW), An-Sheng Liu (TW), Li-Chen Fu (TW)

In this paper, we propose an indoor action detection system which can automatically keep the log of users’ activities of daily life since each activity generally consists of a number of actions. The hardware setting here adopts top-view depth cameras which makes our system less privacy sensitive and less annoying to the users, too. We regard the series of images of an action as a set of key-poses in images of the interested user which are arranged in a certain temporal order and use the latent SVM framework to jointly learn the appearance of the key-poses and the temporal locations of the key-poses. In this work, two kinds of features are proposed. The first is the histogram of depth difference value which can encode the shape of the human poses. The second is the location-signified feature which can capture the spatial relations among the person, floor, and other static objects. Moreover, we find that some incorrect detection results of certain type of action are usually associated with another certain type of action. Therefore, we design an algorithm that tries to automatically discover the action pairs which are the most difficult to be differentiable, and suppress the incorrect detection outcomes. To validate our system, experiments have been conducted, and the experimental results have shown effectiveness and robustness of our proposed method.

#1511 Quaternion Decomposition Based Discriminant Analysis for Color Face Recognition

Rushi Lan (MO), Yicong Zhou (CN)

In this paper, we propose a novel quaternion decomposition based discriminant analysis (QDDA) method for color face recognition. Unlike traditional approaches that handle color face images by vector representation or by each color channel individually, QDDA makes use of the quaternion to encode all color channels such that we can process all these channels in a holistic way and consider their relations simultaneously. In order to extract more discriminant color information from the image, a decomposition operation is performed to the quaternion matrix. A linear discriminant analysis is finally implemented to the obtained subcomponents for feature extraction. Experimental results have demonstrated the effectiveness of QDDA by comparing with other quaternion based methods.

#2495 Improved Reversible Data Hiding in Encrypted Images using Histogram Modification

Shuang Yi (MO), Yicong Zhou (CN)

Inspired by Zhang et al.'s method that applies the integer discrete wavelet transform (DWT) to the original image, and embeds the secret data into the middle (LH, HL) and high (HH) frequency sub-bands of integer DWT coefficients with histogram modification based method, we propose a reversible data hiding method that embeds the secret data into the encrypted prediction error values. Compared with the LH, HL and HH integer DWT coefficients, the prediction error values generated by our proposed method are more concentrated to 0, and thus a high visual quality of the marked decrypted image can be achieved. Experimental results show that our proposed method has a better performance than Zhang's.

#1297 A Prediction Classifier Architecture to Forecast Device Status on Smart Environments

Leonardo Heitzmann (BR), Bruno Siqueira Campos Mendonça Vilar (BR), Cristina Wada (BR), Cezar Pinheiro Schroeder (BR), Rayanne Heluy Bezerra (BR), George D.C. Cavalcanti (BR), Rafael Simionato (BR)

In smart environments, the extraction of relevant information in large volumes of data collected from intelligent devices is a crucial issue. The extracted information can assist in automation of user activities and on daily chores, either suggesting or even changing the state of devices based on his/her routine. In this work, we propose a prediction architecture which combines an innovative preprocessing strategy with some well known classification algorithms for the environment automation. The preprocessing enhances the datasets by including features and organizing them in structures that improve the classification results. We verify which preprocessing parameters have significant impact on prediction performance using datasets collected from a real home equipped with sensors. In simulations, the avNNet, mlp and C5.0 classifiers attained the higher accuracies using Friedman and Nemenyi statistical testes, but none of them outperformed the others in all scenarios using this architecture.

#1893 Model Predictive Control for Urban Traffic Flows

Askhat Ibragimovich Diveev (RU), Elena Anatolievna Sofronova (RU), Mikhalev Vasiliy (RU)

A problem of optimal urban traffic flows control is considered. A mathematical model of control by the traffic lights at intersections using the controlled networks theory is given. It is a system of nonlinear finite-differential equations. To present a large scale road networks the model contains the connection matrices that describe interactions between input and output roads in subnetworks. The traffic flow control is performed by the coordination of active phases of traffic lights. A control goal is to minimize the difference between the total input flow and total output flow for all subnetworks. In this paper, a neural network approach for urban traffic road network parameters adjustment is presented. A simulation is conducted under a microscopic traffic simulation software CTraf. Results demonstrate that neural network reinforcement training obtain better parameters of the network model.

#2015 Local invariant representation for multi-instance toucheless palmprint identification

Iesrine Charfi (TN), Hanene Trichili (TN), Adel M. Alimi (TN), Basel Solaiman (FR)

Palmprint identification is a popular biometric technology used for personal characterization. Traditional palmprint recognition methods are mostly based on acquisition devices with contact, and this, may affect their user friendliness. In this paper, a toucheless palmprint identification method based on Scale Invariant Feature Transform (SIFT) descriptors and sparse representation method is proposed, in order to extract palmprint features of left and right palms. The fusion scheme is performed at rank level using Support Vector Machines (SVM) classifier and probability distribution to generate the final identity of a person. Experiments evaluated on CASIA palmprint database and a proposed toucheless REST (REgim Sfax Tunisia) hand database, report promising performances which are competitive to other existing palmprint identification methods.

#1892 Study of the conditionals possibilities effectiveness in the numerical information fusion

Hanen Raissi (TN), Hanene Guesmi (TN), Adel M. Alimi (TN)

Information fusion is a research domain that strives to establish theories that exploit and analyze the data retrieved from multiple sources. Generally, these fusion theories try to combine these data for a classification task and to make the decision efficiently. The possibility theory is one of the most known in the information fusion domain. So, the possibility distribution estimation step represents the key element of success of the fusion process based on possibilistic reasoning. In the framework of the possibility theory, we will concentrate to study the conditional possibilities distributions existing in the literature. Therefore, in this paper, we propose to present a comparative study of the different existing conditional possibilities to fuse numerical information. For this fact, we have evaluated each conditional possibility definition on 15 benchmark databases in order to deduct the best one. Thus, the experiments results provide insights that can help the researchers in the fusion information to increase the performance of its fusion/classification systems by the choosing of the most appropriate conditional possibility distribution.

Poster Session S9

October 12 (Wednesday), 09:30-10:00, Sofitel Budapest Chain Bridge, Poster Spot 2
Chair: Essameddin Badreddin, Co-Chair: Yicong Zhou

#1274 Comparative Study of Logarithmic Image Processing Models for Medical Image Enhancement

Zhou Zhao (MO), Yicong Zhou (CN)

Medical image enhancement is an effective tool to improve visual quality of digital medical images. However, conventional linear image enhancement methods often suffers from problems such as over-enhancement and noise sensitivity. In this paper, we study nonlinear arithmetic frameworks designed to solve the common problems of linear enhancement methods, namely, LIP, PLIP and GLIP. We also introduce nonlinear unsharp masking algorithms based on the logarithmic image processing models for medical image enhancement. Experiments are conducted to evaluate and compare the performance of the methods.

#1739 Non-Linear Model Based Control and Parameter Identification of a Hex-Rotor UAV

Benjamin Franziskus Kirsch (DE), Alexander Alexopoulos (DE), Essameddin Badreddin (DE)

An implementation of a non-linear control scheme for hex rotors will be presented. The cascaded control scheme consisting of an attitude, a velocity and a position control level, empowers the hex rotor to be easily upgraded with more sophisticated behaviors. The attitude control utilizes the backstepping approach, which was introduced by Bouabdallah, 2005 for quad rotors, later improved and adapted to hex rotors by Arellano-Muro, 2013. The implementation of the velocity and position controllers follow Voos, 2009. Parameters, necessary for the model based control were identified numerically, with the help of direct measurement and by the use of flight experiment data and parameter estimation techniques. Validation of the controllers is done by analyzing real flight data, which was taken during outdoor flight experiments, testing both manual flight and position hold.

#2461 Combining intrusion detection datasets using MapReduce

Farah Jemili (TN), Mondher Essid (TN)

Extensive use of computer network and huge amount of data had led several works to focus on intrusion detection system, which are based on single dataset or to combine multiple detection techniques to analyze detection rate and false positive flag. This paper presents a new way to combine intrusion detection dataset, we will concentrate about KDD99, DARPA dataset using bigdata technique (mapreduce). One main goal is to generate single dataset with different attack type that is realistic and meets real world criteria. Another major goal is to generate low false flag and higher detection rate. This work consists in combining dataset and removing redundancy information using Bigdata technique, in final step we will implement NaiveBayes network and K2 algorithm using WEKA Tools to analyze the dataset.

#2323 Validating “Is ECC-ANN Combination Equivalent to DNN?” for Speech Emotion Recognition

Rupayan Chakraborty (IN), Sunil Kumar Kopparapu (IN)

Use of the error correcting codes (ECC) in a multi-class audio emotion recognition problem is proposed to improve the emotion recognition accuracy. We visualize the emotion recognition system as a noisy communication channel, thus motivating the use of ECC. We assume the emotion recognition process consists of an audio feature extractor followed by an artificial neural network (ANN) for emotion classification. In our formulation, the noise in the communication channel is a result of insufficiently learnt ANN classifier which results in an erroneous emotion classification. We first show that the ECC-ANN combination performs better than the ANN classifier, justifying the use of ECC-ANN combination. We further make the conjecture that ECC in ECC-ANN combination can be visualized as a part of Deep Neural Network (DNN) where the intelligence is under control. We show through rigorous experimentation, on Emo-DB database, that the use of ECC-ANN combination is equivalent to the DNN; in terms of the improved recognition accuracies over an ANN. Our experimental results show that both ECC-ANN and DNN give a minimum absolute improvement of around 13.75%.

#1768 Design Functional Decomposition Based on Flow

Sabah S. Al-Fedaghi (KW)

Technological complexity and faster revision have led to an increasingly complicated design process; hence, there is great interest in such issues as efficiency and reliability. The focus of this paper is a conceptual (in contrast to mathematical or logical) analysis to assist in accomplishing such a task. Specifically, the paper focuses on the design phase of functional decomposition, in which an overall function can often be divided into identifiable subfunctions corresponding to subtasks. Many diagrammatic languages in this field utilize a block diagram in which the processes and subsystems are understood to be inside a given block (black box), and with functions usually defined by statements consisting of a verb and a noun. But this type of diagrammatic representation suffers from many shortcomings. Flows are intermingled with a control flow, the whole is mixed with its parts, and the number of potential types or names of constructs is enormous. The paper proposes an alternative description based on pure flow and triggering made up of five basic stages. The two approaches are contrasted through examples. The results point to a conceptual improvement gained by use of the proposed method as an abstract formulation of tasks.

#1834 Comparing Single Task Assignments Control with Supervisory Control through Automated Plan Generation

Thomas Remmersmann (DE), Ulrich Schade (DE), Christopher M. Schlick (DE)

The workload of a single operator of a multi robot systems increases with the number of robots in use. Supervisory control is a general idea to solve this issue. In this paper we present an experiment in which we compare single-robot-control and group robot control. Using single-robot-control the user must task each robot separately. Using group-robot-control, he can task the whole group and a planning component generates a plan and observes the execution. We compare performance, errors and workload of the user under single robot control and group robot control conditions.

Poster Session S10

October 12 (Wednesday), 11:00-12:30, Sofitel Budapest Chain Bridge, Poster Spot 1
Chair: Ljiljana Trajkovic, Co-Chair: Peter Corcoran

#1051 Activity Recognition and Sensor Positioning

Sabah S. Al-Fedaghi (KW)

Sensors are used in numerous applications, including medical care, home automation, and security. In use of sensors, recognition of human activities is important, with a focus on behavior related to the application. This paper discusses a conceptual (in contrast to technology-oriented) approach to positioning of sensors for monitoring the activities of a human subject. In the relationship among potentially infinite types of activities, a limited number of sensors, and limited locations, the problem discussed in this paper is whether there are generic types of activities that can be monitored. Accordingly, five basic types of activities are identified in the context of a flow-based model developed in the field of computer science. The activities form [abstract] machine-based spaces instead of an architectural floor plan. Hence, “monitoring spots” (e.g., sensors) can be allocated according to types of activities. The paper demonstrates this method by taking floor plans from the literature of houses that include sensors and converting to a diagram of machines. The resultant description has potential as a nonarchitectural method for positioning of sensors.

#1967 Detecting BGP Anomalies Using Machine Learning Techniques

Qingye Ding (CA), Zhida Li (CA), Prerna Batta (CA), Ljiljana Trajkovic (CA)

Border Gateway Protocol (BGP) anomalies affect network operations and, hence, their detection is of interest to researchers and practitioners. Various machine learning techniques have been applied for detection of such anomalies. In this paper, we first employ the minimum Redundancy Maximum Relevance (mRMR) feature selection algorithms to extract the most relevant features used for classifying BGP anomalies and then apply the Support Vector Machine (SVM) and Long Short-Term Memory (LSTM) algorithms for data classification. The SVM and LSTM algorithms are compared based on accuracy and F-score. Their performance was improved by choosing balanced data for model training.

#2401 Ontology Traceability for the Adaptation of Services in Pervasive Environment

Naima Nebhani (FR)

Recently, interaction with computer applications in a pervasive environment benefit increasingly from mobile technologies. These technologies generally attribute to these environments of physical and social properties. Therefore, the adoption of these technologies ensures more flexibility and creates new forms of use. The consideration of the context of use in pervasive interactive applications is a field of research known as Sensitivity to context or context-awareness. A sensitive application context must be able to manage the context information in order to provide adequate services. The inclusion of these two components is made the object of our contribution. Indeed, to achieve the context management, we adopt the concept of ontology through basic universal descriptions of domain context awareness. Presenting the context of management models based on ontology it's very important to adapt the context sensitivity application. This paper presents a formal Context-awareness model based an ontology traceability to provides adaptive services in order to accomplish a specific goal at any moment and any place. The proposed ontology traceability will be integrated into our context platform adaptation platform. In addition, this kind of traceability allows the supervision and management of what is happening at the environment and, in consequence, to improve the service of information visualization offered to users.

#1570 Towards the development of a standardized performance evaluation framework for eye gaze estimation systems in consumer platforms

Anuradha Kar (IE), Peter Corcoran (IE)

There is a need to standardize the performance of eye gaze estimation (EGE) methods in various platforms for human computer interaction (HCI). Because of lack of consistent schemes or protocols for summative evaluation of EGE systems, performance results in this field can neither be compared nor reproduced with any consistency. In contemporary literature, gaze tracking accuracy is measured under non-identical sets of conditions, with variable metrics and most results do not report the impact of system meta-parameters that significantly affect tracking performances. In this work, the diverse nature of these research outcomes and system parameters which affect gaze tracking in different platforms is investigated and their error contributions are estimated quantitatively. Then the concept and development of a performance evaluation framework is proposed- that can define design criteria and benchmark quality measures for the eye gaze research community.

#2246 Toward new family beta maps for chaotic image encryption

Mourad Zaied (TN), Rim Zahmoul (TN)

Recent research on image encryption algorithms has been increasingly based on chaotic systems, but the drawbacks of small key space and weak security in chaotic cryptosystems are obvious. In this paper, new chaotic maps based on beta function were created. The generation of different pseudo random sequences was carried out to shuffle the position of the image pixels and to confuse the relationship between the encrypted image and the original image, thereby significantly increasing the resistance to attacks. The proposed system has the advantage of bigger key space, smaller iteration times and high security analysis such as key space analysis, statistical analysis and sensitivity analysis.

#2312 Real-time Rotation invariant Action Recognition using Microsoft Kinect

Sarath Sasidaran Raniapsara (US), Ferat Sahin (US)

A Human Action recognition system is proposed using the Skeletal Tracking from Kinect. The angular information of the joints helps in handling scaling errors. Vectors are generated using the joint coordinates and the angles of each joint are used as features for key pose recognition. A rotational compensation is included in the feature to handle rotational errors. The key poses are recognized using Similarity Matching Technique, neural network and decision tree algorithms. The recognized key postures are fed into a decision forest to pick the action based on the trained sequence of key poses.

#1251 Actuated Green Wave Control for Grid-like Network Traffic Signal Coordination

Zhenyu Yang (CN), Zhijun Ding (CN)

To deal with urban traffic congestion, this paper proposes an actuated green wave method. It extends an arterial actuated bandwidth method to network situations. The arterial bandwidth is based on several key temporal differences to determine phase patterns and offsets. The network is decomposed in such a way that it only consists of arterial bandwidth problems. It adds intersections from the start point in a breadth-first-search manner until the target road network is covered. To further make the bandwidth method dynamic, gap-out logic is also embedded in each cycle using vehicle counts detected by trap detectors. Given detected real-time parameters, the timing plan is updated periodically to adapt to traffic variations. An offset transitioning logic is also proposed to smooth timing plan updates. Finally, simulation tests are conducted against a self-organized actuated control method, on a 52-intersection road network using VISSIM. The results show that for more saturated situations the proposed method outperforms the actuated method in terms of average delay, stops, link speeds and vehicle arrivals.

#2179 Agent-supported Knowledge Acquisition for Digital Humanities Research

Tamás Mészáros (HU)

Computer-based information processing tools face many challenges in the field of digital humanities, especially in literary studies. Big data and knowledge acquisition methods often could not cope with texts from the distant past. To solve the problem a multi-agent information processing framework is proposed that performs preprocessing tasks to increase the quality of knowledge acquisition methods. The framework is part of a cloud-based research platform, also presented in this paper. The platform provides shared document and data storage, programmable statistical analysis and on-line publishing tools.

#1640 On Localization and Mapping with RGB-D Sensor and Hexapod Walking Robot in Rough Terrains

Petr Cizek (CZ), Jan Faigl (CZ)

In this paper, we address a problem of precise on-line localization of hexapod walking robot operating in rough terrains. We consider existing Simultaneous Localization and Mapping approach with a low cost structured light (RGB-D) sensor. We propose to combine this sensor and localization method with the developed adaptive motion gait that allows the robot to crawl various types of terrain, such as stairs, ramps, or small wooden blocks. In such an environment a precise estimation of the full 6-DOF pose to create a map of the robot surroundings is essential. The considered set-up of the robot operational environment allows us to evaluate the impact of individual terrain types and influence of individual parameters on the localization accuracy. The reported evaluation results indicate a relation between the terrain type, parametrization of the method and the localization accuracy.

Poster Session S11

October 12 (Wednesday), 11:00-12:30, Sofitel Budapest Chain Bridge, Poster Spot 2
Chair: Abdollah Homaifar, Co-Chair: Peng Wang

#2197 Semi-asynchronous Fault Diagnosis of Discrete Event Systems

Alejandro Porter White (US), Ali Karimoddini (US)

This paper proposes a diagnostics tool for a Discrete-Event System (DES) under uncertain activation conditions. This diagnosis tool, the diagnoser (as it is called), detects, identifies, and locates system faults in relation to a set of states of which the system under diagnosis could possibly be located, upon the diagnoser's instance of activation. This diagnoser is designed to diagnose system faults that occur prior to and/or after the diagnoser's activation; thus removing the procedural constraint of initializing the system and diagnoser synchronously. Illustrative examples are provided to detail the proposed diagnosis procedure.

#1210 Adaptive Probabilistic Tracking with Discriminative Feature Selection for Mobile Robot

Peng Wang (CN), Yongkang Luo (CN), Wanyi Li (CN), Hong Qiao (CN)

Object tracking is one of the important tasks for mobile robot, and developing a robust and real-time visual tracking algorithm which can adaptively capture the varying appearance of target under challenging conditions for mobile robot is still an open problem. The main challenges of visual tracking for mobile robot come from variation of target's appearance and disturbance of environment. To cope with these problems, one of the most important topics is how to select the best tracking features. In this paper, we propose a novel adaptive probabilistic tracking method with discriminative feature selection for mobile robot. Different from the existing adaptive tracking algorithms which select the discriminative features in a finite feature set, the proposed method treats feature selection as an estimation problem of the best feature tunable parameters in a continuous space. The estimation of the best tunable parameters and object tracking are implemented via different particle filters with novel observation models. A novel target model updating strategy is also proposed to adapt to the varying appearance of target and resist gradual drift. Experiments show the robustness of the proposed method under challenging conditions.

#2501 Virtual Reality Social Training for Adolescents with High-Functioning Autism

Robert E Mourning (US), Ying Tang (US)

Virtual reality training has potential to be an effective mode of therapy for players with autism spectrum disorders, but existing systems are not suited to the complex interactions required for this application; evaluation and treatment of autism is still a challenging task for human experts. In this paper we present an adaptive training system that learns to map player performance deficits to the most effective instructional response. This system uses a neural network to monitor player performance and a learning fuzzy inference system to map performance deficits to instructional techniques. The functionalities of the system are then evaluated.

#1255 Grey Dominance-based Rough Set Approach to Decision System with Three-parameter Interval Grey Number

Dang Luo (CN), Wenxin Mao (CN), Huifang Sun (CN)

A method of knowledge acquisition for the decision information system whose attribute value of alternatives is three-parameter interval grey number is proposed in this paper. First, in classic rough set, the decision table must be given in advance, but we can only establish information system from the collected data. So, we establish the decision table from information system with the grey relational clustering decision method. Then, we construct the grey dominance relation based on the dominance extent between two three-parameter interval grey numbers, and put forward a method of extracting decision rules and attribute reduction. The last case about the comprehensive evaluation of icebreaking car is given to illustrate the effectiveness of the proposed method.

#2265 A Stochastic Learning Approach for Construction of Brick Structures with a Ground Robot

Sergio Ronaldo Barros dos Santos (BR), Diego O Dantas (BR), Sidney N Givigi (CA), Areolino Neto (BR), Luciano Buonocore (BR), Cairo Lucio Nascimento Jr. (BR)

In this paper, we describe an architectural framework by which a mobile robot can learn how to autonomously assemble solid 3D brick structures according to user-specified designs. The policies of actions to perform the construction task are obtained from a simulation environment using Reinforcement Learning (RL) and Particle Swarm Optimization (PSO) approaches. The proposed planning architecture is used to simultaneously solve three problems: 1) to generate feasible construction policies, 2) to define the set of maneuvers for the vehicle to carry out the assembly task, and 3) to obtain the set of trajectories for handling and mounting parts while avoiding fixed obstacles. During the learning process the power limitation of the ground robot is taken into account. Simulation results show that the set of learned actions may efficiently perform the construction procedures without resulting in conditions which prevent the fulfillment of the assembly procedures. The synthesis of this system opens the way to the development of intelligent construction approaches using ground robots.

SMC Junior 2016

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Junior Keynote Talk I: Robots, Men, and Cybernetics

October 10 (Monday), 13:30-14:15, InterContinental Budapest, Ballroom I

Tamás Haidegger
Antal Bejczy Center for Intelligent Robotics
Óbuda University, Hungary

Abstract

20 years ago, robots were stuck in the factories, working behind fences and safeguarding systems. Today, robotics is mainstream, and giant corporations from Google to Toyota and Amazon invest billions into the field. The recent rise of service robots forecasts a human–robot collaborative society, however, no one really knows what will be the rules of a safe and productive co-existence. One of the robotics community's major tasks is to streamline development trends, work on the harmonization of technological advancement, legislations, standards and the society. The talk introduces the key areas—from self-driving cars to medical assistive devices—where the biggest leap in robotics has been observed, looking into the key enabling technologies and foreseeable consequences. Driven by the huge potential economic benefits, full automation will hit the roads within a few years, while there are numerous open technological and safety issues. In medicine, advanced robotic technology has been used to make surgeries safer, more precise or to access and manipulate tissue in micro scale, yet using only robotic technology also means that surgeons lose their manual dexterity and practice to perform classical surgeries. The current requirement of possible human intervention will not hold for long in either domain, however, anomalies do happen. As it is foreseen, robotic technology can only be superior on average measured against humans. The engineering community aims to promote cutting edge technology, to connect the developers and link them to the users of these services, while sharing the responsibility for these new technologies radically changing the way we live.

Short Biography

Tamás Haidegger received his M.Sc. degrees from the Budapest University of Technology and Economics (BME) in Electrical Engineering and Biomedical Engineering in 2006 and 2008, respectively. His Ph.D. thesis (2011) was based on a neurosurgical robot he helped developing when he was a visiting scholar at the Johns Hopkins University. His main field of research is control/teleoperation of surgical robots, image-guided therapy and supportive medical technologies. Currently, he is an adjunct professor at the Óbuda University, serving as the deputy director of the Antal Bejczy Center for Intelligent Robotic. Besides, he is a research area manager at the Austrian Center of Medical Innovation and Technology (ACMIT), working on minimally invasive surgical simulation and training, medical robotics and usability/workflow assessment through ontologies.

Tamás is an active member of various other professional organizations, including the IEEE Robotics an Automation Society, IEEE EMBC, euRobotics aisbl and MICCAI. He is a national delegate to an ISO/IEC standardization committee focusing on the safety and performance of medical robots. He has co-authored more than 130 peer reviewed papers published at various scientific meeting and conference proceedings, refereed journals and books in the field of biomedical/control engineering and computer-integrated surgery. He has been maintaining a professional blog on medical robotic technologies for over 8 years: surgrob.blogspot.com. Tamás is a passionate photographer, rock climber and an advocate of city-biking. More information of Dr. Haidegger can be found: http://irob.uni-obuda.hu/.

Junior Keynote Talk II: Regulating Depth of Anesthesia: we are so different, yet so much alike

October 10 (Monday), 14:15-15:00, InterContinental Budapest, Ballroom I

Clara M. Ionescu
Research group on Dynamical Systems and Control (DySC)
Department of Electrical engineering, Systems and Automation
Faculty of Applied Sciences
Ghent University, Belgium

Abstract

Depth of anesthesia (DOA) control paradigm is not new, yet it captured lately renewed interest from the research community due to the increase necessity in personalized medicine and integration of patient socio-bio-emo response in the cyber-physical world of today’s healthcare. This keynote addresses this problem from a system engineering standpoint, whereas the role of patient’s response is analysed and quantified into suitable tools for closed loop DOA control. The solution proposed is rather an “operator guide” and not a fully automatic assist device. The operator in this case is obviously the clinician who plays the role of God even for a limited time during general anesthesia operative procedures. Real life cases are presented and illustrate the necessity of an integrated approach.

Short Biography

Clara M. Ionescu was born in 1979, Cimpulung, Romania. She received the M.Sc. degree in industrial informatics and automation from ”Dunarea de Jos” University, Galati, Romania, in 2003. She obtained the Ph.D. degree at Ghent University, Gent, Belgium in 2009, on the identification of the human respiratory system by means of fractional order models. Currently, she is a professor in the same university, involved in several international projects, with both industrial and biomedical applications, in identification and control. Her main research interests are in biomedical applications, with identification and advanced control objectives in drug delivery systems, multi-drug interaction systems, diagnosis procedures for respiratory diseases and the problematic of nanorobot medicine from control engineering point of view. C. Ionescu has been the holder of a prestigious post-doctoral grant from Flanders Research Center (FWO) during 2011-2016. More information of Dr. ir. Ionescu can be found: http://users.ugent.be/~cionescu/.

Junior Cybernetics

October 12 (Wednesday), 16:00-17:30, InterContinental Budapest, Ballroom II
Session Chair: Kashpruk Nataliia

#1046 Parallel machine scheduling with predefined parts of jobs and family setup times

Hyun-Jung Kim (KR)

We examine a parallel machine scheduling problem with family setup times for minimizing the makespan. Each job consists of predefined parts and the parts of a job can be processed concurrently at different machines. We first analyze a special case, in which jobs are not divided into parts, with LPT (Longest Processing Time) and list schedules and provide the worst-case bounds. Then we develop an efficient heuristic algorithm for scheduling parts of jobs and propose its worstcase performance ratio. The motivation for this research is IoTbased smart factory applications with 3D printers as processing machines.

#1384 Embedding Optimized Trajectory and Motor Controller Into the Szabad(ka)-II Hexapod Robot

István Kecskés (CS), Péter Odry (HU), Ervin Burkus (HU), Ákos Odry (HU)

The driving of the Szabad(ka)-II hexapod robot was characterized with its minimal and non-optimized structure during the development of the robot. For this driving algorithm, a simulation environment has been developed, and based on the simulation model and recorded measurement results, the aforementioned algorithm has been validated. In the next step of the development, the optimization of the robot driving algorithm was elaborated in its simulation environment. In order, to implement the optimized controllers and trajectory, the software of the embedded system has to be rewritten, through which the developed fuzzy controllers and the high resolution leg-trajectories could be run on the robot. This paper on the one hand, introduces the essential aspects of the implementation and realization procedures of the optimized driving algorithm, on the other hand, gives a comparison assessment of the old and the new driving algorithms.

#1538 Comparison Identificatipon of Statistical and Fuzzy Models of Time Series

Nataliia Viktorivna Kashpruk (PL)

The paper presents the basic methods of time series models identification. Exemplary calculations have been carried out on the base of the currencies courses. The first part of this paper is dedicated to the statistical analysis of time series models. In other part of the paper the adaptive network-based fuzzy inference system (ANFIS) has been used for prediction of time series data. The results of comparative analysis of statistical and fuzzy models have been presented.

Junior-Cybernetics in Applied Sciencies (I)

October 12 (Wednesday), 11:00-12:30, InterContinental Budapest, Ballroom III
Session Chairs: Dana Copot, György Eigner

#1742 Mixed MFC-VRFT Approach for a Multivariable Aerodynamic System Position Control

Raul Cristian Roman (RO), Mircea Bogdan Radac (RO), Radu Emil Precup (RO)

This paper proposes a mixed nonlinear data-driven Model-Free Control (MFC) – Virtual Reference Feedback Tuning (VRFT) technique, where the parameters of the MFC algorithm are automatically computed via VRFT. The resulted mixed MFC-VRFT algorithm is then tested on a Multi Input-Multi Output twin rotor aerodynamic system model, and the results are compared with an MFC algorithm whose parameters were optimally computed using a Gravitational Search algorithm.

#1775 In vitro glucose concentration estimation by means of fractional order impedance models

Dana Copot (BE), Robin De Keyser (BE), Clara M. Ionescu (BE)

This paper presents the application of fractional calculus tools, i.e. fractional order impedance and Cole-Cole elements to detect, measure and estimate glucose concentrations by means of electrochemical impedance spectroscopy. In this paper, the fractional order impedance model is presented and compared with the measured impedance. The model parameters are related to various physical conditions of the test-cells and a baseline measurements along with blind evaluation are presented. The results obtained indicate that the fractional order impedance model can capture the dynamics of the measured impedance.

#1982 Investigation of the TP-based modeling possibility of a nonlinear ICU diabetes model

György Eigner (HU), Imre J. Rudas (HU), Levente Kovács (HU)

In-silico modeling is an important discipline of biomedical engineering. Advanced controllers, which provide high quality control only can be developed, if the available mathematical model of the processes to be controlled are exist. Further, those control design methodologies, which are interconnected with the modeling process may reach better performance than regular methods. Linear Parameter Varying (LPV) approaches with Linear Matrix Inequality (LMI) based modeling and controller design are able to deal with the requirements in case of biomedical processes. In this paper, we demonstrated the usability of the recently developed Tensor Product (TP) model transformation based modeling in case of diabetes modeling. TP transformation based approaches comply with the aforementioned requirements, since the modeling and controller design can be handled as a connected, LPVLMI method. The achieved results will be used for TP transformation based controller design in our later work.

#1990 Infectious Hospital Agents: an individual-based simulation framework

Róbert Pethes (HU), Tamás Ferenci (HU), Levente Kovács (HU)

In this paper we present the plan, motivation, background, and the design of an agent-based simulation framework describing the spread of Hospital-Associated Infections (HAIs). We are developing a general simulation environment that is able to model wide range of pathogen transmission scenarios in hospital environment. The elements of the simulation include among others: admission and discharge patients, pathogen transmission via healthcare workers, colonization and infection, modelling hospital events, scheduling treatments, the interventions against HAI spreading. The evolution of the model is tracked in discrete time, and the simulation is driven by stochastic events sampled from predefined distributions. Our aim is to build a general, customisable and extensible simulation environment for the domain of HAIs, therefore the presented design is in Object-Oriented fashion. We implement the system in R using S4 classes, although the design is general. The results of the simulations are time series and transmission networks.

Junior-Cybernetics in Applied Sciencies (II)

October 12 (Wednesday), 14:00-15:30, Sofitel Budapest Chain Bridge, Academy 3
Session Chairs: György Eigner, Dana Copot

#2115 Speed control strategy of geophysical measurement platform for archaeological prospection: a conceptual study

Thoa Thi Mac (BE), Cosmin Copot (BE), Lieven Verdonck (BE), Robin De Keyser (BE)

Shallow geophysics have become an important tool in archaeological prospection (i.e. the investigation of archaeological remains without recurring to excavations). This paper presents the conceptual study for speed control of geophysical measurement platform for archaeological prospection on challenging terrain using a fuzzy logic approach. A traversal-terrain speed behavior is introduced to have suitable platform movement on the interested terrain regions. The regional traverse-terrain behavior is complemented by following behaviors: traversal terrain behaviors, local obstacle avoiding and geophysical investigating behavior. The fuzzy based speed control strategy has several advantages. Firstly, the fuzzy logic rules that govern the autonomous geophysical measurement platform (AGMP) motion are simpler and more understandable since it can emulate the archaeologist drivers knowledge and experience. Secondly, the behavior-based strategy has a modular structure that can be extended to incorporate new behaviors. The experiments are implemented on a Lego robot to test the proposed approach.

#2206 Augmented Lifecycle Space for traceability and consistency enhancement

József Klespitz (HU), Bíró Miklós (AT), Levente Kovács (HU)

In software development application lifecycle management (ALM) systems are used to support the development process. As these products are tailored for best fitting the applied programs and their actual usage is diverse. Often, this means that products of different vendors are applied, which reduce the reachability between different artefacts and the overall consistency of the system. In this paper we are analyzing the applicability of Augmented Lifecycle Space as a new approach. This approach provides the capability to enhance the traceability and consistency while reducing human effort through automation both in homogeneous and heterogeneous tool environments.

#1574 Novel Methods for Image-Guided ToF Depth Upsampling

Ivan Eichhardt (HU), Dmitry Chetverikov (HU), Zsolt Jankó (HU)

Sensor fusion is an important part of modern cyber-physical systems that observe and analyse real-world environments. Time-of-Flight depth cameras provide high framerate low-resolution depth data that can be efficiently used in many applications related to cyber-physical systems. In this paper, we address the critical issue of upsampling and enhancing the low-quality depth data using a calibrated and registered high-resolution colour image or video. Two novel algorithms for image guided depth upsampling are proposed based on different principles. A new method for video-guided upsampling is also presented. Initial test results on synthetic and real data are shown and discussed.

#1591 Fuzzy and Deep Learning Approaches for User Modeling in Interactive Design of Watershed Plans

Andrew Hoblitzell (US), Meghna Babbar-Sebens (US), Snehasis Mukhopadhyay (US)

Determining the optimal design of a watershed is a highly subjective process which involves the consideration of many distinct factors by several different stakeholder groups. We describe additional functionality for our watershed planning system, called WRESTORE (Watershed REstoration Using Spatio- Temporal Optimization of REsources) (http://wrestore.iupui.edu), where stakeholders can collaboratively optimize best management practices on to the watershed. WRESTORE utilizes the USDA's public domain Soil and Water Assessment Tool hydrologic model for watershed simulations. Reinforcement learning and interactive genetic algorithms are applied for the search process. The new functionality described is a user modeling component that develops a computational model of a user's decision-making, based on real-time user-provided ratings for a subset of possible designs. The user modeling task utilizes neural network approaches, such as deep learning. We believe the originality of our approach centers on integrating user models in to the hydrological decision support process. This paper thus has three objectives: (i) outline current work in user modeling and watershed design, (ii) describe our system for interactive optimization of watershed design, and (iii) describe our work on implementing accurate and stable user predictive models to boost optimization performance.

#2092 Interactive Q-Learning for Social Robots that Learn from the Wizard: A Pilot Study

Gergely Magyar (SK)

This paper discusses interactive Q-learning as a method for learning appropriate robot behavior from the human teleoperator in order to increase the robot's autonomy in various human-robot interaction scenarios. We demonstrate the usability of our approach on a simulation of a simple task. The results prove the feasibility of this method in different kinds of interactions. As a conclusion, we discuss the possibility of including this type of learning to a cloud-based Wizard of Oz system.

Junior Systems Science & Engineering (I)

October 11 (Tuesday), 11:00-12:30, InterContinental Budapest, Ballroom III
Session Chair: Premachandra Chinthaka

#1250 Fast Lane Boundary Recognition by a Parallel Image Processor

Chinthaka Premachandra (JP), Ryo Gohara (JP), Kiyotaka Kato (JP)

Road domain detection is a highly important topic for the development of automated driving systems and driving support systems that use vehicle-mounted cameras. Much past research related to road domain detection has focused on lane detection. Commonly, this is performed by applying edge detection to a road image, then applying a Hough transform to perform straight-line detection. Detected straight lines are then analyzed to extract lane boundaries. However, the Hough transform is calculation intensive, requiring long processing times. This paper applies a parallel processor to image detection and investigates a Hough transform suited to parallel processing to realize faster lane detection.

#1257 Joint estimation of states and parameters of vehicle model using cubature kalman filter

Yan Sun (CN), Qijun Chen (CN)

Road condition is changed in the vehicle motion, unknown parameter is required in real-time estimation. Considering the unknown parameter of the vehicle dynamic system, For the purpose of pursuing accuracy estimation of vehicle states, this paper propose two kinds of strategies to estimate the state and parameter simultaneously, the joint cubature kalman filter and the dual cubature kalman filter. Firstly of all, a nonlinear double vehicle dynamic model based on Magic tire model is introduced. And then the algorithm of the joint cubature kalman filter (JCKF) and the dual cubature kalman filter (DCKF) are applied to vehicle state estimation. Finally, simulations are carried out using the Carsim and Matlab/Simulink to evaluate the algorithms. Simulation results demonstrate that the DCKF algorithm has relatively high accuracy and performances better than the JCKF under various road conditions.

#1474 New model for a variant of Pick up and Delivery Problem

Zaher Al Chami (FR), Herve Manier (FR), Marie-Ange Manier (FR)

In pickup and delivery problems with time windows (PDPTW), vehicles have to transport loads from pickup locations to delivery locations while respecting capacity and time constraints. When global capacity is not sufficient, the choice of locations to be served is an additionnal problem (selective variant). This paper presents an exact algorithm which solves the Selective PDPTW, where precedence constraints must be considered (paired demands). The objective is to minimize the total transportation cost or to maximize the profit. We tested our proposed algorithm on benchmark instances from the literature and on our instances. The computational results obtained show the efficiency of our approach.

#1519 Controlled Parking for Self-Driving Cars

Shahroz Tariq (KR)

We explored the problems which are soon to be faced while parking autonomous cars in parking lots. Like where is the closest parking slot available to the autonomous car? How to navigate to that location? What kind of parking structures could be good for autonomous cars? We also provide an initial solution which uses a central server and the graph of the parking lot to guide the cars to the closest parking slots. With experiments, we have shown that our pro-posed method should be effective for the controlled parking for self-driving cars.

Junior Systems Science & Engineering (II)

October 11 (Tuesday), 14:00-15:30, InterContinental Budapest, Duna Salon II
Session Chair: Dániel András Drexler

#1637 Novel Palmprint Biometric System Combining Several Fractal Methods for Texture Information Extraction

Raouia Mokni (TN), Monji Kherallah (TN)

This paper presents a new method to recognize the person's identity through their palmprints. Palmprint recognition is among the most reliable physiological characteristics that can be used especially in forensic applications thanks to its simplicity and its ease of use, its user friendliness and high identification reliability. Accordingly, it has gained great popularity within the pattern recognition field over the past three decades. In this paper, we suggest a new approach for personal identification based on palmprint features extracted using the various methods of fractal theory. These methods have been broadly applied in image processing fields to estimate the fractal dimensions of an image as an important parameter for the analysis of objects of irregular shapes of the texture image. The novelty of this approach is two-fold. On the one hand, we apply the Box counting (BC), the Mass Radius (MS) and the Cumulative Intersection (CumInt) methods to extract the palmprint texture information. On the other hand, the combination of efficient information from the three descriptors has been presented in order to make identification system more efficient and achieve better performances. Then, we explore such texture information features by using classical machine learning techniques: the K-Nearest Neighbor (KNN), the Support Vector Machine (SVM) and the Multiclass Random Forest classification algorithms. The results of the experiments conducted on two large datasets show that our proposed method gives better recognition rates of about 96.35% for CASIA-Palmprint dataset and 95.98% for IITD-Touchless-Palmprint dataset. These results obtained are compared to other well-known state-of-the-art approaches.

#1907 User-Level Large Scale Load Forecasting Based on GPU

Zhiming Xu (CN), Xun Liang (CN), Gang Peng (CN)

Load forecasting is an essential part in power system management and planning. In recent years, more and more researchers started to focus on the behavior of terminal customers, trying to improve the accuracy of load forecasting. This paper proposes to use the neuron network model to predict each user's load first, and then aggregate all the forecasting results to get higher level prediction. In order to speed up the process, we also design a model based on CUDA. We conducted several experiments on real-world data (160 thousand consumers' load profiles) and the results confirm the effectiveness and efficiency of our method.

#1969 Second-order and implicit methods in numerical integration improve tracking performance of the closed-loop inverse kinematics algorithm

Dániel András Drexler (HU)

A general approach to solve the inverse kinematics problem of series manipulators, i.e. finding the required joint motions for the desired end effector motions, is based on the linear approximation of the forward kinematics map and discretization of the continuous problem. Due to the linearization, first velocities are calculated, so numerical integration needs to be done to get the joint variables. This general solution is just a numerical approximation, thus improving the tracking performance of the inverse kinematics algorithm is of great importance. The application of several numerical integration techniques (implicit Euler, explicit trapezoid, implicit trapezoid) is analyzed, and a fix point iteration is given that can be used to calculate implicit solutions. The tracking performance of the spatial inverse positioning problem of a spatial manipulator is analyzed by checking the tracking error in the desired direction (i.e. along the derivative of the desired end effector path) and in the plane perpendicular to the desired direction. The application of the explicit and implicit trapezoid methods yielded much better tracking performance in the directions orthogonal to the desired direction when the end effector had to track a linear path, while the tracking performance in the desired direction was similar for all the methods. Simulations showed that the application of implicit and second-order methods in the numerical integration may greatly improve the tracking performance of the closed-loop inverse kinematics algorithm.

#1525 Kalman filter based cooperative landmark localization in indoor environment for mobile robots

Gábor Péter (HU), Bálint Kiss (HU)

Cost-effective localization in indoor environments is a critical task in numerous applications of mobile robots. Sensors on board of individual robots may have low accuracy, but the fact that they share the same environment may be exploited to design a cooperative localization technique. Our approach assumes that the mobile robots can share the measurements of their on-board sensors with each other thanks to some communication scheme and to a database of such measurements. The presented method is based on the Bayes theorem. By fusing the measurements of multiple agents, a higher accuracy can be achieved than any of the separate units might be able to reach considering the landmark locations. Simulation results in a testbed motion scenario show the advantages of the method presented.

Junior Systems Science & Engineering (III)

October 12 (Wednesday), 11:00-12:30, InterContinental Budapest, Duna Salon IV
Session Chair: Bhowmik Biswajit

#2458 Electrodes Arrangement on Brain-Computer Interface for the ALS's Posture

Yuki Ijichi (JP), Hisaya Tanaka (JP)

A brain–computer interface (BCI) can operate a computer by analyzing electroencephalogram data. A BCI does not require body motion; therefore, the physically handicapped, such as those who suffer from amyotrophic lateral sclerosis (ALS), can also operate a computer. However, with ALS patients, attaching electrodes requires significant time and effort. In this study, we examine the number and arrangement of electrodes for a character input BCI in consideration of the limitations encountered with ALS patients. We found that the percentage of correct answers was greater with a smaller number of electrodes than the current number of electrodes. Moreover, we consider that the Cz and CP4 electrode positions are effective for P300 discrimination.

#2028 Invariance Principle for Transportation Network

Mohamad Sleiman (FR), Rachid Bouyekhf (FR), Abdellah El Moudni (FR)

Traffic signal control strategies concern generally two distinct objectives: the prevention or reduction of the congestion. Traffic congestion appears when the traffic demand exceeds the capacity of the network. In this case, some lanes of the network are saturated and consequently an overflow occurs in some intersections. In this paper, we show that congestion can be avoided by forcing the number of vehicles to not exceed the level corresponding to the optimal operational traffic of each lane. By using the concept of positive invariance and Linear Matrix Inequality (LMI), we derive a state feedback traffic light control laws that achieves our objective and at the same time respecting both the constraints of state and control variables. The results of the simulations indicate that our control strategy guarantees a high degree of control benefit.

#2410 One Poison is Antidote Against Another Poison

Biswajit Bhowmik (IN), Santosh Biswas (IN), Jatindra Kumar Deka (IN), Bhargab B. Bhattacharya (IN)

The presence of open-faults in NoC channels drastically drops packets while routing them causing severe degradation of network performance. Nevertheless, it can still be compensated by utilizing a fault-repairing scheme. This paper shows how the performance of a NoC architecture can be improved through self-repairing of open channels using short-defects. Simulation results reveal that the performance degrades to nearly 30% when the channels suffer from manufacturing open-faults, and to 10% when they are self-repaired with the help of co-existent short-defects. Thus, the overall performance can be improved beyond 65%.

Junior Human-Machine Systems (I)

October 12 (Wednesday), 14:00-15:30, InterContinental Budapest, Duna Salon IV
Session Chair: Varszegi Kristof

#1171 An Open Source Audio Effect Unit

Chung-Fan Yang (TW), Hao-Yi Chih (TW)

A development of an embedded acoustic effecter is proposed, together with the analysis on resource limitation and optimization possibility of an audio DSP system based on an underlying adopted microcontroller. The introduction of the microcontroller and its corresponding digital signal processing are sought to reduce cost and lower the barrier on developing the embedded DSP system. With the basic building blocks provided by open source communities, both hardware and software of the embedded DSP system have been constructed agilely with a promising level of customization. As a liberal prototype, the development would be beneficial to any kind of utilization in the open source communities.

#1227 Analysis Method for ERD in Mu-rhythm Detection in Motor Imagery Brain–Computer Interface

Shuhei Nagamori (JP), Hisaya Tanaka (JP)

Motor imagery brain–computer interfaces (MIBCI) use hand or foot MI to control computers. However, MIBCI control accuracy is low. Previously, we determined that using max power in the mu band method, i.e., the peak trace method (PTM), improves event-related desynchronization (ERD) detection accuracy. Control accuracy may be improved by improving ERD detection accuracy in an MIBCI. In this study, we compare the PTM to the band power method to determine the most effective method for ERD detection during MI tasks. Overall, experimental results indicate that we could not detect ERD more accurately using the PTM. However, the PTM may be effective depending on the mu rhythm occurrence pattern.

#1281 Interfacing with a speller using EOG glasses

Nathaniel Barbara (MT), Tracey Ann Camilleri (MT)

Bio-signal based human computer interface (HCI) systems are a good alternative to standard touch based interfaces, offering subjects with motor impairments an alternative means of communication. This work investigates the use of electrooculography (EOG) to interface with a speller application. The use of a wireless EOG glasses currently on the market, known as JINS MEME, comprising only three dry electrodes, is compared to the standard two-pair EOG electrode configuration using wet electrodes. A blink accuracy of 97.63% and a saccade accuracy of 73.38% was obtained using a novel thresholding algorithm on the EOG data collected through the MEME glasses and the results were shown to be comparable to those obtained using wet surface electrodes. A real-time menu driven keyboard is also proposed and tested using the different eye movement recording techniques. In this case an average writing speed of 7.11 letters per minute, with a classification accuracy of 90.59% was obtained using signals recorded from the MEME glasses, showing that this new technology offers an ergonomic system that can easily be used in eye-based assistive applications.

#1613 Comparison of Algorithms for Detecting Hand Movement from EEG signals

Kristóf Várszegi (HU)

In an ideal future limb function can be restored after suffering any kind of damage from an accident or a disease. The dream of fully functional prosthetic limbs depicts a great opportunity towards this vision. One of the main challenges is to create a control algorithm which processes physiological signals of the human body and moves the prosthetic limb according to the user's intentions. Brain-Computer Interfaces (BCIs) are popular subjects of research worldwide in the view of prosthesis control. Building mostly on EEG (electroencephalogram) signals, such systems must perform a challenging task – extracting control information from a signal with extremely low signal-to- noise ratio. Various digital signal processing and machine learning algorithms have been published in the past few years, but there is still no clear candidate for the title of the best one for e.g. detecting hand movement intention. In this paper various algorithms are compared on the example of detecting hand movement from EEG signals in real-time. The first goal of this paper is to present a couple of promising methods from other researchers in the past years, along with demonstrating the performance of other algorithms on a certain grasp-and-lift task. Another goal of the paper is to outline a future direction for the research of movement intent detection algorithms.

#1964 Evaluation of Driver Steering Performance with Haptic Guidance under Passive Fatigued Situation

Zheng Wang (JP), Rencheng Zheng (JP), Tsutomu Kaizuka (JP), Keisuke Shimono (JP), Kimihiko Nakano (JP)

Haptic steering technology has been developed to support drivers for more accurate and reliable vehicular control. This paper investigates the evaluation of steering performance when a haptic guidance steering system is implemented for passive fatigued drivers. The haptic system continuously produces torque on the steering wheel to inform drivers about the lateral lane deviations; consequently, drivers are aware of the active torque and then contribute to the steering task by interacting with the system. An experiment with 12 participants was conducted in a high-fidelity driving simulator. In a within- subject counterbalanced design, one session included implement of haptic system and the other excluded haptic system. A monotonous long-period driving course was designed to induce drivers' passive fatigue. Electromyography signals of the brachioradialis muscles were measured to examine grip strength of a driver holding a steering wheel. Results show that the risk of lane departure was significantly reduced when the haptic system was activated. In addition, grip strength of the drivers decreased when cooperating with the haptic system.

Junior Human-Machine Systems (II)

October 12 (Wednesday), 16:00-17:30, InterContinental Budapest, Duna Salon IV
Session Chair: Sato Ryuya

#2017 Gaze Pattern Analysis in Multi-Display Systems for Teleoperated Disaster Response Robots

Ryuya Sato (JP), Mitsuhiro Kamezaki (JP), Shigeki Sugano (JP), Hiroyasu Iwata (JP)

In unmanned construction, work efficiency is lower than that in manned construction due to lack of visual information. Thus, we previously developed an autonomous camera control system to provide various visual information suited to work states through multiple displays. However, that system increased the cognitive load on operators, and required them to have much experience to choose appropriate views for various situations. Next, we should investigate the degree of effectiveness for each view in a certain state. Thus, in this study, we analyzed gaze patterns to clarify which are the displays that operators often watch in work states, i.e., moving, grasping, transport, and releasing. We then derived which gaze patterns have higher work performance, including time efficiency and safeness. We clustered gaze patterns using Ward's method, which is a criterion applied in hierarchical clustering. To evaluate the objective of this study, we conducted experiments involving debris transport tasks, using a virtual reality simulator. The results indicated that gaze patterns differed in operators and we found that better time efficiency related to specific gaze patterns for each work state.

#2155 Optimal Feedback Control Framework Suggests that Changes in The Preferred Direction During BMI Experiments may Occur Even with no Adaptation

Miri Benyamini (IL), Miriam Zacksenhouse (IL)

Brain Machine Interfaces (BMIs) rely on the correlation between neural activity and movement kinematics. However, many characteristics of the neural activity change after switching from pole control to brain control. Of particular interest are changes in the preferred direction (PD), and whether they reflect adaptation to the BMI filter. Here we investigate changes in the PD of simulated neurons that encode signals that are relevant for state estimation and control with the framework of optimal feedback control (OFC). Simulated BMI experiments based on the OFC framework demonstrate that changes in the PD may occur even with no adaptation. Further theoretical and simulations indicate the conditions under which there is no change in the PD upon switching to brain control. . Insights gained from this research can be used to improve the design of BMI filter – not only to minimize reconstruction error during pole control, but also to endow the neurons with desired PDs in brain control.

#2275 A Smart HMI for Assisting with Drive Safety Using Emotion Prediction Based on EEG Data

Gokul Sidarth Thirunavukkarasu (AU), Mohajer Navid (AU), Hamid Abdi (AU)

This paper provides an overview on the past pieces of literature on emotion prediction systems and the different machine learning algorithms used to classify emotions. We propose a system which incorporates the emotion prediction system with a custom Smart Human Machine Interface (SHMI) for vehicle drivers to improve drive safety. This is achieved based on EEG signals and basic vehicle information's obtained from an OBD (On-Board Diagnostics) data. EEG signals are classified into four emotional states: happy, sad, relaxed and angry. In this paper, we present an initial development of the Smart Human Machine Interface (SHMI) for emotion detection for vehicle applications. To evaluate the classification of the EEG signals we use Russell's circumflex model, Higuchi Fractal Dimension (HFD), PSD (Power Spectral Density) for feature extraction and Support Vector Machines (SVM) for classification.

#2428 Recognition of Infant's Emotions and Needs from Speech Signals

Xuan Zhou (CN), Jian Wang (CN), Hongzhi Hu (CN), Weihui Dai (CN), Lina Wei (CN), Huajuan Mao (CN)

Speech is not only a way for infants under one year of age to communicate with the outside world, but also the important information source to reflect their emotions and needs, as well as health status and mental level. In order to explore the intelligent machine technology for understanding infant's emotions and needs from speech signals, and therefore help parents in child rearing, this paper studied the signal processing and feature extraction of the above speeches. It seems that a high accuracy and reliable result couldn't be reached from the infant's speech signals only in dealing with multi kinds of emotions and needs. So an effective recognition approach considering the combined features of acoustic characteristics and rearing behaviors was proposed based on the self-adapting algorithm. Experiment results showed that most common emotions and needs of infants, such as happy, hungry, and sleepy states which reflect their typically physiological and psychological status in daily life, can be recognized correctly at a relatively high accuracy.

Junior Social Event

Junior Post Conference Tour

Post conference Budapest Tour for the first 150 Junior applicants (guided tour by professional youths to meet Budapest as the City of Young Generation).

Applications should be sent to Gábor Szögi, SMC Junior 2016 Technical Program Committee Co-Chair (szogi.gabor@hok.uni-obuda.hu). Please use "SMC Junior 2016 Post Conference Tour" as subject. In addition, you have the possibility to register at the Post Conference Tour registration point at InterContinental Budapest.

Exhibitors

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Details about the Hastlayer project: https://hastlayer.com.

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SMC 2017 Call for Papers

2017 IEEE International Conference on Systems, Man, and Cybernetics, October 5–8, 2017, Banff Center, Banff, Canada

http://www.smc2017.org

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Haohong Wang, TCL America
Tiago Falk, INRS Montreal
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Pradeep Atrey, Univ. of Albany
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Peter Liu, Carleton Univ.

SMC Junior Chairs
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Housam Babiker, Univ. of Alberta

The 2017 IEEE International Conference on Systems, Man, and Cybernetics (SMC 2017) will be held in Banff Centre one of the most modern conference facility in North America, with majestic mountain view. SMC 2017 is the flagship conference of the IEEE Systems, Man, and Cybernetics Society. It provides an international forum for researchers and practitioners to report most recent innovations and developments, summarize state-of-the-art, and exchange ideas and advances in all aspects of systems science and engineering, human machine systems, and cybernetics. Advances in these fields have increasing importance in the creation of intelligent environments involving technologies interacting with humans to provide an enriching experience and thereby improve quality of life.

Papers related to the conference theme are solicited, including theories, methodologies, and emerging applications. Contributions to theory and practice, including but not limited to the following technical areas, are invited:

Systems Science & Engineering
Communications
Conflict Resolution
Consumer/Industrial Applications
Control of Uncertain Systems
Cooperative Systems and Control
Decision Support Systems
Discrete Event Systems
Distributed Intelligent Systems
Enterprise Information Systems
Fault Monitoring and Diagnosis
Intelligent Power Grid
Smart Metering
Infrastructure Systems & Services
Homeland Security
Intelligent Green Production
Intelligent Transportation Systems
Large-Scale System of Systems
Manufacturing Systems/Automation
Mechatronics
Micro and/or Nano Systems
Quality/Reliability Engineering
Robotic Systems
Service Systems & Organizations
Smart Sensor Networks
System Modeling and Control
Technology Assessment

Human-Machine Systems
Assistive Technology
Augmented Cognition
Brain-based Information Communications
Design Methods
Entertainment Engineering
Human-Computer Interaction
Human Factors
Human Performance Modeling
Human-Machine Cooperation & Systems
Human-Machine Interface Web Intelligence Interaction
Information Visualization
Information Systems for Design/Marketing
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Interactive and Digital Media
Interactive Design Science & Engineering
Kansei (sense/emotion) Engineering
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Agent-Based Modeling
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Biometric Systems and Bioinformatics
Computational Intelligence
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Cybernetics for Informatics
Evolutionary Computation
Expert and Knowledge-Based Systems
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Heuristic Algorithms
Hybrid Models of NN, Fuzzy Systems and Evolutionary Computing
Image Processing/Pattern Recognition
Fuzzy Systems and their applications
Intelligent Internet Systems
Knowledge Acquisition in Intelligent
Machine Learning
Machine Vision
Media Computing
Medical Informatics
Neural Networks and their Applications
Optimization
Self-Organization
Swarm Intelligence

Important Dates

February 15, 2017	Deadline for submission of proposals for Special Sessions
March 15, 2017	Acceptance/rejection notification of proposals for Special Sessions
April 7, 2017	Deadline for submission of contributions for Regular and Special Sessions
April 15, 2017	Deadline for submission of proposals for Tutorials and Workshop Sessions
May 25, 2017	Acceptance notification for Tutorials and Workshop Sessions
May 25, 2017	Acceptance notification for Regular and Special Session papers
May 30, 2017	Submission deadline for Late Breaking and Industrial papers
June 30, 2017	Acceptance notification for Late Breaking and Industrial papers
July 9, 2017	Final camera-ready papers due for Regular, Special Sessions, Short Paper Sessions, and Demo Paper Sessions
August 5, 2017	Deadline for early registration
October 5-8, 2017	Conference dates

Call for Regular Session Papers
Prospective authors are invited to submit full-length papers electronically through the conference website. Papers should be concise but contain sufficient details and references to allow critical review.

Call for Special Sessions
Special Sessions provide a focused discussion of new or innovative topics. Special Session organizers should collect at least five papers, download the special session proposal template from the SMC 2017 website, and submit the completed proposal to the Special Sessions Chairs.

Call for Short Paper Sessions and Demo Paper Sessions
These categories of contributions are intended to promote applied research and applications, including work in progress, and facilitate increased collaboration between industrial and academic members of the SMC community.

Note: Accepted papers that are not PHYSICALLY presented at SMC 2017 will be excluded from the IEEE Xplore.

SMC 2016 Budapest

http://smc2016.org/

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