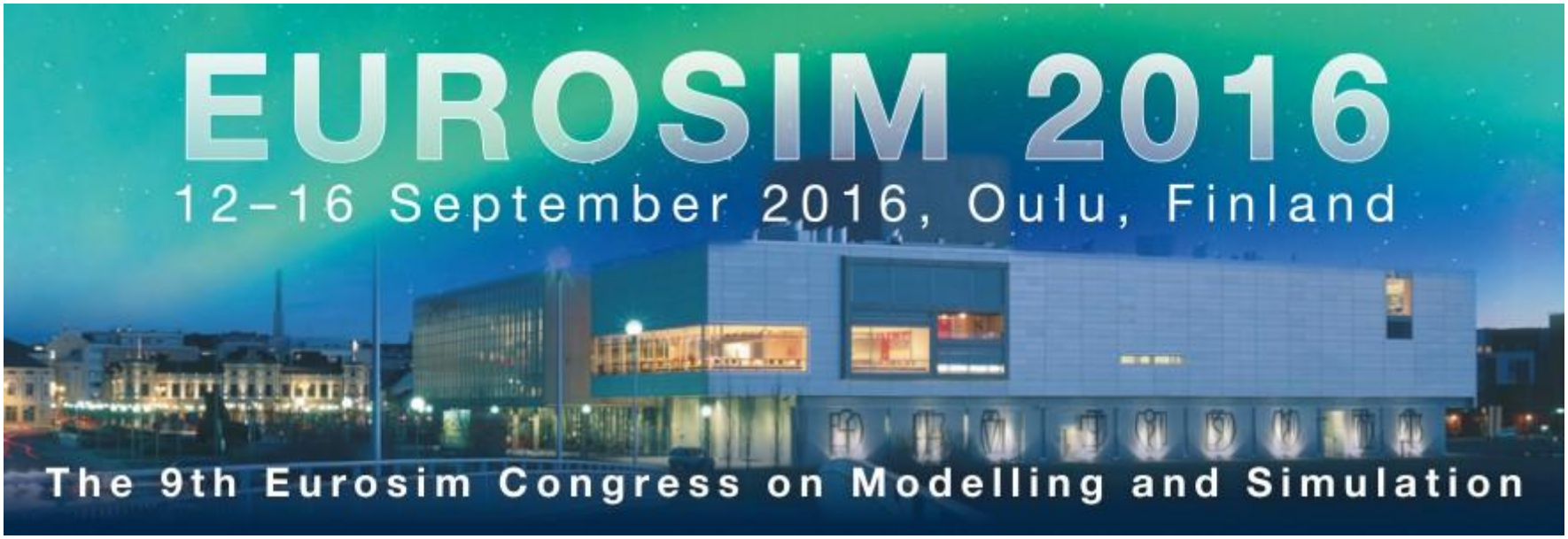

Conference Program and Abstracts of Scheduled papers

Federation of European Simulation Societies

Denmark Finland Norway Sweden Iceland

SIMS - Scandinavian Simulation Society

IFAC INTERNATIONAL FEDERATION OF AUTOMATIC CONTROL

IEEE Finland

IEEE

UNIVERSITY OF OULU

Suomen Automaatioseura ry
Finnish Society of Automation

IEEE computer society

WELCOME ADDRESS

We are delighted to welcome our colleagues from Europe and the rest of the world to this 9th EUROSIM Congress on Modelling and Simulation, held at the University of Oulu, Oulu, Finland, 12-16 September 2016. The 57th International Conference of Scandinavian Simulation Society, SIMS 2016, is embedded within the EUROSIM 2016 Congress. The program committee has organized an exciting and balanced program comprising presentations from distinguished experts in the field, and important and wide-ranging contributions on state-of-the-art research that provide new insights into the latest innovations in the field of modelling and simulation.

EUROSIM 2016 is organized by Scandinavian simulation society (SIMS), Finnish Society of Automation (FSA), Finnish Simulation Forum (FinSim), University of Oulu and Finnish Automation Support Ltd. and is technically co-sponsored by IEEE Finland Section, IEEE Computer Society, The International Federation of Automatic Control Technical Committees on TC 3.2, TC 6.1, TC 6.2, TC 6.3 and TC 6.4, and University of Oulu. EUROSIM 2016 proved to be very popular and received submissions with authors from more than 40 countries. The conference program committee had a very challenging task of choosing high quality submissions. Each paper was peer reviewed by several independent referees of the program committee and, based on the recommendation of the reviewers, 184 papers were finally accepted for publication. The papers offer stimulating insights into emerging modelling and simulation techniques and their applications in a wide variety of fields within science, technology, business, management and industry. Contributions are structured by

- Application domains, including Bio- and ecological systems, Building and construction, Economic and social systems, Energy, Industrial processes, Security and military, Transportation and vehicle systems, Water and wastewater, Weather and climate;
- Functionalities, including Control and optimization, Communication and security, Education and training, e-Learning, Fault detection & fault tolerant systems, Human-Machine interaction, Mechatronics and robotics, Planning and scheduling, Sensing, Virtual reality and visualization;
- Methodologies, including Computational intelligence, Conceptual modelling, Complex systems, Data analysis, Discrete event simulation, Distributed parameter systems, Parallel and distributed interactive systems, Simulation tools and platforms.
- Minisymposia integrate these areas in Control education, Wastewater, Applied energy, Solar thermal power plants, Complex dynamic systems, Chemical processes, Big data analysis and soft computing, Innovative technology and Cooperative automation.

We would like to express our sincere thanks to the plenary speakers, authors, session chairs, members of the program committee and additional reviewers who made this conference such an outstanding success. Finally, we hope that you will find the conference to be a valuable resource in your professional, research, and educational activities whether you are a student, academic, researcher, or a practicing professional. Enjoy!

EUROSIM2016 Conference Committee

EUROSIM2016

9th EUROSIM Congress on Modelling and Simulation

12 – 16 September 2016, Oulu, Finland

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The EUROSIM 2016 Congress

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Congress Participants should wear their Name Badges, during all congress functions at the venue as well as to any social venue, to gain access to the Sessions and Events.

Program at a Glance

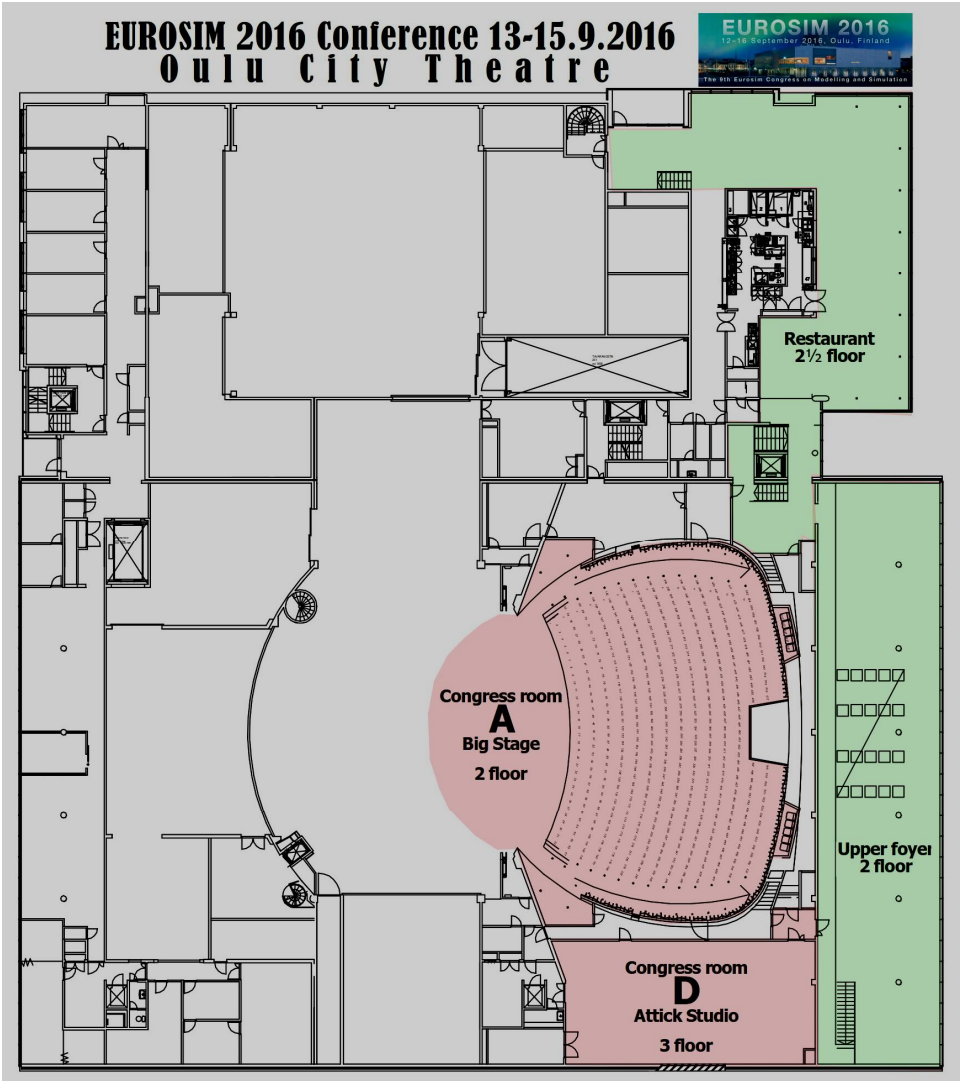
Session Code: **Wed.PM1.A** means Wednesday afternoon first session in room A. Other Time periods: AM1, AM2, PM1, PM2, PM3			**Paper Code (PC)**: e.g. **S08.2** see following pages for a full list: Track letter/number: **S08** and paper number within track e.g. **2**, **S08.2** **+ Sequence separator between papers in same track: S08.2+3+4+10+11+12**		
9 - 9.30	Day-1: Tuesday 13 September 2016, Opening Session (Keynote Speaker-1 & 2 + 64 papers)				
9.30 -10.15	Tue.AM1.A, Plenary, Keynote-1: Prof. Rebei Bel Fdhila,				
10.15 -10.45	Coffee				
10.45 -12.45 6 papers	Tue.AM2.A: S08.2+1+4+10+11+12	Tue.AM2.B: M10.3+4+5+6+15+17	Tue.AM2.C: M01.6, F09.2+3, M11.3, M10.7, F09.1	Tue.AM2.D, M07.1+2+3+4+5, M10.1	Tue.AM2.E 11.05 - 12.45, 5 papers S04.1+2+3+8+4
12.45 -13.45	Lunch				
13.45 -14.30	Tue.Pm1.A, Plenary, Keynote-2: Assistant Professor Vito Logar				
14.35 -15.35 3 papers	Tue.PM2.A: Panel, M&S in Clean Tech	Tue.PM2.B: S08.5+7+9	Tue.PM2.C: M11.4+2, F09.4	Tue.PM2.D: M10.2+11	Tue.PM2.E: S09.2+1+3
15.30 -16.00	Coffee				
16.00 - 17.40 5 papers	Tue.PM3.A: S05.4+6+1+2+3	Tue.PM3.B: S08.3+6+8, A01.7, M01.10	Tue.PM3.C: M03.1+2+3+4+5	Tue.PM3.D: S10.1, F04.1+2, M05.1, A08.4	Tue.PM3.E: S07.1+2+3+4+5
	Day-2: Wednesday 14 September 2016 (Keynote Speaker-3 & 4 + 66 papers)				
9 - 10	Wed.AM1.A: Plenary, Keynote-3: Dr Galia Weidl				
10 - 10.30	Coffee				
10.30 - 12.30 6 papers	Wed.AM2.A: A08.7+13+8+9+11+1	Wed.AM2.B: S03.1+3, A09.1+2, A01.1, S03.2	Wed.AM2.C: S06.1+2+3+4+5+7	Wed.AM2.D: A05.10, A02.1+2+3, A05.9+12	Wed.AM2.E: A06.1+4+7+5+3+9
12.30 - 1330	Lunch				
13.30 - 14.15	Wed.PM1.A: Plenary. Keynote-4: Adjunct Professor Harri Kokkola				
14.20 - 15.20 3 papers	Wed.PM2.A: Panel, Future Energy Systems	Wed.PM2.B->G, Poster Session: A08.2+3	Wed.PM2.C: S06.6+8	Wed.PM2.D: A11.3+4	Wed.PM2.E: A07.1, A11.2+1
15.20 - 15.50	Coffee				
15.50 - 17.50 6 papers	Wed.PM3.A: A05.1+11+2+3+7+5	Wed.PM3.B: A08.5+6+10+12, F01.2+1	Wed.PM3.C: M01.12+5+11, M04.1+2	Wed.PM3.D: M01.2+3+7, F01.3, M06.4	Wed.PM3.E: M10.8+14+13, M11.5, M09.1
	Day-3: Thursday 15 September 2016 (Keynote Speaker-5 & 6 + 51 papers)				
9 - 9.45	Thu.AM1.A: Plenary, Keynote-5: Director Roy Calder				
9.45 - 10.15	Coffee				
10.15 - 12.15 6 papers	Thu.AM2.A: S04.6+7+9+5+10	Thu.AM2.B: A06.8, M01.1, M10.18, A06.6, F01.4, A06.2	Thu.AM2.C: M06.1+2+3+5, S05.5	Thu.AM2.D: S01.1+2, F03.1+2+3+4	Thu.AM2.E: A04.1, F02.3+4+2+1
12.15 - 13.15	Lunch				
13.15 - 14.00	Thu.PM1.A: Plenary, Keynote-6: Dr Alexey Popov				
14.05 - 15.05 3 papers	Thu.PM2.A: Panel, IS & IoT in Future Automation	Thu.PM2.B: M10.9+12+10	Thu.PM2.C: F08.2+1,	Thu.PM2.D: M01.4+8+9	Thu.PM2.E: A01.2+3+6
15.10 - 16.10 3 papers	Thu.PM3.A: F10.1+2	Thu.PM3.B: M10.16+19, M11.1	Thu.PM3.C: A05.6+4+8	Thu.PM3.D: F06.1+2, F05.1	Thu.PM3.E: A01.4+5
16.15 – 16.45	Close of Conference, Information about next congress, Eurosim 2019, Photo Opportunity and Coffee				

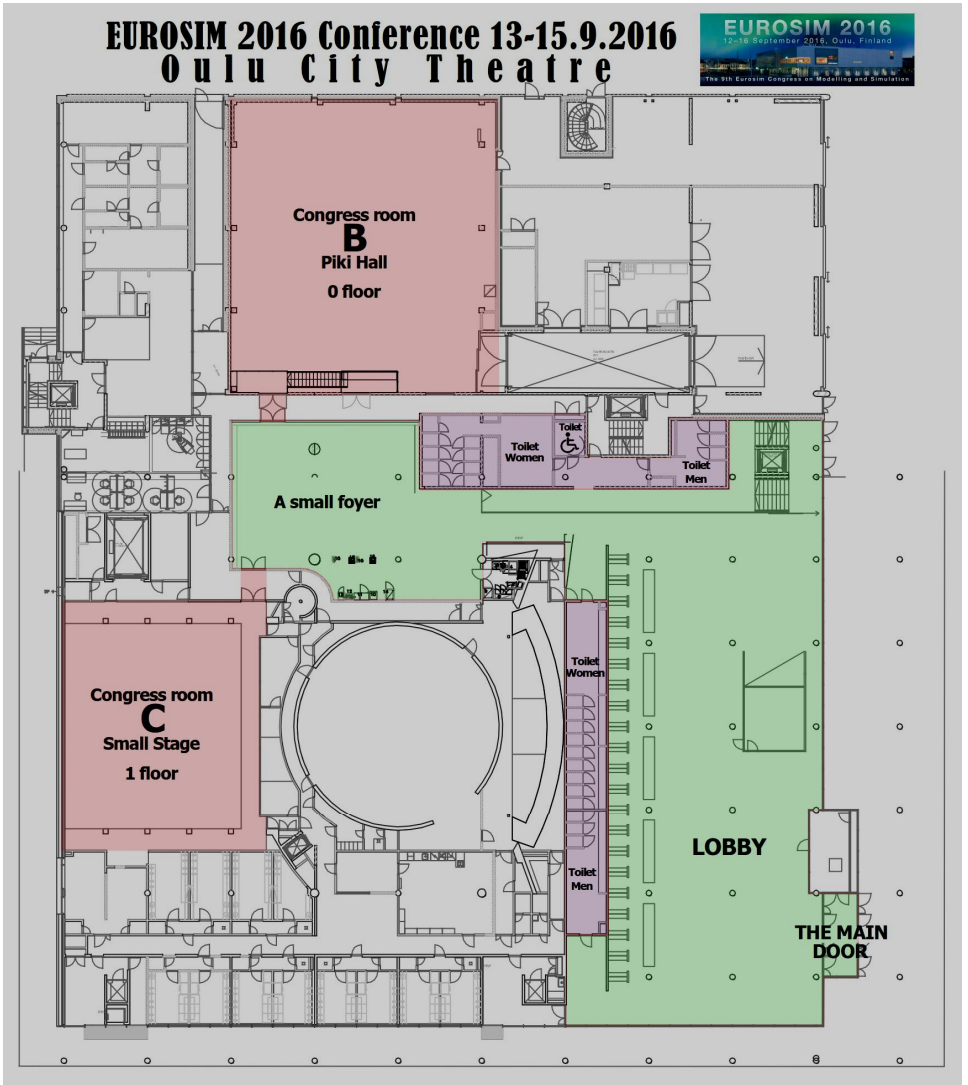
EUROSIM2016, SESSION CHAIRS & CO-CHAIRS

1	Tue.AM1.A	Erik Dahlquist (Mälardalen University, Sweden). Nora Cecilie Ivarsdatter Furuvik (University College of Southeast Norway, Norway)
2	Tue.AM2.A	Yukinori Suzuki (Muroran Institute of Technology, Japan). Kai Zenger(Aalto University, Finland)
3	Tue.AM2.B	Michal Gerza (Tomas Bata University in Zlin, Czech Republic). Christian Scheifele (University of Stuttgart, Germany)
4	Tue.AM2.C	Artis Teilans (Rezekne Academy of Technologies, Latvia). Naoki Sunaguchi (Yamagata University, Japan)
5	Tue.AM2.D	Bernt Lie (University College of Southeast Norway, Norway). Edna Da Silva (Mälardalen University, Sweden)
6	Tue.AM2.E	Konstantinos Kyprianidis (Mälardalen University, Sweden). Britt M.E. Moldestad (University College of Southeast Norway, Norway)
7	Tue.PM1.A	Felix Breitenecker (Vienna University of Technology, Austria). Aarne Pohjonen (University of Oulu, Finland).
8	Tue.PM2.A	Bernt Lie (University College of Southeast Norway, Norway). Jesus Zambrano (Mälardalen University, Sweden)
9	Tue.PM2.B	Yukinori Suzuki (Muroran Institute of Technology, Japan). Kai Zenger (Aalto University, Finland)
10	Tue.PM2.C	Artis Teilans (Rezekne Academy of Technologies, Latvia). Waldemar Leite Filho (DCTA-IAE, Brazil)
1	Tue.PM2.D	Edna Da Silva (Mälardalen University, Sweden). Britt M.E. Moldestad (University College of Southeast Norway, Norway).
2	Tue.PM2.E	Agostino G Bruzzone (University of Genoa, Italy). Eric Halbach (Aalto University, Finland)
3	Tue.PM3.A	Luis J. Yebra (CIEMAT-Plataforma Solar de Almería, Spain). Esko K. Juuso (University of Oulu, Finland)
4	Tue.PM3.B	Yukinori Suzuki (Muroran Institute of Technology, Japan). Kai Zenger (Aalto University, Finland)
5	Tue.PM3.C	Rebei Bel Fdhila (ABB Corporate Research, Sweden). Andreas Koerner (Vienna University of Technology, Austria)
6	Tue.PM3.D	Michal Gerza (Tomas Bata University in Zlin, Czech Republic). Antti Koistinen (University of Oulu, Finland)
7	Tue.PM3.E	Britt M.E. Moldestad (University College of Southeast Norway, Norway). Teemu Sihvonen (VTT Technical Research Centre of Finland Ltd., Finland)
8	Wed.AM1.A	Lars Eriksson Linköping University, Sweden). Antonio Vitale (Italian Aerospace Research Centre, Italy)
9	Wed.AM2.A	Lars Eriksson (Linköping University, Sweden). Miguel Mujica Mota (Amsterdam University of Applied Sciences, The Netherlands)
20	Wed.AM2.B	Jesus Zambrano (Mälardalens Högskola, Sweden). Mika Liukkonen (University of Eastern Finland, Finland).
1	Wed.AM2.C	Yuri Senichenkov (State Saint Petersburg Polythecnic University, Russia). Lev Utkin (Peter the Great Saint-Petersburg Polytechnic University, Russia)
2	Wed.AM2.D	Konstantinos Kyprianidis (Mälardalen University, Sweden). Petri Hietaharju (University of Oulu, Finland).
3	Wed.AM2.E	Gasper Music (University of Ljubljana, Slovenia). Juhani Heilala (VTT Technical Research Centre of Finland Ltd, Finland).
4	Wed.PM1.A	Bernt Lie (University College of Southeast Norway, Norway). Markku Ohenoja (University of Oulu, Finland)
5	Wed.PM2.A	Erik Dahlquist (Mälardalen University, Sweden). Cristian Nichita (University of Le Havre, France)
6	Wed.PM2.B>G **Poster Session**	
7	Wed.PM2.C	Yuri Senichenkov (State Saint Petersburg Polythecnic University, Russia). Anton Novikov (Siberian Federal University, Russia).
8	Wed.PM2.D	Felix Breitenecker (Vienna University of Technology, Austria). Niki Popper (dwh Simulation Services, Austria)
9	Wed.PM2.E	Bernt M. Åkesson (Finnish Defence Research Agency, Finland). Marcel Müller (University of Applied Sciences Würzburg-Schweinfurt, Germany)
30	Wed.PM3.A	Britt M.E. Moldestad (University College of Southeast Norway, Norway). Juha Kuronen (Fortum Oyj, Finland).

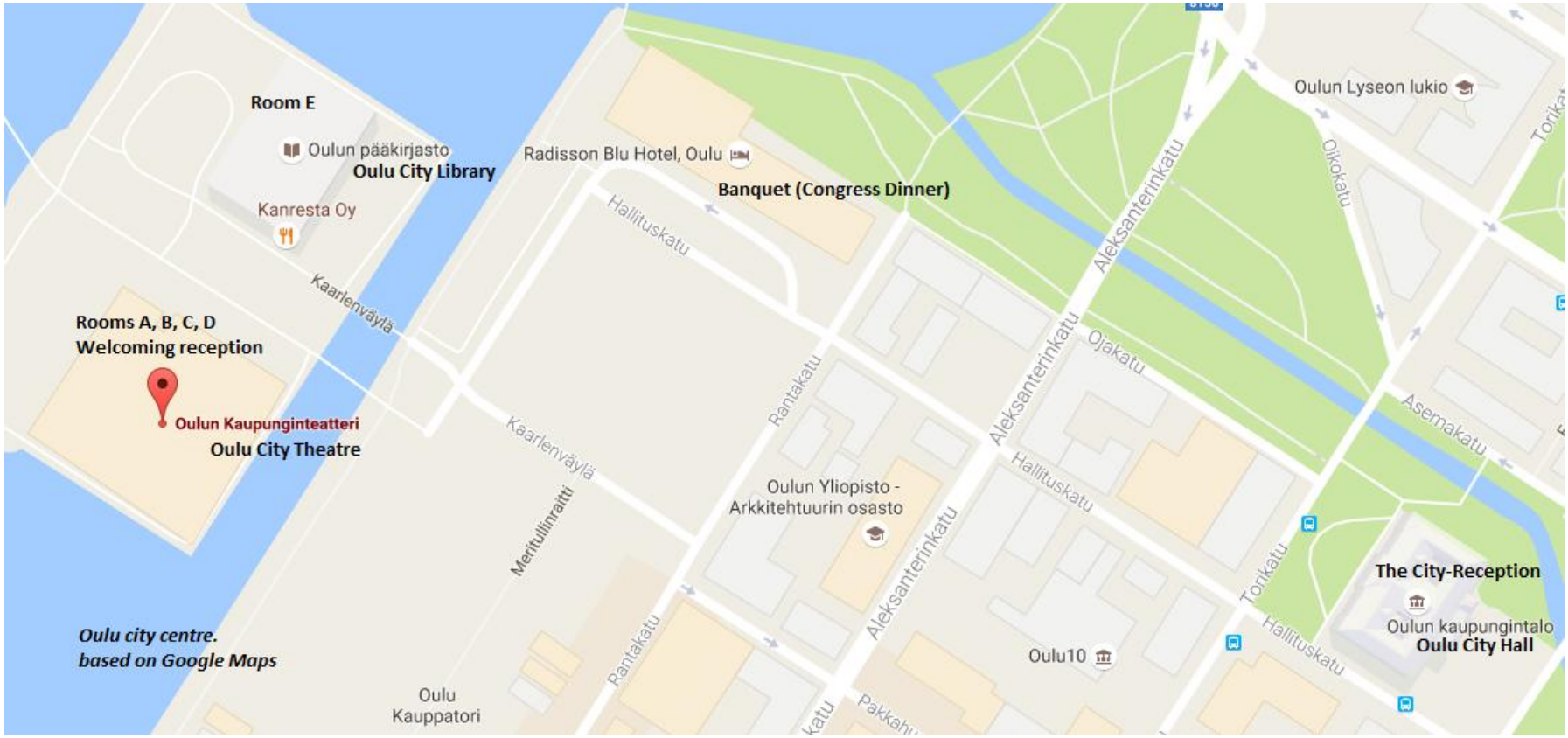
31	Wed.PM3.B	Lars Eriksson (Linköping University, Sweden). Mika Pylvänäinen (University of Oulu, Finland)
2	Wed.PM3.C	Siu Kang (Yamagata University, Japan), Karim Benyamna (ITMO University. Russia)
3	Wed.PM3.D	Michal Pluhacek (Tomas Bata University in Zlin, Czech Republic). Riku-Pekka Nikula (University of Oulu, Finland)
4	Wed.PM3.E	Bernt Lie (University College of Southeast Norway, Norway) Daniel Rippel (BIBA - Bremer Institut für Produktion und Logistik GmbH at the University of Bremen, Germany)
5	Thu.AM1.A	Kauko Leiviskä (University of Oulu, Finland). Tomas Björkqvist (Tampere University of Technology, Finland)
6	Thu.AM2.A	Erik Dahlquist (Mälardalen University, Sweden). Tomi Thomasson (VTT Technical Research Centre of Finland Ltd., Finland)
7	Thu.AM2.B	Vito Logar (University of Ljubljana, Slovenia). Pekka Siirtola (University of Oulu, Finland)
8	Thu.AM2.C	Emilio Jiménez Macías (University of La Rioja, Spain). Mikko Harju (Nokia, Finland)
9	Thu.AM2.D	Kai Zenger (Aalto University, Finland). Tiina Komulainen (Oslo and Akershus University College of Applied Sciences, Norway)
40	Thu.AM2.E	Alessandro Vizzarri (University of Rome Tor Vergata, Italy). Yoji Morita (Kyotogakuen University, Japan).
1	Thu.PM1.A	Emilio Jiménez Macías (University of La Rioja, Spain). Antti Koistinen (University of Oulu, Finland)
2	Thu.PM2.A	Esko K. Juuso (University of Oulu, Finland). Lars Eriksson (Linköping University, Sweden)
3	Thu.PM2.B	Niklas Paganus (Fortum Power and Heat Ltd., Finland). Adrian Pop (Linköping University, Sweden)
4	Thu.PM2.C	Andreas Koerner (Vienna University of Technology, Austria). Juliana Sagawa (Federal University of São Carlos, Brazil)
5	Thu.PM2.D	Leon Bobrowski (Bialystok University of Technology, Bialystok, Poland). Niki Popper (dwh Simulation Services, Austria)
6	Thu.PM2.E	Gorazd Karer (Faculty of Electrical Engineering, University of Ljubljana, Slovenia). Sabri Pllana (Linnaeus University, Sweden)
7	Thu.PM3.A	Juhani Heilala (VTT Technical Research Centre of Finland Ltd, Finland). Tiina Komulainen (Oslo and Akershus University College of Applied Sciences, Norway)
8	Thu.PM3.B	Niklas Paganus (Fortum Power and Heat Ltd., Finland). Adrian Pop Linköping University, Sweden)
9	Thu.PM3.C	Robert Lis (Wroclaw University of Science and Technology, Poland). Glaucio L. Ramos (Federal University of São João Del-Rei, Brazil)
50	Thu.PM3.D	Hiroyuki Kano (Tokyo Denki University, Japan). Mika Pylvänäinen (University of Oulu, Finland)
51	Thu.PM3.E	Sabri Pllana (Linnaeus University, Sweden). Ari Jääskeläinen (Savonia University of Applied Sciences, Finland)

EUROSIM2016, ROOM LOCATIONS, A, B, C, D





EUROSIM2016, LOCATIONS OF ROOMS A, B, C, D, E, BANQUET AND CITY-RECEPTION



Oulu City Theatre

Congress room A: Big Stage

Congress room B: Piki Hall

Congress room C: Small Stage

Congress room D: Attic Studio

Meeting room F: Cabinet

Oulu City Library

Congress room E: Pakkala Hall

Social Programme

Welcome Reception

Monday, September 12, 19:00 - 21:00, Oulu City Theatre, Upper foyer

Oulu City Reception

Tuesday, September 13, 19:00 – 20:30, Oulu City Hall

Congress Banquet Dinner

Wednesday, September 14, 19:30 - , Hotel Radisson Blue Oulu

Papers per Track

Seq	#	00.O Keynotes	First author	Presenters: names
1	1570279768	*Modelling and Simulation of the Electric Arc Furnace Processes*	Vito Logar	Logar
2	1570285113	*Situation Awareness and Early Recognition of Traffic Maneuvers*	Galia Weidl	Weidl
		Track A01. Bio-/Ecological Systems: Agriculture, Bioinformatics/Bioengineering, Biological/Medical Systems.		
1	1570262518	*Monitoring Suspended Solids and Total Phosphorus in Finnish Rivers*	Mauno Ronkko	Ohenoja
2	1570274049	*Artificial Neural Networks Application in Intraocular Lens Power Calculation*	Martin Sramka	Vlachynska
3	1570283258	*Tuning of Physiological Controller Motifs*	Tormod Drengstig	Tveit
4	1570283908	*How Does Modern Process Automation Understand the Principles of Microbiology and Nature*	Ari Jaaskelainen	Jaaskelainen
5	1570284274	*The Internet of Things for Aging and Independent Living: A Modeling and Simulation Study*	David Perez	Pllana
6	1570284355	*Modelling of Target-Controlled Infusion of Propofol for Depth-of-Anaesthesia Simulation in Matlab-Simulink*	Gorazd Karer	Karer
7	1570297644	*Development of a Genetic Algorithms Optimization Algorithm for a Nutritional Guidance Application*	Petri Heinonen	Heinonen
		Track A02. Building/Construction: Automation, Engineering, Built Environment, Energy/Health		
1	1570281362	*Modular Model Predictive Control Concept for Building Energy Supply Systems: Simulation Results for a Large Office Building*	Barbara Mayer	Mayer
2	1570284077	*Study of Different Climate and Boundary Conditions on Hygro-Thermal Properties of Timber-Framed Envelope*	Filip Fedorik	Fedorik
3	1570288007	*Evaluation of Structural Costs in Building. Simulation of the Impact of the Height and Column Arrangement*	Javier Ferreiro-Cabello	Jiménez-Macías
		Track A04. Economic and Social Systems: Computational Finance/Economics. Control Education.		
1	1570283499	*Efficiency of QEs in USA Through Estimation of Precautionary Money Demand*	Yoji Morita	Morita
		Track A05. Energy Systems: Electricity/Heat/Gas Networks, Geothermal, Hydropower, Plants, Smart Grids for Heat/Electricity, Solar, Wind		
1	1570271609	*Riser of Dual Fluidized Bed Gasification Reactor: Investigation of Combustion Reactions*	Rajan Thapa	Thapa
2	1570272895	*Model Predictive Control for Field Excitation of Synchronous Generators*	Thomas Oyvang	Oyvang
3	1570279617	*Modelling and Dynamic Simulation of Cyclically Operated Pulverized Coal-Fired Power Plant*	Juha Kuronen	Kuronen
4	1570283826	*Hardware-in-the-Loop Emulation of Three-Phase Grid Impedance for Characterizing Impedance-Based Instability*	Tuomas Messo	Reinikka
5	1570283864	*Parametric CFD Analysis to Study the Influence of Fin Geometry on the Performance of a Fin and Tube Heat Exchanger*	Shobhana Singh	Singh
6	1570283910	*Voltage Stability Assessment of the Polish Power Transmission System*	Robert Lis	Lis
7	1570283993	*Agglomeration Detection in Circulating Fluidized Bed Boilers Using Refuse Derived Fuels*	Nathan Zimmerman	Zimmerman

8	1570284086	*dSPACE Implementation for Real-Time Stability Analysis of Three-Phase Grid-Connected Systems Applying MLBS Injection*	Tomi Roinila	Luhtala
9	1570284177	*Semi Discrete Scheme for the Solution of Flow in River Tinnelva*	Susantha Dissanayake	Lie
10	1570284190	*Peak Load Cutting in District Heating Network*	Petri Hietaharju	Hietaharju
11	1570284279	*Screening of Kinetic Rate Equations for Gasification Simulation Models*	Kjell-Arne Solli	Solli
12	1570286533	*Preprocessing Methods for Load Profile Clustering*	Anna Frost	Frost
		Track A06. Industrial Processes: Chemical, Forest, Manufacturing, Metal, Mining/Mineral Processing, Pharmaceutical Industry		
1	1570274006	*Simulation of Glycol Processes for CO2 Dehydration*	Lars Øi	Øi
2	1570279599	*Mixing and Segregation of Two Particulate Solids in the Transverse Plane of a Rotary Kiln*	Sumudu Karunarathne	Karunarathne
3	1570281898	*Interactive Visual Analytics of Production Data - Predictive Manufacturing*	Juhani Heilala	Heilala
4	1570283821	*Cost Optimization of Absorption Capture Process*	Lars Øi	Øi
5	1570284096	*Fuzzy Modelling of Air Preparation Stage in an Industrial Exhaust Air Treatment Process*	Ales Sink	Music
6	1570284188	*From Iterative Balance Models to Directly Calculating Explicit Models for Real-time Process Optimization and Scheduling*	Tomas Bjorkqvist	Bjorkqvist
7	1570284248	*Principal Component Analysis Applied to CO2 Absorption by Propylene Oxide and Amines*	Wathsala Jinadasa	Jinadasa
8	1570284345	*Modeling and Portfolio Optimization of Stochastic Discrete-Event System Through Markovian Approximation: An Open-Pit Mine Study*	Roberto Ribeiro	Ribeiro
9	1570286091	*Concept for Mathematical Models for Subprocesses in the Manufacture of Particleboards*	Carina Poll	Poll
		Track A07. Security and Military		
1	1570283040	*Simulating the Effect of a Class of Sensor Fuzed Munitions for Artillery on a Multiple Target Element System*	Henri Kumpulainen	Akesson
		Track A08. Transportation/Vehicle Systems, Aerospace/Automotive Applications, Autonomous Systems/Vehicles, Harbour/Shipping/Marine, Logistics, Vehicle Systems		
1	1570260175	*Simulation Environment for Development of Unmanned Helicopter Automatic Take-off and Landing on Ship Deck*	Antonio Vitale	Vitale
2	1570267408	*Actuator Fault Tolerant Control for a Rotary Wing Aircraft* Poster Paper	Emre Kiyak	Kiyak
3	1570267645	*Fault Tolerant Control for a Rotary Wing Aircraft* Poster Paper	Gulay Unal	Unal
4	1570268780	*Formal Verification of Multifunction Vehicle Bus*	Lianyi Zhang	Zhang; Li
5	1570272956	*A Model of a Marine Two-Stroke Diesel Engine with EGR for Low Load Simulation*	Xavier Llamas	Llamas
6	1570273062	*Safe Active Learning of a High Pressure Fuel Supply System*	Mark Schillinger	Schillinger
7	1570274400	*MAKE SPACE!: Simulating the A380 Operations in Mexico City Airport*	Miguel Mujica Mota	Mujica Mota
8	1570275878	*A Causal Model for Air Traffic Analysis Considering Induced Collision Scenarios*	Marko Radanovic	Radanovic

9	1570283259	*Multi-Sourcing and Quantity Allocation Under Transportation Policies*	Aicha Aguezzoul	
10	1570283628	*Simulation Model of a Piston Type Hydro-Pneumatic Accumulator*	Juho Alatalo	Pylvänäinen
11	1570284156	*Controlling Emergency Vehicles in Urban Traffic with Genetic Algorithms*	Monica Patrascu	Patrascu
12	1570284324	*The Effect of Pressure Losses on Measured Compressor Efficiency*	Kristoffer Ekberg	Ekberg
13	1570286065	*Implementation of an Optimization and Simulation Based Approach for Detecting and Resolving Conflicts At Airports*	Paolo Scala	Scala
		Track A09. Water/Waste-water: Treatment Plants and Networks		
1	1570269734	*A Variogram-Based Tool for Variable Selection in a Wastewater Treatment Effluent Prediction*	Markku Ohenoja	Ohenoja
2	1570284121	*Water Content Analysis of Sludge Using NMR Relaxation Data and Independent Component Analysis*	Mika Liukkonen	Liukkonen
		Track A11. Other Application Domains		
1	1570274599	*Firing Accuracy Analysis of Electromagnetic Railgun Exterior Trajectory Based on Sobol's Method*	Dongxing Qi	Ping Ma
2	1570282475	*Modelling and Simulation of a Paraglider Flight*	Marcel Müller	Müller
3	1570284277	*Modelling of a New Compton Imaging Modality for an In-Depth Characterisation of Flat Heritage Objects*	Patricio Guerrero Prado	Guerrero Prado
4	1570288804	*Falsification by Modelling and Simulation for Investigations in Hallstatt Archaeology*	Felix Breitenecker	Popper
		Track F01. Control and Optimization: Computers in Control, Adaptation, Intelligent Analyzers, Model-based Control		
1	1570267472	*Analysis of Optimal Diesel-Electric Powertrian Transients During a Tip-In Maneuver*	Vaheed Nezhadali	Eriksson
2	1570283781	*Numerical Efficiency of Inverse Simulation Methods Applied to a Wheeled Rover*	Thaleia Flessa	Flessa
3	1570283939	*An Improved Kriging Model Based on Differential Evolution*	Xiaobing Shang	Ma
4	1570284178	*Simulation of Control Structures for Slug Flow in Riser During Oil Production*	Roshan Sharma	Sharma
		Track F02. Communication and Security: Internet/Cloud Computing, Mobile/Wireless Systems, Security		
1	1570274254	*Security Threats and Recommendation in IoT Healthcare*	Hanim Eken	Eken
2	1570284301	*Simulation of Data Communication System Taking Into Account Dynamic Properties*	Galina Antonova	Antonova
3	1570298806	*Simulation of HTTP-based Services Over LTE for QoE Estimation*	Alessandro Vizzarri	Vizzarri
4	1570298817	*Simulation of VoLTE Services for QoE Estimation*	Alessandro Vizzarri	Vizzarri
		Track F03. Education and Training, e-Learning		
1	1570271838	*Constructive Assessment Method for Simulator Training*	Laura Marcano	Marcano
2	1570273011	*Learning Heat Dynamics Using Modelling and Simulation*	Merja Mäkela	Mäkela
3	1570284208	*OO Modelling and Control of a Laboratory Crane for the Purpose of Control Education*	Borut Zupancic	Zupancic
4	1570288003	*A New Approach Teaching Mathematics, Modelling and Simulation*	Stefanie Winkler	Winkler

		Track F04. Fault Detection & Fault Tolerant Systems: Condition Monitoring, Maintenance		
1	1570286391	*Extracting Vibration Severity Time Histories From Epicyclic Gearboxes*	Juhani Nissilä	Nissilä
2	1570286415	*The Effect of Steel Leveler Parameters on Vibration Features*	Riku-Pekka Nikula	Nikula
		Track F05. Human-Machine Interaction		
1	1570274327	*Interactive Modeling and Simulation of Micromirror MEMS Devices*	Sarbast Rasheed	Rasheed
		Track F06. Mechatronics and Robotics		
1	1570274462	*Spline Trajectory Planning for Path with Piecewise Linear Boundaries*	Hiroyuki Kano	Kano
2	1570284035	*A Harvest Vehicle with Pneumatic Servo System for Gathering a Harvest and Its Simulation Study*	Katsumi Moriwaki	Moriwaki
		Track F08. Planning and Scheduling		
1	1570284154	*Creating Social-aware Evacuation Plans Based on a GIS-enable Agent-based Simulation*	Kasemsak Padungpien	Padungpien
2	1570286948	*A Simulation Model for the Closed-Loop Control of a Multi-Workstation Production System*	Juliana Sagawa	Sagawa
		Track F09. Sensing: Image, Speech and Signal Processing. Circuits, Sensors and Devices.		
1	1570271566	*Transmission of Medical Images Over Multi-Core Optical Fiber Using CDMA: Effect of Spatial Signature Patterns*	Antoine Abche	Abche
2	1570282767	*Two-Step Reconstruction with Total Variation Regularization From Limited Views for Differential Phase-Contrast Computed Tomography*	Naoki Sunaguchi	Sunaguchi
3	1570283965	*Semantic Based Image Retrieval Through Combined Classifiers of Deep Neural Network and Wavelet Decomposition of Image Signal*	Nadeem Qazi	Qazi
4	1570284235	*A Method for Modelling and Simulation the Changes Trend of Emotions in Human Speech*	Reza Ashrafidoost	Ashrafidoost
		Track F10. Virtual Reality and Visualization, Computer Art, Serious Games, Visualization		
1	1570284181	*3D Virtual Fish Population World for Learning and Training Purposes*	Bikram Kawan	Kawan
2	1570287624	*Virtual Reality Simulators in the Process Industry - A Review of Existing Systems and the Way Towards ETS*	Jaroslav Cibulka	Komulainen; Cibulka
		Track M01. Computational Intelligence: Evolutionary, Fuzzy, Knowledge, Natural Language, Nature Inspired, Neural/Neuro-fuzzy, Patterns/Machine Intelligence		
1	1570265370	*Automatic Recognition of Steel Plate Side Edge Shape Using Classification and Regression Models*	Pekka Siirtola	Siirtola
2	1570277400	*Simulating the Effect of Adaptivity on Randomization*	Adam Viktorin	Viktorin
3	1570282975	*Self-adaptive of Differential Evolution Using Neural Network with Island Model of Genetic Algorithm*	Linh Tao	Tao
4	1570283683	*Developing New Solutions for a Reconfigurable Microstrip Patch Antenna by Inverse Artificial Neural Networks*	Ashrf Aoad	Aoad
5	1570283800	*Wind Speed Prediction Based on Incremental Extreme Learning Machine*	Elizabeta Lazarevska	Lazarevska
6	1570284223	*Fuzzy Clustering Algorithm Applied to the Radio Frequency Signals Prediction*	Paulo Tiburcio Pereira	Ramos

7	1570284228	*Single Swarm and Simple Multi-Swarm PSO Comparison*	Michal Pluhacek	Pluhacek
8	1570284313	*Dynamic Artificial Neural Network (DANN) MATLAB Toolbox for Time Series Analysis and Prediction*	Khim Chhantyal	Chhantyal
9	1570284334	*Flow Rate Estimation Using Dynamic Artificial Neural Networks with Ultrasonic Level Measurements*	Khim Chhantyal	Chhantyal
10	1570285633	*Estimation of Discontinuities From Point Cloud Based on Variable-Box Segmentation Method*	Shun Matsukawa	Matsukawa
11	1570287938	*Comparison of Different Models for Residuary Resistance Prediction*	Elizabeta Lazarevska	Lazarevska
12	1570292878	*Flat Patterns Extraction with Collinearity Models*	Leon Bobrowski	Bobrowski
		Track M03. Conceptual Modelling		
1	1570271809	*Simulation of Bubbling Fluidized Bed Using One-Dimensional Model Based on Euler-Euler Method*	Cornelius Agu	Agu
2	1570272522	*A New Concept of Functional Energetic Modelling and Simulation*	Mert Mokukcu	Mokukcu
3	1570288006	*Possibilities in State Event Modelling of Hybrid Systems*	Andreas Koerner	Koerner
4	1570289031	*Mean-Field Approximation of a Microscopic Population Model for Austria*	Martin Bicher	Bicher
5	1570293373	*Taking Into Account Workers' Fatigue in Production Tasks: a Combined Simulation Framework*	Aicha Ferjani	Ferjani
		Track M04. Complex Systems		
1	1570280081	*Methodology and Procedures of Cyber-Physical-Socio Systems Integrated Modelling and Simulation*	Boris Sokolov	Benyamna
2	1570285768	*Synaptic Learning of the Resonator Network Interacting with Oscillatory Background and Noise*	Taishi Matsumura	Matsumura
		Track M05. Data Analysis: Fractional Differentiation, Reinforcement Learning, Semantic Mining, Statistical Analysis		
1	1570278097	*Reliable Detection of a Variance Increase in a Critical Process Variable*	Mika Pylvänäinen	Pylvänäinen
		Track M06. Discrete Event Simulation		
1	1570281408	*Modeling and Simulation of Train Networks Using Max-Plus Algebra*	Jari Boling	Al-bermanei
2	1570284217	*Simulation Metamodeling Using Dynamic Bayesian Networks with Multiple Time Scales*	Mikko Harju	Harju
3	1570284335	*Size Rate of an Alternatives Aggregation Petri Net Developed Under a Modular Approach*	Juan Ignacio Latorre-Biel	Latorre-Biel
4	1570286061	*A Simulation Model of a School's Evacuation*	Dins Lolans	Lolans; Kucerenko
5	1570287611	*Transformation of Petri Net Models by Matrix Operations*	Juan Ignacio Latorre-Biel	Latorre-Biel
		Track M07.Distributed Parameter Systems: Computational Fluid Dynamics, Partial Differential Equations, Stochastic Systems		
1	1570276159	*Prediction of Dilute Phase Pneumatic Conveying Characteristics Using MP-PIC Method*	K. Amila Chandra	Ariyaratne
2	1570283681	*Simulation of Flame Acceleration and DDT*	Knut Vaagsaether	Welahetti
3	1570283898	*Modelling and Simulation of Phase Transition in Compressed Liquefied CO2*	Sindre Tosse	Welahetti

4	1570284327	*Parallel Simulation of PDE-based Modelica Models Using ParModelica*	Gustaf Thorslund	Pop
5	1570284985	*Blood Flow in the Abdominal Aorta Post 'Chimney' Endovascular Aneurysm Repair*	Hila Ben Gur	Brand
		Track M09.Parallel and Distributed Interactive Systems		
1	1570284566	*Loadbalancing on Parallel Heterogeneous Architectures: Spin-image Algorithm on CPU and MIC*	Ahmed Eleliemy	Koistinen
		Track M10. Simulation Tools/Platforms: Domain-Specific Tools, Simulation Software, Hardware in the Loop, Verification and Validation		
1	1570272523	*CFD Approaches for Modeling Gas-Solids Multiphase Flows - A Review*	W. K. Hiromi Ariyaratne	Ariyaratne
2	1570273086	*Simulation of Horizontal and Vertical Water Flooding in a Homogeneous Reservoir Using ECLIPSE*	Ambrose Ugwu	Ugwu
3	1570274693	*Simulator Coupling for Network Fault Injection Testing*	Emilia Cioroaica	Cioroaica
4	1570275592	*Validation Method for Hardware-in-the-Loop Simulation Models*	Tamas Kokenyesi	Kokenyesi
5	1570280452	*Embedded Simulations in Real Remote Experiments for ISES e-Laboratory*	Michal Gerza	Gerza
6	1570281302	*Development of a Hardware in the Loop Setup with High Fidelity Vehicle Model for Multi Attribute Analysis*	Jae Sung Bang	Bang
7	1570282885	*From Low-Cost High-Speed Channel Design, Simulation, to Rapid Time-to-Market*	Nansen Chen	Chen
8	1570283474	*Note on Fire Simulation Efficiency Realized on Computer Cluster*	Lukas Valasek	Valasek
9	1570283835	*Automatic Generation of Dynamic Simulation Models Based on Standard Engineering Data*	Niklas Paganus	Paganus
10	1570283927	*A Simulation Model Validation and Calibration Platform*	Shenglin Lin	Li
11	1570283996	*The Application of Inflow Control Device for an Improved Oil Recovery Using ECLIPSE*	Ambrose Ugwu	Ugwu
12	1570284113	*Industrial Evaluation of an Efficient Equation Model Debugger in OpenModelica*	Åke Kinnander	Pop
13	1570284201	*Domain-Specific Modelling of Micro Manufacturing Processes for the Design of Alternative Process Chains*	Daniel Rippel	Rippel
14	1570284220	*API for Accessing OpenModelica Models From Python*	Bernt Lie	Lie
15	1570284221	*Hardware-in-the-Loop Simulation for Machines Based on a Multi-Rate Approach*	Christian Scheifele	Scheifele
16	1570284241	*Powertrain Model Assesment for Different Driving Tasks Through Requirement Verification*	Anders Andersson	Andersson
17	1570284275	*Modeling and Implementation of a Point of Sale System and Prepayment Meter Based on the IEC 62055-41 Metering Standard*	Reagan Mbitiru	Mbitiru
18	1570285697	*Analytical Approximations and Simulation Tools for Water Cooling of Hot Rolled Steel Strip*	Aarne Pohjonen	Pohjonen
19	1570288800	*Comparing Modelling and Simulation Approaches for Structural Dynamic Systems by Means of the ARGESIM Benchmarks*	Felix Breitenecker	Breitenecker
		Track M11. Other Methodologies		
1	1570274613	*A Novel Credibility Quantification Method for Welch's Periodogram Analysis Result in Model Validation*	Yuchen Zhou	Ma
2	1570283971	*Identification Scheme for the Nonlinear Model of an Electro-Hydraulic Actuator*	Waldemar Leite Filho	Leite Filho

3	1570284350	*Mathematical Model of the Distribution of Laser Pulse Energy*	Pavels Narica	Cacivkins; Narica; Teilans
4	1570284360	*Mathematical Model of Forecasting Laser Marking Experiment Results*	Pavels Narica	Cacivkins; Narica
5	1570284442	*Classification of OpenCL Kernels for Accelerating Java Multi-agent Simulation*	Pitipat Penbharkkul	Penbharkkul
		Track S01. Best Practices and New Trends in Control Education		
1	1570283869	*Experiences and Trends in Control Education: A HiOA/USN Perspective*	Tiina Komulainen	Komulainen
2	1570284288	*Challenges and New Directions in Control Engineering Education*	Kai Zenger	Zenger
		Track S03. Modelling and Control Aspects in Wastewater Treatment Processes		
1	1570272939	*A Simplified Model of an Activated Sludge Process with a Plug-Flow Reactor*	Jesus Zambrano	Zambrano
2	1570272954	*Monitoring a Secondary Settler Using Gaussian Mixture Models*	Jesus Zambrano	Zambrano
3	1570284314	*Industrial Model Validation of a WWT Bubbling Fluidized Bed Incinerator*	Souad Rabah	Rabah
		Track S04. Modelling and Simulation in Applied Energy		
1	1570272983	*Simulation of Oil Production in a Fractured Carbonate Reservoir*	Nora Cecilie Ivarsdatter Furuvik	Furuvik
2	1570276985	*Simulation of CO2 for Enhanced Oil Recovery*	Ludmila Vesjolaja	Vesjolaja
3	1570279816	*Simulation of Heavy Oil Production Using Inflow Control Devices*	Emmanuel Okoye	Okoye
4	1570283490	*Modeling of Wood Gasification in an Atmospheric CFB Plant*	Erik Dahlquist	Naqvi
5	1570283663	*Initial Results of Adiabatic Compressed Air Energy Storage (CAES) Dynamic Process Model*	Tomi Thomasson	Thomasson
6	1570283689	*Modeling of Black Liquor Gasification*	Erik Dahlquist	Dahlquist
7	1570283907	*Cascade Optimization Using Controlled Random Search Algorithm and CFD Techniques for ORC Application*	Ramiro Ramirez	Da Silva
8	1570283991	*Simulation of Light Oil Production From Heterogeneous Reservoirs*	Arash Abbasi	Abbasi
9	1570283998	*Functionality Testing of Water Pressure and Flow Calculation for Dynamic Power Plant Modelling*	Timo Yli-Fossi	Yli-Fossi
10	1570288005	*Performance of Electrical Power Network with Variable Load Simulation*	Ahmed Al Ameri	Nichita
		Track S05. Modelling and Simulation in Solar Thermal Power Plants		
1	1570282947	*Mathematical Modeling of the Parabolic Trough Collector Field of the TCP-100 Research Plant*	Antonio J. Gallego	Yebra
2	1570283752	*Mathematical Conditions in Heliostat Models for Deterministic Computation of Setpoints*	Moises Villegas-Vallecillos	Yebra
3	1570284142	*Object-Oriented Dynamic Modelling of Gas Turbines for CSP Hybridisation*	Luis J. Yebra	Yebra
4	1570284271	*Object-Oriented Modelling and Simulation of a Molten-Salt Once-Through Steam Generator for Solar Applications Using Open-Source Tools*	Francesco Casella	Casella

5	1570284295	*Performance Evaluation of Alternative Traffic Control Schemes for an Arterial Network by DES Approach-Overview*	Jennie Lioris	Lioris
6	1570286110	*SolarTherm: A New Modelica Library and Simulation Platform for Concentrating Solar Thermal Power Systems*	Alberto de la Calle	de la Calle
		Track S06. Object-Oriented Technologies of Computer Modelling and Simulation of Complex Dynamical Systems		
1	1570257261	*Method to Develop Functional Software for NPP APCS Using Complex Mathematical Modeling of NPP in SimInTech*	Alexander Shchekaturov	Sokolov
2	1570268949	*Object-Oriented Modeling with Rand Model Designer*	Yuri Senichenkov	Senichenkov
3	1570268960	*Rand Model Designer's Numerical Library*	Yuri Senichenkov	Senichenkov
4	1570283273	*Adaptive Robust SVM-based Classification Algorithms for Multi-Robot Systems Using Sets of Weights*	Lev Utkin	Utkin
5	1570284212	*Network-Centric Control Methods for a Group of Cyber-Physical Objects*	Vladimir Muliukha	Utkin
6	1570284239	*Modelling and Operation Framework for Robotics in High Performance Cloud Computing Environment*	Alexey Lukashin	Utkin
7	1570287573	*Solving Stiff Systems of ODEs by Explicit Methods with Conformed Stability Domains*	Anton Novikov	Novikov
8	1570287579	*Numerical Algorithm for Design of Stability Polynomials for the First Order Methods*	Evgenyi Novikov	Novikov
		Track S07. Chemical Process Systems Simulation		
1	1570273110	*Modelling and Simulation of PtG Plant Start-Ups and Shutdowns*	Teemu Sihvonen	Sihvonen
2	1570277442	*Simulation of Particle Segregation in Fluidized Beds*	Janitha Bandara	Bandara
3	1570284184	*Dynamic Model of an Ammonia Synthesis Reactor Based on Open Information*	Bernt Lie	Jinasena
4	1570284230	*Comparison of OpenFoam and ANSYS Fluent*	Prasanna Welahetti	Welahetti
5	1570284251	*Impact of Particle Diameter, Particle Density and Degree of Filling on the Flow Behavior of Solid Particle Mixtures in a Rotating Drum*	Sumudu Karunarathne	Karunarathne
		Track S08. Industrial Optimization Based on Big Data Technology and Soft Computing		
1	1570281472	*A Novel Metaheuristic Algorithm Inspired by Rhino Herd Behavior*	Gai-Ge Wang	Zenger
2	1570281526	*Perspectives on Industrial Optimization Based on Big Data Technology and Soft Computing Through Image Coding*	Yukinori Suzuki	Suzuki
3	1570281731	*A Novel Flower Pollination Algorithm Based on Genetic Algorithm Operators*	Fouad Allouani	Zenger
4	1570282366	*Static Stability of Double-Spiral Mobile Robot Over Rough Terrain*	Naohiko Hanajima	Hanajima
5	1570283445	*A Search Method with User's Preference Direction Using Reference Lines*	Tomohiro Yoshikawa	Yoshikawa
6	1570284063	*Effects of Chain-Reaction Initial Solution Arrangement in Decomposition-Based MOEAs*	Hiroyuki Sato	Sato
7	1570284124	*On Demand Response Modeling and Optimization of Power in A Smart Grid*	Olli Kilkki	Kilkki
8	1570284127	*Application of Musical Expression Generation System to Learning Support of Musical Representation*	Mio Suzuki	Suzuki
9	1570284254	*Verifying an Implementation of Genetic Algorithm on FPGA-SoC Using SystemVerilog*	Hayder AL-Hakeem	AL-Hakeem
10	1570284270	*A New Approach Based on Simplifying Problem and Partially Fixing Customers Sequence for Large Scale Vehicle Routing*	Shinya Watanabe	Watanabe

		Problem		
11	1570288012	*Interpolating Lost Spatio-Temporal Data by Web Sensors*	Shun Hattori	Hattori
12	1570293069	*Recursive Data Analysis in Large Scale Complex Systems*	Esko Juuso	Juuso
		Track S09. Simulation as Enabler for Innovative Technology Design/Testing applied to Space Exploration/Base Operations		
1	1570272703	*Investigation of Robotic Material Loading Strategies Using an Earthmoving Simulator*	Eric Halbach	Halbach
2	1570293052	*Modeling and Simulation as Support for Development of Human Health Space Exploration Projects*	Agostino Bruzzone	Bruzzone
3	1570297487	*SDNizing the Wireless LAN - A Practical Approach*	Manzoor Khan	Dorsch
		Track S10. Cooperative Automation		
1	1570284137	*Information From Centralized Database to Support Local Calculations in Condition Monitoring*	Antti Koistinen	Koistinen

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Program Sessions at a Glance, Tuesday and Wednesday

Tuesday, September 13					
Time	**A**	**B**	**C**	**D**	**E**
09:00 am-09:30: *Opening Session*					
09:30 am-10:15 am : Tue.AM1.A: *Plenary: Thermal Management Simulations within Power Engineering at ABB*					
10:45 am-12:45 pm	Tue.AM2.A: *Industrial Optimization Based on Big Data Technology and Soft Computing-I*	Tue.AM2.B: *Embedded and Hardware in Loop*	Tue.AM2.C: *Signal processing and transmission I*	Tue.AM2.D:*Distributed Parameter Systems*	Tue.AM2.E: *Modelling and Simulation in Applied Energy-I*
01:45 pm-02:30 pm: Tue.PM1.A: *Plenary: Modelling and Simulation of the Electric Arc Furnace Processes*					
02:30 pm-03:30 pm	Tue.PM2.A: *Panel: M&S in Cleantech*	Tue.PM2.B: *Industrial Optimization Based on Big Data Technology and Soft Computing-II*	Tue.PM2.C: *Signal processing and transmission-II*	Tue.PM2.D:*Distributed Parameter Systems*	Tue.PM2.E: *Innovative Technology*
04:00 pm-05:40 pm	Tue.PM3.A: *Modelling and Simulation in Solar Thermal Power Plants*	Tue.PM3.B: *Industrial Optimization Based on Big Data Technology and Soft Computing-III*	Tue.PM3.C: *Conceptual Modelling*	Tue.PM3.D:*Condition Monitoring and Fault Tolerant Control*	Tue.PM3.E: *Chemical Process Systems Simulation*
Wednesday, September 14					
09:00 am-10:00 am: Wed.AM1.A: *Plenary: Situation Awareness and Early Recognition of Traffic Maneuvers*					
10:30 am-12:30 pm	Wed.AM2.A: *Control and Planning in Transportation Systems*	Wed.AM2.B: *Water & Wastewater*	Wed.AM2.C: *Object-Oriented Technologies of Computer Modelling and Simulation of Complex Dynamical Systems*	Wed.AM2.D: *Energy Supply for Buildings & Data Analysis*	Wed.AM2.E: *Industrial Processes: Capture Processes, Manufacturing*
01:30 pm-02:15 pm : Wed.PM1.A: *Plenary: Simulating the composition of the atmosphere*					
02:15 pm-03:15 pm	Wed.PM2.A: *Panel: Future Energy Systems*	Wed.PM2.B->F: *Poster Session*	Wed.PM2.C: *Object-Oriented Technologies of Computer Modelling and Simulation of Complex Dynamical Systems*	Wed.PM2.D: *Art and Archaeology*	Wed.PM2.E: *Security and Military*
03:45 pm-05:50 pm	Wed.PM3.A: *Gasification and Power Plants*	Wed.PM3.B: *Modeling, Simulation, Control and Optimization in Transportation*	Wed.PM3.C: *Complex Systems*	Wed.PM3.D: *Evolutionary* Computation	Wed.PM3.E: *Parallel & Integrated Simulation*
Thursday, September 15 Continued on next page					

Program Sessions at a Glance, Thursday

Thursday, September 15					
09:00 am-09:45 am: Thu.AM1.A: *Plenary: Using the Power of Simulation to bring Bottom Line Benefits to the Mining, Minerals and Metals Operations*					
10:15 am-12:15 pm	Thu.AM2.A: *Modelling and Simulation in Applied Energy-II*	Thu.AM2.B: *Industrial Processes: Mining, Metal and Oil Industry*	Thu.AM2.C: *Discrete Event Simulation*	Thu.AM2.D: *Best Practices and New Trends in Control Education*	Thu.AM2.E:*Communication & Security*
01:15 pm-02:00 pm: Thu.PM1.A: *Plenary: Online simulation platform for biophotonic applications*					
02:05 pm-03:05 pm	Thu.PM2.A: *Panel: Intelligent Systems and IoT in Future Automation*	Thu.PM2.B: *Modelling Tools-I*	Thu.PM2.C: *Planning and scheduling*	Thu.PM2.D: *Artificial Neural Networks*	Thu.PM2.E: *Biological Systems and Health*
03:10 pm-04:10 pm	Thu.PM3.A: *Virtual Reality & Visualization*	Thu.PM3.B: *Modelling Tools-II*	Thu.PM3.C: *Power Transmission and Three-Phase Systems*	Thu.PM3.D:*Mechatronics and Robotics*	Thu.PM3.E:*Bioprocesses and IoT*
04:15 pm-04:45: *Closing Session*					

Tuesday, September 13, 09:00-09:30

Opening Session, Room A

The Vice Rector for Cooperation affairs, Dr. Matti Sarén, University of Oulu, Finland

President of EUROSIM, Dr. Esko Juuso, University of Oulu, Finland

President of SIMS, Prof. Erik Dahlquist, Mälardalen University, Sweden

Congress Chair, Prof. Kauko Leiviskä, University of Oulu, Finland

Tuesday, September 13, 09:30 - 10:15, Tue.AM1.A

Plenary, Room A, Chairs: Erik Dahlquist (Mälardalen University, Sweden), Nora Cecilie Ivarsdatter Furuvik (University College of Southeast Norway, Norway)

Thermal Management Simulations within Power Engineering at ABB

Prof. Rebei Bel Fdhila

ABB Corporate Research, Sweden
Email: rebei.bel_fdhila@se.abb.com

The area of thermal management is driven by miniaturization in industry e.g. power electronics, motors or transformers. It is a natural response to size restrictions as in automotive and robotics, to space excessive cost e.g. offshore applications or simply to industrial or comfort requirements. Besides that, unceasing market and technology demand for higher currents, higher voltages or higher power is inevitably leading to a substantial power density increase justifying large losses and generating important amounts of heat. Confined electrical systems, enclosures containing electrical components and other apparatus and devices can generate a lot of heat able to significantly reduce the life time of an installation if no appropriate thermal solutions were adopted. Cooling is also needed to provide the appropriate process or product quality with minimizing energy consumption and environmental impact. An ever-increasing power density drives the need for more effective thermal management solutions where several phenomena e.g. electromagnetic, thermal and/or mechanical can be simultaneously taken into account. ABB is a leading company within power and automation technologies and to maintain its product quality and market penetration has always invested in acquiring state-of-the-art hardware and software tools to cope with its technology needs and ambitions. We are also building our own integrated multiphysics simulation methods able to develop accurate thermal solutions that account for the major interacting physical phenomena. This presentation can introduce you to our know-how in terms of numerical predictions of coupled systems and will also provide you with several examples of solutions where advanced simulations have been used.

Biography

Rebei Bel Fdhila (male), Adjunct Professor in Process Modelling and Computational Fluid Dynamics at Mälardalen University since 2006. Got a PhD in 1991 from the National Polytechnic Institute of Toulouse, France “INP Toulouse/ENSEEIHT” within multiphase flows and worked as a post-doc with EDF and CNRS in France followed by Twenty University in Holland. Since 1995 he joined ABB Corporate Research in Sweden first as a researcher and today acting in his global role as a Corporate Research Fellow in Thermal Management. He has a large experience within the advanced modeling and simulation world. 30+ publications and 9 active patent families.

Tuesday, September 13, 10:45 - 12:45

Tue.AM2.A: Industrial Optimization Based on Big Data Technology and Soft Computing-I
Room: A
Chairs: Yukinori Suzuki (Muroran Institute of Technology, Japan), Kai Zenger (Aalto University & School of Electrical Engineering and Automation, Finland)

10:45 ***Perspectives on Industrial Optimization Based on Big Data Technology and Soft Computing Through Image Coding***
Yukinori Suzuki (Muroran Institute of Technology, Japan)
Industrial systems being rapidly innovated due to recent information technology of IoT and fruitful results of artificial intelligence. We discuss roles of big data technologies and soft computing to optimize industrial systems and to design robust systems through image coding. We show a code book (CB) design for vector quantization (VQ) to discuss roles of soft computing and big data technology. The CBs were designed by conventional clustering algorithms. However, these conventional algorithms cannot provide CBs that encode and/or decode images with high image quality and low bits rate. We show a perspectives to overcome this problem to integrate big data technology and soft computing.

11:05 ***A Novel Metaheuristic Algorithm Inspired by Rhino Herd Behavior***
Gai-Ge Wang (Jiangsu Normal University, P.R. China); Xiao-Zhi Gao (Aalto University, Finland); Kai Zenger (Aalto University & School of Electrical Engineering and Automation, Finland); Coelho Leandro dos Santos (Pontifical Catholic University of Parana, Brazil)
In this paper, inspired by the herding behavior of rhinos, a new kind of swarm-based metaheuristic search method, namely Rhino Herd (RH), is proposed for solving global continuous optimization problems. In various studies of rhinos in nature, the synoptic model is used to describe rhino's space use and estimate its probability of occurrence within a given domain. The number of rhinos increases year by year, and this increment can be forecasted by several population size updating models. Synoptic model and a population size updating model are formalized and generalized to a general-purpose metaheuristic optimization algorithm. In RH, null model without introducing any influences is generated as the initial herding. This is followed by rhino modification via synoptic model. After that, the population size is updated by a certain population size updating model, and newly-generated rhinos are randomly initialized within the given conditions. RH is benchmarked by fifteen test problems in comparison with biogeography-based optimization (BBO) and stud genetic algorithm (SGA). The results clearly show the superiority of RH in searching for the better function values on most benchmark problems over BBO and SGA.

11:25 ***Static Stability of Double-Spiral Mobile Robot Over Rough Terrain***
Naohiko Hanajima, Taiki Kaneko, Hidekazu Kajiwara and Yoshinori Fujihira (Muroran Institute of Technology, Japan)
In this paper, we investigate static stability for a double-spiral mobile robot. Recently a double-spiral mobile architecture has been proposed. It is a new locomotion mechanism suitable for the wetlands that suppresses damage to vegetation and does not sink in the mud. The static walking motion on flat ground has been performed successfully in numeric simulation. To overcome rough terrain locomotion, we need to ensure the stability of the walking motion on the rough terrain. We applied normalized energy stability margin (NESM) to the double-spiral mobile robot in order to investigate its static stability over rough terrain. We show the method to obtain the NESM value in terms of the vector calculation. In the numerical case study, we drew NESM maps to investigate the static stabilities when the inclination of the slope varied or the pose and orientation of the robot changed. We adopted a moment in the swing phase where the stability of the robot's balance was easily lost. We found that the robot has sensitive directions in terms of stability. Planning the route and motion of the robot in the rough terrain could help maintain its stability.

11:45 ***A New Approach Based on Simplifying Problem and Partially Fixing Customers Sequence for Large Scale Vehicle Routing Problem***
Shinya Watanabe (Muroran Institute of Technology, Japan); Tetsuya Sato (Mizuho Information & Research Institute, Inc., Jersey); Kazutoshi Sakakibara (Toyama Prefectural University, Japan)
This paper proposed a specialized evolutionary approach for large scale vehicle routing problems (VRPs). Our approach includes two original mechanisms; simplification of problem and partially fixing of customers' sequence. The first one tries to simplify the problem by integrating some neighbor customers into one set recursively and after this simplification this iterates to restore the simplified problem to original one gradually. Also second mechanism is directed toward the reduction of search space by fixing a part of customers' sequence. Our approach is designed to perform an effective search by the interaction of these mechanisms especially in large scale VRPs. Through some test problems having different characteristics, it was demonstrated how our approach could be performed effectively as compared with normal approach (without these original mechanisms) for large scale VRPs.

12:05 ***Interpolating Lost Spatio-Temporal Data by Web Sensors***
Shun Hattori (Muroran Institute of Technology, Japan)
We experience various phenomena (e.g., rain, snow, and earthquake) in the physical world, while we carry out various actions (e.g., posting, querying, and e-shopping) in the Web world. Many researches have tried to mine the Web for knowledge about various phenomena in the physical world, and also several Web services using Web-mined knowledge have been made available for the public. Meanwhile, the previous papers have introduced various kinds of "Web Sensors" with Temporal Shift, Temporal Propagation, and Geospatial Propagation to sense the Web for knowledge about a targeted physical phenomenon, i.e., to extract its spatiotemporal data sensitively by analyzing big data on the Web (e.g., Web documents, Web queries, and e-shopping logs), and compared them based on their correlation coefficients with Japan Meteorological Agency's physically-sensed spatiotemporal statistics to ensure the accuracy of Web-sensed spatiotemporal data sufficiently. As an industrial application of Web Sensors to a problem of the loss or error of physically-sensed spatiotemporal data due to some sort of troubles (e.g., temporary faults of JMA's observatories), this paper tries to enable Web Sensors to interpolate lost spatiotemporal data of physical statistics by regression analysis.

12:25 ***Recursive Data Analysis in Large Scale Complex Systems***
Esko K. Juuso (University of Oulu, Finland)
Advanced data analysis is needed in practical applications in large scale complex systems. Variable specific data-driven solutions provide consistent levels, which can be used in compact model structures. In changing operating conditions, the recursive analysis extends the applicability of these structures in building and tuning dynamic and case-based models for complex systems since the meanings change more frequently than the interactions. The methodology provides information about uncertainty, fluctuations and confidence in results. The scaling approach brings temporal analysis to all measurements and features: trend indices are calculated by comparing the averages in the long and short time windows, a weighted sum of the trend index and its derivative detects the trend episodes and severity of the trend is estimated by including also the variable level in the sum. The trend episodes and temporal adaptation of the scaling functions with time are used in the early detection of changes in the operating conditions. The levels are understood as fuzzy labels and the decision making is based on fuzzy calculus. The solution is highly compact: all variables, features and indices are transformed to the range [-2, 2] and represented in natural language which is important in integrating data-driven solutions with domain expertise.

Tue.AM2.B: Embedded and Hardware in Loop

Room: B

Chairs: Michal Gerza (Tomas Bata University in Zlin, Czech Republic), Christian Scheifele (University of Stuttgart, Germany)

10:45 ***Simulator Coupling for Network Fault Injection Testing***

Emilia Cioroaica and Thomas Kuhn (Fraunhofer IESE, Germany)

System architectures of embedded systems are undergoing heavy changes. Embedded systems are becoming cyber physical systems with open interfaces and resulting distributed control loops. This calls for new testing approaches that enable early evaluation of system and safety concepts, and support the evaluation of system designs before they are implemented. Simulation is a common technology that supports the testing of embedded systems, but existing simulators are focused and specialized. A single simulator often does not support all necessary models to provide a valid testing environment for system designs. In this paper, we de-scribe our framework for the coupling of communication simula-tors to enable virtual testing and safeguarding of embedded sys-tem designs. The integration of network simulation models and fault injectors enables testing of safety concepts. The applicability of our approach is illustrated in the context of a case study that is based on a vehicle system design realized as contract work.

11:05 ***Validation Method for Hardware-in-the-Loop Simulation Models***

Tamas Kokenyesi and Istvan Varjasi (BME AUT)

The advances in FPGA technology have enabled fast real-time simulation of power converters, filters and loads. HIL (Hardware-in-the-Loop) simulators taking advantage of this technology have revolutionized control software and hardware development for power electronics. Switching frequencies in today's power converters are getting smaller and smaller, so reducing calculation time steps in HIL simulators is critical, especially if simulating lower power circuits. Faster calculation can be achieved with simpler models or lower resolution. Both possibilities require the validation of the FPGA-synthesizable simulation models to check whether they are correct representations of the simulated main circuit or not. The subject of this paper is a validation method treating the simulation error as production variance, which can be measured between different instances of the original main circuit.

11:25 ***Embedded Simulations in Real Remote Experiments for ISES e-Laboratory***

Michal Gerza (Tomas Bata University in Zlin, Czech Republic); Frantisek Schauer (Tomas Bata University in Zlin, Czech Republic & Trnava University in Trnava, Slovakia); Petr Dostal (Tomas Bata University in Zlin, Czech Republic)

The paper focuses on the design of the module of embedded simulations for real remote Internet School Experimental System (ISES) experiments. ISES experimental platform is intended for educational purpose laboratories at schools and universities providing PC oriented measuring environment for Engineering students and students of Natural sciences. At present, the ISES remote laboratories do not provide any provisions for concurrent interactive simulations in form of virtual experiments. This drawback results in lesser attractiveness and understanding of real world phenomena. The designed solution uses the Easy JavaScript Simulations environment to calculate the data, using equations provided by corresponding physics laws, and the ISES module for the simulated data transfer and visualization. In the Introduction the ISES remote laboratory concept is introduced, followed by the State of the art, describing the present state of the ISES physical hardware development and its Measureserver unit, realized as the finite-state machine, in particular. The next section looks into the design and realization of the simulation module, from the adjusting the constants and conditions for corresponding differential equations, through the computation evolution, up to the visualization. Finally, the behavior in the time-domain of the RLC circuit with variable damping is used as an example, is presented.

11:45 ***Development of a Hardware in the Loop Setup with High Fidelity Vehicle Model for Multi Attribute Analysis***
Jae Sung Bang, Tae Soo Kim and Suk Hwan Choi (Hyundai Motor Group, Korea); Raphael Rhote-Vaney and Harikrishnan Rajendran Pillai (Siemens PLM, USA)
This paper describes a novel model-based real-time simulation approach to test, validate and calibrate electronic controllers for Hybrid Electric Vehicle (HEV) applications. The performance of the Hybrid Control Unit (HCU) needs to be evaluated on multiple vehicle attributes such as fuel economy, acceleration and drivability objectives. The multi-attribute evaluation requires a higher level of detail for the vehicle simulation model where the energy flow and drivetrain dynamics are represented accurately. Given the high mechatronic content and the strong interactions among the various controllers in HEV's, it becomes necessary to simulate many of the vehicle controllers on the real-time platform. The higher fidelity vehicle model coupled with the realistic behavior model of the controller network poses challenges in setting up the real-time Hardware-In-the-Loop (HIL) test platform where the vehicle level attributes can be studied. The real-time simulation setup process, its challenges and the methods used to overcome these challenges are described in this paper.

12:05 ***Hardware-in-the-Loop Simulation for Machines Based on a Multi-Rate Approach***
Christian Scheifele (University of Stuttgart, Germany); Alexander Verl (Stuttgart University, Institute for Control Engineering of Machine Tools, Germany)
The commissioning of the entire control system using a digital shadow of the machine offers extensive advantages in industrial control engineering for machine manufacturers and machine integrators. The growing use of a Hardware-in-the-Loop Simulation (HiLS) in the engineering process is accompanied by the steady increase in demands regarding model depth and model scope of the virtual machine. Especially in the area of material flow simulation, currently used simulation setups of HiL-Simulators reach their limits. This paper presents an approach on how a virtual machine could be realized based on a multi-rate approach to increase the model depth and model scope.

12:25 ***Modeling and Implementation of a Point of Sale System and Prepayment Meter Based on the IEC 62055-41 Metering Standard***
Reagan Mbitiru (Carnegie Mellon University, USA); Taha Selim Ustun (Carnegie-Mellon University, USA); Timothy X Brown (University of Colorado, USA)
Developed initially for prepayment electricity meters in Africa, the IEC 662055-41 standard is now the world's most ubiquitous open pre-paid metering standard used most often for electric power dispensing. Now serving more users in Asia than in Africa, this standard is installed in 35 million meters operated by 400 utilities in 30 countries. It uses 16 cycles of a block-cipher substitution and permutation process to both generate 20 digit tokens (through an encryption process) and to decode 20 digit tokens and determine the number of kWhs procured (through a decryption process) using a 64 bit decoder key generated using DES. However, despite the prevalence of this standard, no open and publicly accessible implementations of this standard exist to assist academic or commercial analysis. This paper details a customizable implementation of this standard in software that models both a point of sale system (that generates the tokens) and a meter system (that consumes the tokens) illustrating the decision choices made in modelling the token generation and decoding process as illustrated in this standard.

Tue.AM2.C: Signal Processing and Transmission-I

Room: C

Chairs: Artis Teilans (Rezekne Academy of Technologies & Exigen Services, Latvia), Naoki Sunaguchi (Yamagata University, Japan)

10:45 ***Fuzzy Clustering Algorithm Applied to the Radio Frequency Signals Prediction***

Paulo Tibúrcio Pereira and Glaucio L. Ramos (Federal University of São João Del-Rei, Brazil)

In this work the Fuzzy Clustering technique is used to perform radio frequency signal prediction. This technique is used with georeferencing maps of topography and morphology for the radio frequency power levels signal prediction at the region of Viçosa - MG. The performance of this method is evaluated through tests of propagation and mapping for a 879.660 MHz signal, used in cellular mobile telephony. This method of prediction showed excellent results in comparison with the actual levels of RF power with a success rate greater than the classical models Okumura-Hata and Walfisch-Ikegami. Consequently, this method can be very useful to the tellecomunications companies when making the RF cellular coverage prediction.

11:05 ***Two-Step Reconstruction with Total Variation Regularization from Limited Views for Differential Phase-Contrast Computed Tomography***

Naoki Sunaguchi (Gunma University, Japan); Tetsuya Yuasa (Yamagata University & Graduate School of Science and Engineering, Japan); Rajiv Gupta (Massachusetts General Hospital, USA); Shu Ichihara (Nagoya Medical Center, Japan); Masami Ando (Tokyo University of Science, Japan)

We consider an algebraic reconstruction with total variation (TV) regularization from limited views for differential phase contrast computed tomography (DPC-CT). In order to overcome the drawback of over-flattening nature in TV regularization, we propose the two-step reconstruction, which first reconstructs tomographic images of gradient refractive index from differential projections using the algebraic reconstruction with TV regularization, and then estimates a tomographic image of refractive index by solving the Poisson equation. We incorporated TV regularization into the reconstruction of the gradient refractive index, because the distribution is much more flattened than that of refractive index to be targeted. We demonstrated by simulation that the proposed method can reconstruct a satisfactory image from much smaller number of projections than is required by the sampling theorem.

11:25 ***Semantic Based Image Retrieval through Combined Classifiers of Deep Neural Network and Wavelet Decomposition of Image Signal***

Nadeem Qazi (Middlesex University, United Kingdom); William Wong (Middlesex University, London, United Kingdom)

Recent research towards semantic gap reduction to improve the retrieval accuracy of content based image retrieval system is shifting towards machine learning methods, relevance feedback, object ontology etc. In this research study, we have put forward the idea that semantic gap can be reduced to improve the performance accuracy of image retrieval through two steps process. It should be initiated with the identification of the semantic category of the query image followed by retrieving of similar images from the identified semantic category in the second step. We have demonstrated this idea through constructing a global feature vector using wavelet decomposition of color and texture information of the query image and later used feature vector to identify its semantic category. For an improved identification accuracy of the relevant semantic category of the query image we have used a stacked classifier consisting of Deep Neural Network and logistic regression as base classifiers. The image retrieval process in the identified semantic category was then achieved through Gabor Filter of the texture information of query image. The precision rate of image retrieval as obtained through the proposed algorithm is also compared with the others research work and was found to be improved.

11:45 ***Mathematical Model of the Distribution of Laser Pulse Energy***

Pavels Narica (Rezekne Academy of Technologies, Latvia); Artis Teilans (Rezekne Academy of Technologies & Exigen Services, Latvia); Lyubomir Lazov, Pavels Cacivkins andEdmunds Teirumnieks (Rezekne Academy of Technologies, Latvia)

Method allows for modelling of the complex process of laser pulse energy distribution over flat work surface. The process of calculating the correct result does not use common lasing formulas but instead employs the mathematical model of matrix multiplication of three input matrices representing a pulse model, a line model, and a plane model. The pulse model represents the distribution of planar energy densities within the laser pulse. The line model represents the distribution of pulses within the line. The plane model represents the distribution of lines within the plane. Because mathematical model is implemented within a spreadsheet processor, its size can be adjusted as needed and it can be instantiated multiple times for simultaneous modelling of different input parameters.

12:05 ***From Low-Cost High-Speed Channel Design, Simulation, to Rapid Time-to-Market***

Nansen Chen (MediaTek Inc., Taiwan)

Leadframe packages are always adopted as the low-end devices. When the low-cost channel including the leadframe package and the two-layer PCB is required for high-speed digital signaling over 1 Gb/s, the iteration of full channel simulation and analysis with reliable EDA tools should be taken before the device is rolled out. Different channel designs were characterized in the frequency domain using the 3-D full-wave electromagnetic field solver to analyze the bottleneck of channel performance. Comparison of the full channel S-parameters, the channel with the proposed DDR3 memory controller package suffers less insertion loss. The chip-package-board co-simulations in the time-domain using the chip HSPICE netlists and full channel S-parameters for the DDR3 data accessing at 1.2, 1.4, and 1.6 Gb/s were taken and demonstrated that the channel including the proposed package design had larger timing and voltage margins, and less jitter, overshoot and undershoot, which all conform to JEDEC Standard. The waveform measurement also verified the same prediction that the DDR3 memory controller encapsulated in the modified E-pad LQFP package achieved no cost impact and enough timing margin up to 1458 Mb/s. The performance of mature leadframe packages can be promoted if the careful package designs are taken.

12:25 ***Transmission of Medical Images over Multi-Core Optical Fiber using CDMA: Effect of Spatial Signature Patterns***

Antoine B. Abche, Boutros Kass Hanna, Lena Younes, Nour Hijazi and Elie Naim Inaty (University of Balamand, Lebanon); Elie Karam (university of Balamand, Lebanon)

In this work, the effect of the 2-D Optical Orthogonal Spatial Pattern Codes (OOSPC) is evaluated quantitatively for the transmission of medical images over Multi-core optical fibers using a double blind CDMA technology. The implemented method assumes that N medical practitioners or users are working simultaneously and transmitting images from one site to another. The transmitted images are encoded using a two-steps procedure: 1) coding the pixels (users) using a particular OOSPC and 2) coding the bits using time orthogonal basis functions. The encoding procedure follows the decomposition of an image into its bits to increase the transmission rate by performing a parallel transmission. Then, the encoded information from different images are combined using a multiplexer and are transmitted over multi-core optical fiber. At the receiver end, the collected information is de-multiplexed and the user is identified to reconstruct the original image i.e. is decoded using the same double blind Orthogonal Signatures. The performance is quantitatively evaluated using Monte-Carlo simulation techniques and according to different criteria: Performance number, Bit Error Rate, Root Mean Square Error and Pixel Error Rate.

Tue.AM2.D: Distributed Parameter Systems-I

Room: D

Chairs: Bernt Lie (University College of Southeast Norway, Norway), Edna Da Silva (Mälardalen University, Sweden)

10:45 ***Prediction of Dilute Phase Pneumatic Conveying Characteristics Using MP-PIC Method***
K. Amila Chandra and W. K. Hiromi Ariyaratne (University College of Southeast Norway, Norway); Morten Melaaen (University College of Southeast Norway)
Pneumatic conveying characteristics of a dilute phase flow in a circular horizontal pipe was predicted using MP-PIC method in OpenFOAM code. The pipe diameter is 30.5 mm. The solid particles are plastic pellets which are having 1000 kg/m3 of density and 0.2 mm of particle diameter. The simulations were carried out for 10 m/s of superficial air velocity and for different solids mass loadings 0, 1, 2 and 3. The pressure drop, air velocity profiles and solids distribution were analysed and some of the results were compared with experimental data from the literature. The predicted pressure drops and air velocity profiles show a quite good agreement with the experimental data.

11:05 ***Simulation of Flame Acceleration and DDT***
Knut Vaagsaether (University College of Southeast Norway, Norway)
Presenter: Prasanna Welahetti
This paper presents a combustion model and a simulation method for modeling flame acceleration (FA) and deflagration to detonation transition (DDT) in a premixed gas. The method is intended to produce the most important effects in FA and DDT without resolving the flame front on the computational mesh. The simulations presented here are of stoichiometric hydrogen-air mixtures in a channel with repeated obstacles. The channel is 2 m long and 110 mm wide, with a height of either 20 mm or 40 mm. The obstacles create a blockage ratio of 0.5. The combustion model combines a turbulent burning velocity model and a two-step Arrhenius kinetic rate. The simulations show similar flame speeds and pressures as seen in experiments, and the process of DDT is shown to be caused by shock focusing and shock flame interactions. Results from both 2D and 3D simulations are presented, since the 2D simulations show how the method can reproduce important effects.

11:25 ***Modelling and Simulation of Phase Transition in Compressed Liquefied CO2***
Sindre Tosse, Per Morten Hansen and Knut Vaagsaether (University College of Southeast Norway, Norway)
Presenter: Prasanna Welahetti
A model and solution method for phase transition in compressed liquefied gases is presented. The model is a two-phase 6-equation model with a common flow velocity for the two phases. The numerical method for solving the model is based on the 2. order shock capturing MUSCL-scheme with a HLLC Riemann solver. The van der Waal cubic equation of state is used for closing the set of equations. The phase transition model is based on thermodynamic and mechanical relaxation between the phases. Simulation of expansion and phase transition in pressurized liquefied CO2 is presented and compared with experimental data. The simulations are with a one dimensional geometry and the experiments are performed in a narrow tube. Wall effects in the experiments are not captured in the simulations. The wave structure seen in the experiments is reproduced by the simulation although not quantitatively. The simulations show that the fluid is in the metastable region before it undergoes a phase transition. The level of expansion of the metastable liquid shown in the in the simulations is not seen in the experiments.

11:45 ***Parallel Simulation of PDE-based Modelica Models Using ParModelica***
Gustaf Thorslund and Mahder Gebremedhin (Linköping University, Sweden); Peter Fritzson (Linkoping University, Sweden); Adrian Pop (Linkoping University, Sweden)
The Modelica language is a modelling and programming language for modelling cyber-physical systems using equations and algorithms. In this thesis two suggested extensions of the Modelica language are covered. Those are Partial Differential Equations (PDE) and explicit parallelism in algorithmic code. While PDEs are not yet supported by the Modelica language, this article presents a framework for solving PDEs using the algorithmic part of the Modelica language, including parallel extensions. Different numerical solvers have been implemented using the explicit parallel constructs suggested for Modelica by the ParModelica language extensions, and implemented as part of OpenModelica. The solvers have been evaluated using different models, and it can be seen how bigger models are suitable for a parallel solver. The intention has been to write a framework suitable for modelling and parallel simulation of PDEs. This work can, however, also be seen as a case study of how to write a custom solver using parallel algorithmic Modelica and how to evaluate the performance of a parallel solver.

12:05 ***Blood Flow in the Abdominal Aorta Post 'Chimney' Endovascular Aneurysm Repair***
Hila Ben Gur (Tel Aviv University, Israel); Moshe Brand (Ariel University & Ariel BioMechanics Center, Israel); Gábor Kósa (Tel Aviv University, Israel); Saar Golan (Ariel University, Israel)
Aortic aneurysms are a main death cause in the elderly population throughout the western world. In recent years, more aneurysm repairs are performed endovascularly using stent grafts (SGs) inserted into the aneurysm site through the arterial system (minimally invasive). In this study, we analyze the hemodynamics in an aneurysmatic abdominal aorta (AAA) endovascularly repaired by a stent graft (SG) system using the chimney technique. Computational fluid dynamics (CFD) is employed to study models of a healthy aorta versus an aorta post 'chimney' endovascular aneurysm repair (ChEVAR) using chimney stent grafts (CSG) inserted into each renal artery in parallel to the aortic SG. Results demonstrate that the presence of the CSGs results in stagnation regions and wall shear stress (WSS) modifications, yet the flow regime remains laminar. Thus indicating the spatially contained effects of the ChEVAR technique and further supporting its merit.

12:25 ***CFD Approaches for Modeling Gas-Solids Multiphase Flows - A Review***
W. K. Hiromi Ariyaratne and E. V. P. Jagath Manjula (University College of Southeast Norway, Norway); Chandana Ratnayake (Tel-Tek, Porsgrunn, Norway); Morten Melaaen(University College of Southeast Norway, Norway)
This review study mainly focuses on the application of computational fluid dynamics (CFD) in the investigation of gas-solids multiphase flow systems and one would get a general overview of gas-solids flow models by having an insight to this article. The applicability and limitations of conventional models and recent developments of existing multiphase models for the prediction of gas-solids flows are thoroughly overviewed. Use of conventional Eulerian-Eulerian approach for granular materials and Lagrangian approach incorporated with discrete element method (CFD-DEM) are quite well proven, however some limitations restrict the use of these models in wide range of applications. Therefore, these models are being under improvements and some new models have been introduced to model gas-solids flows, as example dense discrete phase model incorporated with kinetic theory of granular flow (DDPM-KTGF), dense discrete phase model incorporated with discrete element method (DDPM-DEM) and computational particle fluid dynamics (CPFD) numerical scheme incorporated with the multiphase-particle-in-cell (MP-PIC) method. These models have been validated for certain applications under certain conditions, however, further validation of these models in fundamental and applied research is still a necessity.

Tue.AM2.E: Modelling and Simulation in Applied Energy-I

Room: E

Chairs: Konstantinos Kyprianidis (Mälardalen University, Sweden), Britt M.E. Moldestad (University College of Southeast Norway, Norway)

11:05 ***Simulation of Oil Production in a Fractured Carbonate Reservoir***
Nora Cecilie Ivarsdatter Furuvik and Britt M.E. Moldestad (University College of Southeast Norway, Norway)
CO2-EOR is an attractive method because of its potential to increase the oil production from matured oilfields, at the same time reduce the carbon footprint from the industrial sources. The field response to the CO2-EOR technique depends on the petrophysical properties of the reservoir. Carbonate reservoirs are characterized by low permeability and strong heterogeneity, causing significant amounts of water and CO2 to be recycled when CO2 is reinjected into the reservoir. Naturally fractured carbonate reservoirs have low oil production, high water production, early water breakthrough and high water cut. This study focuses on the oil production and the CO2 recycle ratio in naturally fractured carbonate reservoirs, including near-well simulations using the reservoir software Rocx in combination with OLGA. The simulations indicate that closing the fractured zone causes delayed water breakthrough and dramatically reduced water cut, resulting in improved oil recovery as well as lower production and separation costs.

11:25 ***Simulation of CO2 for Enhanced Oil Recovery***
Ludmila Vesjolaja, Britt M.E. Moldestad, Arash Abbasi, Ambrose Ugwu and Emmanuel Okoye (University College of Southeast Norway, Norway)
CO2-EOR is one of the main methods for tertiary oil recovery. The injection of CO2 does not only improve oil recovery, but also contribute to the mitigation of greenhouse gas emissions. In this study, near well simulations were performed to determine the optimum differential pressure and evaluate the effect of CO2 injection in oil recovery. By varying the drawdown from 3 bar to 20 bar, the most suitable differential pressure for the simulations was found to be 10 bar. The effect of CO2 injection on oil recovery was simulated by adjusting the relative permeability curves using Corey and STONE II correlations. By decreasing the residual oil saturation from 0.3 to 0.15 due to CO2 injection, the oil recovery factor increased from 0.52 to 0.59 and the water production decreased by 22%.

11:45 ***Simulation of Heavy Oil Production Using Inflow Control Devices***
Emmanuel Okoye and Britt M.E. Moldestad (University College of Southeast Norway, Norway)
Production of heavy oil requires the application of new technologies in order to handle the challenges associated with the production. The main challenges are early water breakthrough, resulting in high water cut and low oil recovery. Especially in heterogeneous reservoirs, early water breakthrough and high water cut lead to low productivity and high separation costs. Different types of inflow control devices (ICD) have proven to be effective in delaying water breakthrough and the newer technology has also the ability to choke for water after breakthrough. The near well simulation tool, NETool, was used to simulate oil production from homogeneous and heterogeneous heavy oil reservoirs after water breakthrough has occurred. The oil and water production using nozzle ICD and autonomous ICD (RCP) completion have been simulated and compared. ICD is producing more oil than RCP, but it is also producing significantly more water. The well with ICD completion gave about 4-5 times higher water cut than the well with RCP completion. Estimates indicates that by utilizing the newest technology, autonomous inflow control valve (AICV), the water cut can be reduced significantly without reducing the oil production.

12:05 ***Simulation of Light Oil Production From Heterogeneous Reservoirs***

Arash Abbasi and Britt M.E. Moldestad (University College of Southeast Norway, Norway)

Water breakthrough is a big challenge in light oil production, and different types of inflow control devices are developed to delay or reduce breakthrough. Light oil production from a heterogeneous reservoir is simulated to study the effect of three types of inflow controllers, one passive controller and two autonomous controllers. NETool is used as the near-well simulation tool. The functionality of ICD and RCP is included in NETool, whereas AICV is simulated based on expected behaviour. The total production rates and water cut versus drawdown and the performance curves for ICD, RCP and AICV are studied. The results confirm that RCP and AICV reduce the water production and water cut significantly. The water cut is about 27% for RCP and 44% for ICD at 15 bar. AICV is designed to close 99% for water, and produces negligible amounts of water. The RCP completed well produces about 310 m3 oil and 110 m3 water per day at drawdown 15 bar. ICD produces about 230 m3 water per day, whereas AICV produces insignificant amount of water. The results confirm that the water production decreases with RCP and AICV compared to ICD. Delayed and reduced water production will result in increased oil recovery.

12:25 ***Modeling of Wood Gasification in an Atmospheric CFB Plant***

Erik Dahlquist (Mälardalen University, Sweden); Muhammad Naqvi (Mälardalen University, Sweden); Eva Thorin and Jinyue Yan (Mälardalen University, Sweden); Konstantinos Kyprianidis (Mälardalen University, Sweden); Philip Hartwell (BioRegional MiniMills Ltd., United Kingdom)

The energy situation in both process industries and power plants is changing and it is of interest to investigate new polygeneration solutions combining production of chemicals with the production of power and heat. Examples of such chemicals are methane, hydrogen, and methanol etc. Integration of gasification into chemical recovery systems in the pulp and paper production systems and into the combined heat and power (CHP) systems in power plant applications are among the possible polygeneration systems. It is also interesting to look at the potential to introduce combined cycles with gas turbines and steam turbines as a complement. To perform such analysis, it is important to have relevant input data on what gas composition we can expect from running different type of feed stock. In this paper, we focus on the wood pellets. Experimental results are correlated into partial least squares models to predict major composition of the synthesis gas produced under different operating conditions. The quality prediction models then are combined with physical models using Modelica for investigation of dynamic energy and material balances for large plants. The data can also be used as input to analysis using e.g. ASPEN plus and similar system analysis tools.

Tuesday, September 13, 13:45 - 14:30, Tue.PM1.A

Plenary: Room A, Chairs: Felix Breitenecker (Vienna University of Technology, Austria), Aarne Pohjonen (University of Oulu, Finland)

Modelling and Simulation of the Electric Arc Furnace Processes

Assistant Professor Vito Logar

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Current market demands on steel quality, price and production times dictate the introduction of several technological innovations regarding the electric arc furnace (EAF) steelmaking. One of the fields, which is rapidly developing and has a significant potential is related to the advanced software support of the EAF operation, which combines data acquisition, advanced monitoring and proper control of the EAF. This paper briefly presents the idea and development of all key EAF-process models, which are together with measured EAF data used to estimate the unmeasured process values. The models are based on fundamental physical laws and are implemented mainly using non-linear, time-variant ordinary differential equations. The validation results that were performed using operational EAF measurements indicate high levels of estimation accuracy and the final outcome of the study results in a fully operational EAF model, describing all crucial steel-recycling processes. The accuracy of the presented models is in the range of +/- 15 K for steel temperature and +/-10 % for steel composition. Therefore, the versatility and accuracy of the models allows the usage of the models in broader software environments in a form of soft sensors for process monitoring, process optimization and operator decision support.

Biography

Vito Logar is an Assistant Professor at the Faculty of Electrical Engineering, Univ. of Ljubljana. He is working on the described area for many years in several projects. So his research interests include modelling and optimization techniques regarding the electric arc furnace steel recycling processes. In 2013 he received the award for outstanding scientific achievement for the year 2011 from the Slovenian Research Agency (ARRS). In 2014 he received the award for outstanding scientific and pedagogic achievements from the University of Ljubljana. He is currently also the president of the Slovenian society for modelling and simulation SLOSIM.

More info on EAF modelling and simulation: EAF Simulator: http://msc.fe.uni-lj.si/eaf.asp
More info on the research: ResearchGate: https://www.researchgate.net/profile/Vito_Logar

Tuesday, September 13, 14:35 - 15:35

Tue.PM2.A: Panel: Modelling and Simulation in Cleantech

Room: A

Chairs: Bernt Lie (University College of Southeast Norway, Norway), Jesús Zambrano (Mälardalen University, Sweden)

What is cleantech? Cleantech consists of products and services which are focused on the use of renewable natural resources and recycled materials in an energy-efficient way. Cleantech utilizes biological natural resources and turns them into food, energy, and other products and services. Cleantech uses clean technologies, which saves the environment by efficient recycling of materials. How? We have a broad range of technologies related to recycling, renewable energy, information technology, green transportation, electric motors, green chemistry, lighting, grey water, and more. Does this mean that cleantech is gradually introduced in all areas?

The environment is restored with pollution removal and avoidance. What can we do in practise? Air has been a focus area in industry, energy and traffic. Water treatment has been developed to remove undesirable chemicals, biological contaminants, suspended solids and gases from contaminated water. Where do we have the main risks? Availability of usable water may set constraints on operation. In industrial processes, closed water circulation is a goal which is beneficial for the environment. Wastewater treatment is needed for purifying contaminated water before returning it to the nature. Why are there difficulties in combining industrial and domestic wastewater treatment? Mining introduces many challenges for the environment. Renewable energy, including wind power, solar power, biomass, hydropower, biofuels etc., is an essential part in integrating cleantech with the energy production. Waste can be used as raw material or fuel in many ways. Power plants can use waste in energy production. What are the main challenges?

A circular economy aims to close the loop to make economy more sustainable and competitive. This should be more than just recycling. What does this mean? Water and wastewater treatment are good examples. There are challenging tasks for Information technology, modelling, control and optimisation. How can we proceed? What kind of Modelling and Simulation is important in Cleantech? How can we compare alternative solutions and build situation awareness? The problem solving in cleantech includes smart integration of all the historical elements, earth, fire, water and air, with data.

Tue.PM2.B: Industrial Optimization Based on Big Data Technology and Soft Computing-II
Room: B
Chairs: Yukinori Suzuki (Muroran Institute of Technology, Japan), Kai Zenger (Aalto University & School of Electrical Engineering and Automation, Finland)

2:35 ***A Search Method with User's Preference Direction Using Reference Lines***
Tomohiro Yoshikawa (Nagoya University & Graduate School of Engineering, Japan)
Recently, a lot of studies on Multi-Objective Genetic Algorithm (MOGA), in which Genetic Algorithm is applied to Multi-objective Optimization Problems (MOPs), have been reported actively. MOGA has been also applied to engineering design fields, then it is important not only to obtain Pareto solutions having high performance but also to analyze the obtained Pareto solutions and extract the knowledge in the designing problem. The another has studied the analysis methods of acquired Pareto solutions by MOGA. The aim of these methods is, however, to analyze solutions, and the feedback of the analysis results into the search is little focused. This paper proposes a search method that uses reference lines for a user's preference direction which is defined by the user's attention based on visualization results of a pre-search.

2:55 ***On Demand Response Modeling and Optimization of Power in A Smart Grid***
Olli Kilkki (Aalto University School of Electrical Engineering, Finland); Kai Zenger (Aalto University & School of Electrical Engineering and Automation, Finland)
The electrical grid is under reform; the increasing volatile renewable energy production and distributed local generation compel the development of a future where the consumption of electricity can also participate in maintaining the production-consumption balance of the grid. There is a vast amount of recent research activity related to exploiting residential and industrial consumption elasticity. This paper presents a selected overview of various facets of modeling, optimizing and simulating the demand response potential and effects, especially with emergent soft computing methods. In addition, some illustrating examples are presented, where various relevant approaches from recent state-of-the-art research, including soft computing methods, are reviewed.

3:15 ***Verifying an Implementation of Genetic Algorithm on FPGA-SoC Using SystemVerilog***
Hayder AL-Hakeem and Suvi Karhu (University of Vaasa, Finland); Jarmo Alander (University of Vaasa Finland, Finland)
In this paper we show how an efficient implementation of genetic algorithms can be done on field programmable gate array i.e. on programmable hardware using the latest hardware design language aiding verification. A four-way number partitioning problem of 128 unsigned 16-bit integers is used as a test case of the implementation. However, other similar problems could be solved using the proposed approach. The design was implemented using a combination of reusable verified intellectual property cores for arithmetic operations and Very High Speed Integrated Circuit Hardware Design Language to describe the genetic algorithms operators in register transfer level. The register transfer level components were verified in ModelSim using SystemVerilog assertions and covergroups. Test results show significant improvements in performance compared to Matlab simulations running on a core i-7 desktop computer.

Tue.PM2.C: Signal processing and transmission-II

Room: C

Chairs: Artis Teilans (Rezekne Academy of Technologies & Exigen Services, Latvia), Waldemar Leite Filho (DCTA-IAE, Brazil)

2:35 ***Mathematical Model of Forecasting Laser Marking Experiment Results***

Pavels Narica (Rezekne Academy of Technologies, Latvia); Artis Teilans (Rezekne Academy of Technologies & Exigen Services, Latvia); Lyubomir Lazov, Pavels Cacivkins andEdmunds Teirumnieks (Rezekne Academy of Technologies, Latvia)

Method allows for modelling of the anticipatory results of colour laser marking experiments. The process of calculating expected results takes into consideration the construction specifics of laser system being used and displays the results in compact form of a set of parameter matrices that have their values conditionally formatted as colour maps for easy identification of complex patterns. The complete set of all the related parameter matrices, both technical and derived, as well as the specific relations between them form the mathematical model of forecasting laser marking experiment results. Because the mathematical model is implemented within spreadsheet processor, it can be instantiated multiple times for any number of experiments.

2:55 ***Identification Scheme for the Nonlinear Model of an Electro-Hydraulic Actuator***

Waldemar Leite Filho (DCTA-IAE, Brazil)

This work presents the building of a nonlinear model of an electro-hydraulic actuator in order to understand the limit cycle phenomenon that appears when it is used in a closed loop control system. Previously, a first harmonic analysis had been used to identify that system, but the results were unsatisfactory. So, this work aims to build on that model with the use of Fast Fourier Transforms as a way to recognize previously unseen nonlinearities. Hardware in the loop tests are then used in order to find the proper parameters that create a particular limit cycle. Simulation results show that such approach is successful.

3:15 ***A Method for Modelling and Simulation the Changes Trend of Emotions in Human Speech***

Reza Ashrafidoost (Science and Research University, Iran); Saeed Setayeshi (Amirkabir University of Technology)

One of the fastest and richest methods, which represents emotional profile of human beings is speech. It also conveys the mental and perceptual concepts between humans. In this paper we have addressed the recognition of emotional characteristics of speech signal and propose a method to model the emotional changes of the utterance during the speech by using a statistical learning method. In this procedure of speech recognition, the internal feelings of the individual speaker are processed, and then classified during the speech. And so on, the system classifies emotions of the utterance in six standard classes including, anger, boredom, fear, disgust, neutral and sadness. For that reason, we call the standard and widely used speech database, EmoDB for training phase of proposed system. When preprocessing tasks done, speech patterns and features are extracted by MFCC method, and then we apply a classification approach based on statistical learning classifier to simulate changes trend of emotional states. Empirical experimentation indicates that we have achieved 85.54% of average accuracy rate and the score 2.5 of standard deviation in emotion recognition.

Tue.PM2.D: Distributed Parameter Systems-II

Room: D

Chairs: Edna Da Silva (MDH Mälardalen University, Sweden), Britt M.E. Moldestad (University College of Southeast Norway, Norway)

2:35 ***Simulation of Horizontal and Vertical Water Flooding in a Homogeneous Reservoir Using ECLIPSE***

Ambrose Ugwu, Britt Moldestad and Britt M.E. Moldestad (University College of Southeast Norway, Norway)

Over the recent years, several developments have been introduced within the field of oil and gas recovery, with the aim to maximize production. One of these developments is the use of water injection referred to as water flooding to improve oil and gas recovery. The objective of this work is to ascertain the optimal water injection arrangement between vertical and horizontal water flooding using ECLIPSE Reservoir simulation software. Within this work, analyses of oil production rate, water cut, reservoir pressure drop, accumulated oil production and recovery factor were made between horizontal and vertical water flooding in a homogeneous reservoir. Result shows that horizontal water flooding could be effective if water breakthrough is delayed. The increase in oil recovery achieved through this method varied between 6% and 36% while the delay in breakthrough varied between 459 days and 1362 days. This work also predicts production performance for ten years which would be useful for dynamic optimization of water flooding. However, reservoir heterogeneity would introduce geological uncertainty, which could bring mismatch between the simulated case and a real case.

2:55 ***The Application of Inflow Control Device for an Improved Oil Recovery Using ECLIPSE***

Ambrose Ugwu and Britt M.E. Moldestad (University College of Southeast Norway, Norway)

The rate of inflow to a horizontal well can vary along the completion length due to some reasons such as frictional pressure losses or heterogeneity in reservoir permeability. These variations reduce oil sweep efficiency and the ultimate recovery. Owing to this, it is necessary to manage fluid flow through the reservoir in order to maximize oil recovery along horizontal wells. One increasingly popular approach is to use inflow control devices that delay water and gas breakthrough into the well. Inflow control devices balance the inflow coming from the reservoir toward the wellbore by introducing an extra pressure drop. This paper presents the mathematical models used for the implementation of ICD in ECLIPSE. A case study using reservoir conditions similar to Troll offshore Norway was simulated to illustrate the effect of ICD in a heterogeneous reservoir. The simulation result shows that with ICD completion, water breakthrough was delayed for 262 day and water cut after 3000 days reduced by 11%. Despite the delay in water breakthrough, the oil production rate decreased. Although well productivity is reduced by approximately 42%, there is an improved degree of inflow equalization through ICD completion. Gas production was decreased by approximately 51% with ICD completion.

Tue.PM2.E: Innovative Technology
Room: E
Chairs: Agostino G Bruzzone (University of Genoa, Italy), Eric Halbach (Aalto University, Finland)

2:35 ***Modeling and Simulation as Support for Development of Human Health Space Exploration Projects***
Agostino G Bruzzone (University of Genoa, Italy); Giuseppina Murino (SimulationTeam, Italy); Marina Massei (University of Genoa, Italy)
This paper highlights the importance of Interoperable Simulation Systems as precious instruments to support and improve space exploration projects devoted to human health environment research. The research investigates the potential of Modeling & Simulation to realize an environment able to reproduce all components involved in human health space exploration projects in order to reduce all possible disadvantages and, therefore, minimize costs as well as maximize results. The proposed approach enhances the cooperation between scientists, engineering teams and industry to support medical research development in new strategic space missions for human health.the results that will be obtained from this research they will be in any case of fundamental importance for the study on any kind of pathogenesis through targeted spatial missions.

2:55 ***Investigation of Robotic Material Loading Strategies Using an Earthmoving Simulator***
Eric Halbach (Aalto University, Finland); Aarne Halme and Ville Kyrki (Aalto University)
A kinematic earthmoving simulation environment was used to investigate job planning strategies which could increase the performance of automated material loading with a robotic compact skid-steered wheel loader. One new problem studied was the subdivision of a larger rectangular workspace using the smaller rectangular Scoop Area (SA). Two methods for selecting scooping approach vectors were also compared: a Zero Contour (ZC) method which assesses all possible perpendicular approaches along the bottom of the slope, and the proposed alternative High Point (HP) method which scoops towards the highest point in the current workspace from a fixed point. Three jobs were simulated to determine which scooping method and SA dimensions resulted in the highest excavation rate in a truck loading scenario. Assuming the same scoop filling effectiveness, the HP method was found to offer a higher rate than the ZC method due to its more limited driving envelope. The maximum HP rates were achieved with SA dimensions which were narrower and longer than with the ZC method, while the optimal SA dimensions were also found to be dependent on the job parameters. When a higher amount of material to excavate per area was present, smaller SAs resulted in higher rates.

3:15 ***SDNizing the Wireless LAN - A Practical Approach***
Manzoor Ahmed Khan, Patrick Engelhard and Tobias Dörsch (TU Berlin, Germany)
The emerging Internet of Things (IoT) paradigm and plethora of diverse applications provision more flexible network management. Software Defined Networking (SDN) occupies the pivotal role in realizing such a flexible network management.However, the gain of this potential panacea is still unmeasurable in real sense especially when wireless medium is part of the equation, as the validation framework mostly skip capturing the realistic system dynamics. In this paper, we study the performance gain of SDN control implemented in physical testbed comprising of virtualized core and WLAN access network. With this contribution, we aim at realizing a more realistic environment, where the impact of system dynamics on the stakeholders (users and operators) may be studied. We developed a mechanism to map the logical wireless channels over the physical wireless interface of the access point. We also designed and developed a novel approach of switch-2-switch communication in an SDNized wireless environment. SDN (Opendaylight) control application for mobility management, OVS-OVS communication, the mapper tool, visualization andcontrol GUI, and Android applications are amongst the main contribution of this work.

Tuesday, September 13, 16:00 - 17:40

Tue.PM3.A: Modelling and Simulation in Solar Thermal Power Plants

Room: A

Chairs: Luis J. Yebra (CIEMAT-Plataforma Solar de Almería, Spain), Esko K. Juuso (University of Oulu, Finland)

4:00 ***Object-Oriented Modelling and Simulation of a Molten-Salt Once-Through Steam Generator for Solar Applications Using Open-Source Tools***
Francesco Casella and Stefano Trabucchi (Politecnico di Milano, Italy)
Concentrated solar power plants (CSP) coupled with thermal storage have the potential of being competitive with conventional fossil fuel and hydro power plants, in terms of dispatchability and provision of ancillary services. To achieve this potential, the plant design has to be focused on flexible operation, which is the main goal of the PreFlexMS Horizon 2020 European research project. This can be achieved by the integration of a Molten Salt Once Through Steam generator within the power unit, an innovative technology with greater flexibility potential if compared to steam drum boilers, currently the state of the art in CSP. Given the focus on flexible operation, dynamic modelling and simulation from the early design stages is of paramount importance, to assess the plant dynamic behaviour and controllability, and to predict the achievable closed-loop dynamic performance. The present paper aims to demonstrate that it is possible to achieve this goal by means of Modelica-based open-source libraries and tools.

4:20 ***SolarTherm: A New Modelica Library and Simulation Platform for Concentrating Solar Thermal Power Systems***
Alberto de la Calle and Jim Hinkley (CSIRO Energy, Australia); Paul Scott and John Pye (Australian National University, Australia)
In this work we presented the work-in-progress to develop SolarTherm, a new CST technology simulation platform. It is designed to offer user an easy tool suitable for the modelling and simulation of CST power systems including unconventional ones. The focus of this tool is the annual performance and the economic assessment of novel designs of solar thermal plants. SolarTherm is composed by a Modelica library of components and systems and Python-based tools and scripts that provides a simulation framework. It is also compatible with the user-friendly Modelica environments OMEdit and Dymola and it is developed with an open source philosophy, providing all the code in a GitHub server.

4:40 ***Mathematical Modeling of the Parabolic Trough Collector Field of the TCP-100 Research Plant***
Antonio J. Gallego (Universidad de Sevilla, Spain); Luis J. Yebra (CIEMAT-Plataforma Solar de Almería, Spain); Eduardo F. Camacho and Adolfo J. Sánchez (Universidad de Sevilla, Spain)
There are two main drawbacks when operating solar energy systems: a) the resulting energy costs are not yet competitive and b) solar energy is not always available when needed. In order to improve the overall solar plants efficiency, advances control techniques play an important role. In order to develop efficient and robust control techniques, the use of accurate mathematical models is crucial. In this paper, the mathematical modeling of the new TCP-100 parabolic trough collector (PTC) research facility at Plataforma Solar de Almería is presented. Some simulations are shown to demonstrate the adequate behavior of the model compared with the design data from the facility.

5:00 ***Mathematical Conditions in Heliostat Models for Deterministic Computation of Setpoints***

Moises Villegas-Vallecillos (University of Cadiz, Spain); Luis J. Yebra (CIEMAT-Plataforma Solar de Almería, Spain)

In this paper a set of mathematical conditions on heliostat models is presented. Its purpose is to guarantee a deterministic computation of the heliostat setpoints in azimuth and elevation. In Central Receiver (CR) Concentrating Solar Power (CSP) plants, thousands of heliostats are continuously operated, and the updating of their setpoints is required frequently. For this reason, the fulfillment of some mathematical conditions of the mentioned type is important. In a simplified approach, during the operation, each heliostat reflects in its mirror a ray from the sun that impacts on a given aiming point P. This aiming point is assumed to be higher than the heliostat position, in the tower receiver. If v is the incident solar vector, x is the orthogonal vector of the heliostat reflective plane and f(x) is the center of the heliostat mirror, then a system of equations with unknown x is arisen. Imposing certain conditions on f, we can ensure the existence and uniqueness of solution of this system, and provide a sequence converging to such solution. Furthermore, we offer a numerical method for approximating the solution in a deterministic form, which can be computed with the requirements of hard real time systems.

5:20 ***Object-Oriented Dynamic Modelling of Gas Turbines for CSP Hybridisation***

Luis J. Yebra (CIEMAT-Plataforma Solar de Almería, Spain); Sebastián Dormido (UNED, Spain)

This paper presents a dynamic model of a gas turbine developed for the HYSOL project. The model is developed mainly for control purposes and based on mathematical, physical and chemical principles. Approximations and assumptions are presented with the objective to minimize complexity and to maintain a modular structure. The main modules are presented independently and ready to be connected to form the complete and parameterizable gas turbine model. Possible cases of algebraic loops appearance are detected and solutions are proposed to avoid them. First principles compression and expansion maps are developed to avoid non-linear algebraic loops. The Modelica modelling language and the libraries Modelica.Fluid and Modelica.Media have been extensively used for the model(s) development. Simulation cases for compressor and turbine modules are presented.

Tue.PM3.B: Industrial Optimization Based on Big Data Technology and Soft Computing-III

Room: B

Chairs: Yukinori Suzuki (Muroran Institute of Technology, Japan), Kai Zenger (Aalto University & School of Electrical Engineering and Automation, Finland)

4:00 ***A Novel Flower Pollination Algorithm Based on Genetic Algorithm Operators***

Fouad Allouani (University of Khenchela, Algeria); Kai Zenger (Aalto University & School of Electrical Engineering and Automation, Finland); Xiao-Zhi Gao (Aalto University, Finland)

The Flower Pollination Algorithm (FPA) is a new natural bio-inspired optimization algorithm that mimics the real life processes of the flower pollination. Thus, the latter has a quick convergence, but its population diversity and convergence precision can be limited in some applications. In order to improve its intensification (exploitation) and diversification (exploration) abilities, we have introduced a simple modification in its general structure. More precisely, we have added both Crossover and Mutation Genetic Algorithm (GA) operators respectively, just after calculating the new candidate solutions and the greedy selection operation in its basic structure. The proposed method, called FPA-GA has been tested on all the CEC2005 contest test instances. Experimental results show that FPA-GA is very competitive.

4:20 ***Effects of Chain-Reaction Initial Solution Arrangement in Decomposition-Based MOEAs***

Hiroyuki Sato (The University of Electro-Communications, Japan); Minami Miyakawa (Hosei University, Japan); Keiki Takadama (The University of Electro-Communications, Japan)

For solving multi-objective problems, MOEA/D employs a set of weight vectors determining search directions and assigns one solution for each weight vector. Since the conventional MOEA/D assigns a randomly generated initial solution for each weight vector without considering its position in the objective space, mismatched pairs of initial solution and weight are generated, and it causes inefficient search. To enhance MOEA/D based multi-objective optimization, this work proposes a method arranging randomly generated initial solutions to weight vectors based on positions of their solutions in the objective space. The proposed method is combined with the conventional MOEA/D and MOEA/D-CRU, and their search performances are verified on continuous DLTZ4 benchmark problems with 2-5 objectives and different problem difficulty parameters. The experimental results show that the proposed method improves the search performances of MOEA/D and MOEA/D-CRU especially on problems with the difficulty to obtain uniformly distributed solutions in the objective space.

4:40 ***Application of Musical Expression Generation System to Learning Support of Musical Representation***

Mio Suzuki (National Institute of Technology, Kushiro College, Japan)

This paper proposes a learning support system of musical representation by piano using teacher's example of musical expression that is generated based on impression expressed by an adjective with our musical expression generation system. The system evaluates learner's performance comparing with teacher's example using a Kansei space and fuzzy rules expressing the relationship between musical expression and impression. The system presents good points of learner's performance and advice by text to a learner for improvement of learner's musical representation. A learner tries to improve his/her own performance based on system's advice, and the system presents other advice again. Experiment is performed to verify whether the proposed system is useful to a practice of musical representation or not. From the experimental results, it is show that the proposed system is useful to learn musical representation and an approach of the proposed system is suitable because the affirmative evaluation is obtained from the participants who have taken piano lesson. On the other hand, it is found the following. The one is the participants feel that it is hard to understand advice text. The other is to learn musical representation is difficult using the proposed system for learner of low performance skills.

5:00 ***Development of a Genetic Algorithms Optimization Algorithm for a Nutritional Guidance Application***
Petri Heinonen (Nutri-Flow, Finland); Esko K. Juuso (University of Oulu, Finland)
Personalized easy to follow nutritional guidance is getting more important since lifestyle related health problems are increasing. To gain a healthy balanced diet usually requires knowledge of a licensed nutritionist. There is a Fuzzy Expert System (FES) which applies knowledge of nutritionists, health data of an individual, personalized nutritional recommendation, and a meal diary with food composition data to balance a diet. FES generates a set of foods and beverages which should be altered in the diet with information on the direction and importance of the change. This paper presents a selection and a development of an optimization algorithm to be integrated with FES to provide easy to follow nutritional guidance. The selection process is carried out as a literature review. The development of selected Genetic Algorithms (GA) is carried out as an integrated part of Nutritional Guidance application, Nutri-Flow, since FES generates the search space, and is an important part of a Fitness Function of the optimization algorithm. The selection of the design parameters, are described and the test results are presented. Validation of the overall model is carried out with an expert analysis and comparison of the nutrient intake from the initial diet and recommended diet.

5:20 ***Estimation of Discontinuities from Point Cloud Based on Variable-Box Segmentation Method***
Shun Matsukawa, Ken-ichi Itakura and Yukinori Suzuki (Muroran Institute of Technology, Japan); Akira Hayano (JAEA Horonobe Underground Research Center, Japan)
To estimate discontinuities of rocks around a tunnel from a point cloud, an algorithm called DiAna is effective. It obtains a fracture plane from the valid point cloud inside a cubic bounding box using least squares method. To extract the valid point cloud from the cubic bounding box, DiAna determined the threshold values manually. It seems to be hard work for long tunnels. To improve this manual operation, we developed Variable-Box Segmentation (VBS) method for LiDAR data recorded from the tunnel. Estimation results from VBS was compared with the reference planes decided from geological sketch. Similarity between reference planes and planes determined by the developed algorithm seems to be enough to find discontinuities from fractured planes.

Tue.PM3.C: Conceptual Modelling

Room: C

Chairs: Rebei Bel Fdhila (ABB Corporate Research, Sweden), Andreas Koerner (Vienna University of Technology & Institute for Analysis and Scientific Computing, Austria)

4:00 ***Simulation of Bubbling Fluidized Bed Using One-Dimensional Model Based on Euler-Euler Method***

Cornelius Agu, Britt M.E. Moldestad, Lars-Andre Tokheim and Marianne Eikeland (University College of Southeast Norway, Norway)

The behaviour of a fluidized bed is often modeled based on Euler-Euler and Euler-Lagrange fluid-particle computational methods. Depending on the fluid-particle drag model and the numerical method used in solving the model, both methods have been proven successful in predicting the behaviour of fluidized beds. In addition to axial distribution, most studies have been based on three-dimensional (3D) and two-dimensional (2D) computations for obtaining the radial distribution of fluidized bed properties. However, the bed property variations such as distribution of void fraction along the flow direction (up the riser), could be of great interest for design purpose. To save computational cost, an appropriate one-dimensional (1D) model can be used to establish the average property variation along the bed column. In this paper, a 1D model based on Euler-Euler method is presented and solved numerically. The simulated results show that the 1D model predicts reasonably the behaviour of a fluidized bed. The results also show that for the case of a bed with 350 μm glass particle used in the simulation, the model predicts well the onset of different flow regimes, including the superficial gas velocities at minimum fluidization and at onset of slugging regime.

4:20 ***A New Concept of Functional Energetic Modelling and Simulation***

Mert Mokukcu (CentraleSupelec & Sherpa Engineering, France); Philippe Fiani, Sylvain Chavanne and Lahsen Ait Taleb (Sherpa Engineering, France); Cristina Vlad(CentraleSupélec, France); Emmanuel Godoy (SUPELEC, France); Clément Fauvel (Ecole des Mines de Nantes, France)

In this study a new concept of functional modelling and simulation is introduced. First, the necessity and the expected outcomes of the new concept are explained. Secondly, the methodology of functional modelling based on a modular concept and the basic elements are presented, with details of OFS (Organico Functional Set). Then, the implementation of the new modelling concept using Sherpa Engineering's PhiSim environment is described in order to perform simulations. Finally, the proposed modelling method is applied to two different applications: a generic parallel hybrid electric vehicle (HEV) and a waste water treatment unit of a building. Simulation results of parallel HEV application are also presented.

4:40 ***Possibilities in State Event Modelling of Hybrid Systems***

Andreas Koerner (Vienna University of Technology & Institute for Analysis and Scientific Computing, Austria); Stefanie Winkler (Vienna University of Technology & TU Wien, Austria); Felix Breitenecker (Vienna University of Technology, Austria)

This work-in-progress paper illustrates the idea of the conceptional separation between a mathematical model and a simulation model for state event models of dynamic hybrid systems. The traditional modelling and simulation process starts with a mathematical model, followed by an implementation of the model in a certain simulation environment and ends with the parametrisation of the numerical attributes of the simulation environment and the simulation run. Current trends in simulation environments tends to go in the direction of graphical oriented modelling descriptions neglecting the need of a conceptional (mathematical) model in the beginning of the process. This limits the modelling process and restricts possibilities in efficiency. For comparison or benchmarking simulation environments as well as modelling languages, approaches and optimization for hybrid models, a conceptional model offers a framework to review these aspects.

5:00 ***Mean-Field Approximation of a Microscopic Population Model for Austria***
Martin Bicher (Vienna University of Technology, Austria); Niki Popper (dwh Simulation Services, Austria)
Verification and validation of large agent bases models is a complicated process to check for full functionality, the simulation has to be executed various times, which takes both time and computational resources. In this discussion-paper we present an approach that could generally improve this process, applied on an agent-based population model for Austria. A so-called mean-field model in this case a partial differential equation (PDE) is used for this aim. Execution of the PDE simulation only takes a very short time, hence the mean-field model can provide a fast prospect on results, behaviour and sensitivity of the agent based model used.

5:20 ***Taking Into Account Workers' Fatigue in Production Tasks: a Combined Simulation Framework***
Aicha Ferjani (LIMOS & SIGMA Clermont, France); Henri Pierreval and Denis Gien (LIMOS, France); Sabeur Elkosantini (College of Engineering Riyadh, Saudi Arabia)
In manufacturing systems, workers are often subjected to arduous working conditions, such as heavy loads and discomfort postures, which induce fatigue. Because of the effect of fatigue on workers' well-being, as well as on their performances, managers would need to understand the evolution of operators' fatigue during their work, in order to make relevant decisions (e.g. work schedule, facility layout decisions, and rest periods). In this context, we present a simulation modeling framework to evaluate manufacturing systems, which takes the workers' fatigue into account. The suggested framework combines several worldviews: Discrete Event modeling, multi-agent and System Dynamics. Discrete Event concepts are used to describe the manufacturing system dynamic behavior and agents are used to model workers. One important characteristic of agents' behavior on which emphasis is put is fatigue, which is modeled using System Dynamics concepts. The proposed approach is implemented using the Anylogic simulation software.

Tue.PM3.D: Condition Monitoring and Fault Tolerant Control

Room: D

Chairs: Michal Gerza (Tomas Bata University in Zlin, Czech Republic), Antti Koistinen (University of Oulu, Finland)

4:00 ***Information from Centralized Database to Support Local Calculations in Condition Monitoring***
Antti Koistinen and Esko K. Juuso (University of Oulu, Finland)
Maintenance in industry is currently moving from time planned preventive methods to condition-based operation for better process reliability and lowered manufacturing costs. Machine vibrations include information from operating state and machine health and can be used in the computing of several different features for condition monitoring and process control. These describing values can be used for the estimation of remaining useful life (RUL). Local computing enables the use of advanced algorithms for dense vibration data on-site, right next to the monitored process so that the data can be turned into information without the need for large data transfers and centralized computing. Calculated features can be supported with other sensory data, information through expert knowledge, modelling, and data from similar systems in other installations. Developments in wireless technologies enable the use of small nodes in distributed computing. This paper examines the use of locally calculated generalized norms in combination with supporting information from the global maintenance database.

4:20 ***Extracting Vibration Severity Time Histories from Epicyclic Gearboxes***
Juhani Nissilä and Esko K. Juuso (University of Oulu, Finland)
Monitoring epicyclic gearboxes in vital power transition situations is still a challenge. In this study we discuss these challenges with long time vibration measurements through two industrial examples. The first are the two gearboxes in the front axle of a load haul dumper (LHD) from Pyhäsalmi mine and the second a two stage gearbox from Kelukoski water power station (WPS). The LHD was monitored almost continuously for nearly two years until its breakdown. The data from WPS was intermittent from a five month period. We discuss how to find stable conditions for comparable measurements in these cases. For this we utilise a tacho signal from the cardan axle of the LHD and power measurements from the WPS. It is found that in both cases second derivatives of acceleration signals, called snap, respond more quickly to changes in vibration severity. In the LHD case we get clear trends for increasing norms of snap signals. The trends are extracted with nonparametric regression. The shorter measurement period of WPS makes it impossible to say if its changes are only seasonal. Spectral analysis shows increase in high frequency vibration with time in both cases but provides almost no help for detailed diagnostics.

4:40 ***The Effect of Steel Leveler Parameters on Vibration Features***
Riku-Pekka Nikula and Konsta Karioja (University of Oulu, Finland)
The development of steel products with different characteristics increases the need for timely and preventive maintenance and condition monitoring of the production machinery. For instance, the roller levelers at modern steel factories are exposed to a high variation of forces due to the large range of steels leveled. In this study, the vibration measured from a steel leveler used for cold steel strips is analyzed with the goal to identify the effects different operational conditions have. Features, such as generalized norms, generalized norm sums and the crest factor, are computed from the vibration signals. The effects of the steel strip properties and the operational parameters of the machine on these features are then analyzed. The obtained information can be used in the development of steel leveler maintenance.

5:00 ***Reliable Detection of a Variance Increase in a Critical Process Variable***
Mika Pylvänäinen and Toni Liedes (University of Oulu, Finland)
Failures in an industrial process can often be seen as a variance increase in a measured process variable. In order to prevent serious and costly process breakdowns it is crucial to reliably identify such an abnormal variance increase from its normal behavior. The objective of this research was to investigate if stochastic Autoregressive Moving Average, abbreviated ARMA, and Generalized Autoregressive Conditionally Heteroscedastic, abbreviated GARCH, time series modelling are feasible methods for reliable detection of gradually increasing variance in the process variable. Case study was conducted for reliable detection of increased pressure variance that indicates a harmful air leakage in a vacuum chamber in a paper machine. Gradually increasing variance in the chamber pressure was artificially created and a combined ARMA+GARCH time series model was fitted to it and the variance vector was determined. An abnormally high variance was detected from the variance vector by a specified detection limit and a detection sensitivity. According to the simulation results, by controlling the variance vector extracted from the combined ARMA+GARCH time series model, a very slight variance increase in the process variable can be detected more reliably than detecting it from the moving variance vector computed directly from the process variable.

5:20 ***Formal Verification of Multifunction Vehicle Bus***
Lianyi Zhang, Duzheng Qing and Lixin Yu (Beijing Simulation Center, P.R. China); Mo Xia (Tsinghua University, P.R. China); Han Zhang and Zhiping Li (Beijing Simulation Center, P.R. China)
Multifunction Vehicle Bus (MVB) is a crucial component in the Train Communication Network, which is widely used in most of the modern train control systems. How to ensure correctness of MVB has become an important issue. The study described in this paper aims at formal verification of the Master Transfer protocol of MVB, and provides a complete system modelling and specification technique for verification. The MVB system model is described using communicating finite state machine (CFSM) and specification properties are translated from Live Sequence Charts (LSCs). Based on formal modelling and SPIN model checking tool, the system simulation and specification verification have been achieved. Experiments results with SPIN illustrate effectiveness of our approach.

Tue.PM3.E: Chemical Process Systems Simulation

Room: E

Chairs: Britt M.E. Moldestad (University College of Southeast Norway, Norway), Teemu Sihvonen (VTT Technical Research Centre of Finland Ltd., Finland)

4:00 ***Modelling and Simulation of PtG Plant Start-Ups and Shutdowns***
Teemu Sihvonen, Jouni Savolainen and Matti Tähtinen (VTT Technical Research Centre of Finland Ltd., Finland)
As the share of renewable energy sources increases the need for energy storages increases also due to fluctuating nature of renewables (solar and wind). Power-to-Gas (PtG) is one a promising energy storing concept. In PtG process renewable electric energy is used to produce hydrogen via electrolysis. Hydrogen is used together with carbon dioxide in methanation process to produce storable methane. Automation and operation logics of PtG plant have been in the minority in the literature. In this work we have studied start-up and shutdown logics of a PtG plant with dynamic simulations. With this approach we have identified development needs for such logics.

4:20 ***Simulation of Particle Segregation in Fluidized Beds***
Janitha Bandara, Britt M.E. Moldestad, Marianne Eikeland and Rajan Thapa (University College of Southeast Norway, Norway)
Fluidization technology is widely used in solid processing industry due to the high efficiency, high heat and mass transfer rate and uniform operating conditions throughout the reactor. Biomass gasification is an emerging renewable energy technology where fluidized bed reactors are more popular compared to fixed bed reactor systems due to their scalability to deliver high throughput. Fluidization of large biomass particles is difficult, and the process is therefore assisted by a bed material with higher density. The combination of different types of particles makes it challenging to predict the fluid-dynamic behavior in the reactor. Computational particle fluid dynamics (CPFD) simulations using the commercial software Barracuda VR were performed to study the fluidization properties for a mixture of particles with different density and size. The density ratio for the two types of particles was six, which is the typical ratio for bed material to biomass in a gasifier. The results from simulations with Barracuda VR regarding bed pressure drop and the minimum fluidization velocity, show good agreement with available experimental data. The deviation between experimental data and simulations are less than 12%. Particle segregation was clearly observed both in the simulations and in the experimental study.

4:40 ***Dynamic Model of an Ammonia Synthesis Reactor Based on Open Information***
Bernt Lie, Asanthi Jinasena and Bjorn Glemmestad (University College of Southeast Norway, Norway)
Ammonia is a widely used chemical, hence the ammonia manufacturing process has become a standard case study in the scientific community. In the field of mathematical modeling of the dynamics of ammonia synthesis reactors, there is a lack of complete and well documented models. Therefore, the main aim of this work is to develop a complete and well documented mathematical model for observing the dynamic behavior of an industrial ammonia synthesis reactor system. The model is complete enough to satisfactorily reproduce the oscillatory behavior of the temperature of the reactor which has been reported for certain industrial ammonia synthesis reactors.

5:00 ***Comparison of OpenFoam and ANSYS Fluent***
Prasanna Welahetti and Knut Vaagsaether (University College of Southeast Norway, Norway)
Gas-gas single phase mixing were numerically evaluated with static mixer and without static mixer using OpenFoam and ANSYS Fluent codes. The main goal was the gas-gas mixing simulation comparison between ANSYS Fluent and OpenFoam. The same ANSYS mesh was used for each case in both codes. The "reactingFoam" solver and species transport models were used for handling the species in OpenFoam and ANSYS Fluent respectively. The reactingFoam solver is a transient solver and ANSYS Fluent simulated at steady state condition. Standard k-ε model was used to predict the turbulence effect in both Computational Fluid Dynamics codes. OpenFoam gave higher mixing level compared to ANSYS Fluent. Chemical species momentum predictions are more diffusion in OpenFoam and more convective in ANSYS Fluent.

5:20 ***Impact of Particle Diameter, Particle Density and Degree of Filling on the Flow Behavior of Solid Particle Mixtures in a Rotating Drum***
Sumudu Karunarathne (University College of Southeast Norway, Norway); Chameera Jayarathna (Tel-Tek, Norway); Lars-Andre Tokheim (University College of Southeast Norway, Norway)
Two-dimensional CFD simulations were performed to investigate the impact of density, particle diameter and degree of filling on the flow behavior of a solid particle mixture in a transverse plane of a rotary drum. The Eulerian approach with kinetic theory of granular flow was used to simulate granular phases of CaCO3 and Al2O3 under the rolling mode. The volume fractions of each phase reveal that, under the considered conditions, the particle size has a greater impact on segregation than the density. Larger particles are collected at the bottom of the rotating drum while smaller particles move more into the mid-section of the bed. The active layer is responsible for the segregation owing to the trajectory mechanism. Particle segregation due to percolation is more dominant than segregation due to condensation. In addition to that, solids volume fraction variations in the moving bed indicate that the influence of the degree of particle filling made no significant impact on the degree of mixing in the rotating drum.

Wednesday, September 14, 09:00 - 10:00, Wed.AM1.A:

Plenary, Room A, Chairs: Lars Eriksson (Linköping University, Sweden), Antonio Vitale (Italian Aerospace Research Centre, Italy)

Part 1: Autonomous Driving and Levels of Automation,

Part 2: Situation Awareness and Early Recognition of Traffic Maneuvers

Dr Galia Weidl

Daimler AG, Germany
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Situation Awareness and Early Recognition of Traffic Maneuvers

Galia Weidl (Daimler AG, Germany); Anders Madsen (HUGIN EXPERT A/S, Aalborg University, Denmark); Viacheslav Tereshchenko, Wei Zhang and Stevens Wang (University of Stuttgart, Germany); Dietmar Kasper (Daimler AG)

We outline the challenges of situation awareness with early and accurate recognition of traffic manoeuvres and how to assess them. This includes also an overview of the available data and derived situation features, handling of data uncertainties, modelling and the approach for manoeuvre recognition. An efficient and effective solution, meeting the automotive requirements, is successfully deployed and tested on a prototype car. Test driving results show that earlier recognition of intended manoeuvre is feasible on average 1 second (and up to 6.72 s) before the actual lane marking crossing. The even earlier manoeuvre recognition is dependent on the earlier recognition of surrounding vehicles.

Biography

Galia Weidl obtained the MSc.degree in physics and mathematics from St.Petersburg State University, Russia, in 1993, and Fil.Lic. degree in theoretical physics from the University of Stockholm, Sweden, in 1996, and a Tekn.Dr. degree in process engineering from Mälardalen University, Sweden in 2002. Until 2006 she held a postdoctoral appointment at Stuttgart University, Germany. She has held appointments with the research teams at ABB Sweden (1997-2002), Bosch (2006-2008) and Daimler (since 2008). Her current research topic focuses on Bayesian networks in the area of autonomous driving. Galia Weidl was appointed in June 2015 by the European Commission as invited independent expert for Horizon2020.

Wednesday, September 14, 10:30 - 12:30

Wed.AM2.A: Control and Planning in Transportation Systems

Room: A

Chairs: Lars Eriksson (Linköping University, Sweden), Miguel Mujica Mota (Amsterdam University of Applied Sciences, The Netherlands)

10:30 ***MAKE SPACE!: Simulating the A380 Operations in Mexico City Airport***
Miguel Mujica Mota (Amsterdam University of Applied Sciences, The Netherlands); Catya Zuniga (UNAQ, Mexico); Geert Boosten (Amsterdam University of Applied Sciences, The Netherlands)
— Recently, the super heavy A380 started operations between Mexico City and Paris, and it has been announced daily operations in March. In addition, Lufthansa and Emirates are also willing to use the A380 to operate from Frankfurt and Dubai to Mexico, respectively. However, Mexico City International Airport has been reporting severe congestion problems and it is a concern whether these problems can be overcome with the current facilities and procedures together with the increasing super heavy aircraft demand. In this article, a capacity analysis of the operation performed in the airport is presented using information for a particular high season day. A model-based approach which allows simulating daily operation of the A380 is presented. This approach allows to incorporate most of the restrictions besides the stochasticity inherent to the system.

10:50 ***Implementation of an Optimization and Simulation Based Approach for Detecting and Resolving Conflicts at Airports***
Paolo Scala and Miguel Mujica Mota (Amsterdam University of Applied Sciences, The Netherlands); Daniel Delahaye (ENAC, France)
In this paper is presented a methodology that uses optimisation together with simulation techniques applied to a conflict detection and resolution problem at airports. This approach provides more robust solutions to operative problems, since, optimization allows to come up with optimal or suboptimal solutions and, on the other hand, simulation allows to take into account other aspects as stochasticity and interactions between entities. The Airport was modelled following a holistic approach, including both airspace (terminal manoeuvring area), and airside (runways, taxiways, and terminals). In this framework, different restrictions such as speed, separation minima between aircraft, and capacity of airside components were taken into account. The objective of this work is to detect and resolve conflicts both in the airspace and in the airside and have a balanced traffic load on the ground.

11:10 ***A Causal Model for Air Traffic Analysis Considering Induced Collision Scenarios***
Marko Radanovic (Autonomous University of Barcelona, Spain); Miquel Piera (Universitat Autònoma de Barcelona, Spain)
Present research in Air Traffic Management (ATM) systems tries to improve airspace capacity accessibility and efficiency while reducing the management costs and preserving (or increasing) safety performance indicators. The discretization of dynamic aircraft trajectories in a sequence of 4D waypoints (latitude, longitude, altitude and time stamp) specifying a contract between the Airspace User (AU) and the ATM in which the aircraft should be located at a given time stamp on a particular airspace waypoint opens a huge scope of application areas for decision support tools (DSTs). This paper presents causal model of an induced collision scenario, generated by the Traffic alert and Collision Avoidance System (TCAS) logic, in terms of pair-wise encounters. It provides a unit case simulation and tries to introduce a new approach through the Colored Petri Net (CPN) formalism. Present ATM DSTs cannot tackle this type of problems, so they are avoided by over-constraining the minimum distance between trajectories which usually impact on an increment on latent airside capacity and penalties on several KPIs. The proposed model provides a better understanding of the geometry of collision trajectories which is the baseline for the simulation of new conflict-free resolution strategies that could be automated in the future DSTs.

11:30 ***Multi-Sourcing and Quantity Allocation under Transportation Policies***
Aicha Aguezzoul (University of Lorraine, France)
Multi-sourcing, inventory, and transportation management are among the major levers of a supply chain. In this paper, we study the case of multi-sourcing problem by considering the transportation policies used between suppliers and a buyer. Thus, we propose a programming model that determines the optimal order quantities to allocate to the suppliers used, according to the direct or indirect shipment. The objective to minimize in the model is the total logistics cost which is composed of purchasing, inventory, and transportation costs. The constraints related to suppliers, and buyer are considered. A comprehensive example is provided to illustrate the model under some scenarios.

11:50 ***Controlling Emergency Vehicles in Urban Traffic with Genetic Algorithms***
Monica Patrascu, Vlad Constantinescu and Andreea Ion (University Politehnica of Bucharest, Romania)
Emergency officers could often benefit from a route planning system that is based on constant traffic monitoring and complex decision making, seeking to give victims another breath of hope by assisting emergency units with reaching them on time. The main challenge is providing responses in a continuously evolving environment within a prescribed time frame, while using limited resources and information that is often incomplete or uncertain. This paper presents a route control concept for emergency vehicles through high urban traffic. The proposed genetic controller is designed to dynamically reassess the route while the vehicle passes through the road network, continuously generating new routes based on current traffic. The algorithm is tested in an agent based simulation model that includes both traffic participants and a distributed traffic control system.

12:10 ***Simulation Environment for Development of Unmanned Helicopter Automatic Take-off and Landing on Ship Deck***
Antonio Vitale and Davide Bianco (Italian Aerospace Research Centre, Italy); Gianluca Corraro (Italian Aerospace Research Centre (CIRA), Italy); Angelo Martone (Italian Aerospace Research Centre, Italy); Federico Corraro (CIRA, Italy); Alfredo Giuliano and Adriano Arcadipane (Finmeccanica - Helicopter Division, Italy)
Helicopter take-off and landing operations on ship carrier are very hazardous and training intensive. Guidance, Navigation and Control algorithms can help pilots to face these tasks by significantly reducing the workload and improving safety level. The design and verification of such algorithms require the availability of suitable simulation environments that shall be as simple as possible, to enhance physical understanding and lower the computational load. On the other hand, the simulation models shall be sufficiently accurate for catching all the relevant phenomena that can affect helicopter behavior. Developing such simulation environment is not trivial, especially for the considered application, where complex interactions between the ship and the helicopter shall be taken into account. This paper presents the simulation models developed by the Italian Aerospace Research Centre and Finmeccanica to support the design, verification and validation of helicopter trajectory generation and tracking algorithms for automated take-off and landing on a frigate deck. The process for generation and testing of the code to be integrated into the real-time Software-In-the-Loop simulator is also described. The implemented simulation environments contributed to reduce algorithms design time, risks and costs. The developed algorithms were successfully demonstrated in flight.

Wed.AM2.B: Water and Wastewater

Room: B

Chairs: Jesus Zambrano (Mälardalen University, Sweden), Mika Liukkonen (University of Eastern Finland, Finland)

10:30 ***A Simplified Model of an Activated Sludge Process with a Plug-Flow Reactor***

Jesus Zambrano (Mälardalens Högskola, Sweden); Bengt Carlsson (Uppsala University, Sweden); Stefan Diehl (Lund University, Sweden); Emma Nehrenheim (Mälardalens Högskola, Sweden)

The analysis of a simplified activated sludge process (ASP) with one main dissolved substrate and one main particulate biomass component has been conducted with respect to its steady-state. The ASP is formed by a plug-flow reactor (PFR) and a settler with the recycling going to the reactor. The biomass growth rate is described by a Monod function. For this process, it is not possible to get an explicit expression for the effluent substrate concentration when the process is subject to a fixed sludge age. However, in the normal case when the influent substrate concentration is much greater than the effluent substrate concentration, then an explicit approximation for the effluent as a function of the influent and the process parameters is obtained. This work includes numerical examples considering two models for the settler. One model is the ideal settler, which assumes a complete thickening of the activated sludge through the underflow of the settler. The other model takes into account hindered settling and sludge compression. Numerical results show the effectiveness and the limitations of the proposed solution under these scenarios.

10:50 ***Industrial Model Validation of a WWT Bubbling Fluidized Bed Incinerator***

Souad Rabah (University of Picardie Jules Verne & ESIEE-Amiens, France); Mohammed Chadli (UPJV, France)

The environmental concern has significantly raised and specially in the case of bioprocess industries where new standards are more restrictive. In this context, areas of new research have been developed to enhance biological treatment processes productivity and reduce toxicity. In order to ensure the control of the incineration variables, a describing model should be determined. In the previous work, we presented multi variable identification results relative to SIAAP incineration process. This paper concerns model validation of a fluidized-bed incineration furnace by different quality criteria. In this case, our focus is on production phase defined by two incineration modes. Thus, the observed data of each model is compared with the predicted data using quality criteria.

11:10 ***A Variogram-Based Tool for Variable Selection in a Wastewater Treatment Effluent Prediction***

Markku Ohenoja and Jani Tomperi (University of Oulu, Finland)

In this study, a variogram method was utilized as a variable selection tool to find the optimal subsets of variables for developing predictive models for the quality of wastewater treatment effluent. The quality of effluent was here assessed by biological and chemical oxygen demand and suspended solids in biologically treated wastewater. The dataset included in addition to traditional process measurements the results of a novel optical monitoring device which was used for imaging an activated sludge process in-situ during a period of over one year. The study showed that the variogram based method has potential in fast and computationally easy variable selection. The developed models can be used for proactive monitoring and estimating the quality of effluent in several stages hours before in comparison to laboratory analysis taken from treated wastewater.

11:30 ***Water Content Analysis of Sludge Using NMR Relaxation Data and Independent Component Analysis***
Mika Liukkonen (University of Eastern Finland, Finland); Ekaterina Nikolskaya, Jukka Selin and Yrjö Hiltunen (Mikkeli University of Applied Sciences, Finland)
In wastewater treatment, the dewatering of sludge is one of the most important steps, because it affects largely in both the process economics and the costs of sludge disposal. To optimize the dewatering processes, it would be beneficial to be aware of the different water types present in the sludge. In addition to free water, generally there are also mechanically, physically and chemically bound water within the sludge. All these water types behave differently when the sludge is dried, and they all require a different amount of energy when being removed. In this study, the Independent Component Analysis (ICA) method has been applied to an analysis of spectral data obtained from the measurement of wastewater sludge samples with a known moisture content. The results strongly suggest that the ICA method can be used for determining the amount of different water types within the wastewater sludge without a priori knowledge on their shares.

11:50 ***Monitoring Suspended Solids and Total Phosphorus in Finnish Rivers***
Mauno Rönkkö and Okko Kauhanen (University of Eastern Finland, Finland); Jari Koskiaho and Niina Kotamäki (Finnish Environment Institute, Finland); Maija Ojanen (MIKES & Centre for Metrology and Accreditation, Finland); Teemu Näykki (Finnish Environment Institute, Finland); Markku Ohenoja and Esko K. Juuso (University of Oulu, Finland); Petri Koponen and Ville Kotovirta (VTT Technical Research Centre of Finland, Finland)
Monitoring of water quality should not be solely based on laboratory samples. Such activity, although producing reliable results, cannot provide an accurate enough temporal coverage for water quality monitoring. The Finnish Environment Institute, SYKE, has therefore established numerous online water monitoring stations that continuously monitor water quality. The problem with the automatic monitoring, however, is that the recorded values are not reliable as such and need to be subject to quality control and uncertainty estimation. Here, as the main contribution, we present a computational service that we have implemented to automate and integrate the water quality monitoring process. We also present a case study regarding the river Väänteenjoki and discuss the obtained uncertainty results and their implication.

12:10 ***Monitoring a Secondary Settler Using Gaussian Mixture Models***
Jesus Zambrano (Mälardalens Högskola, Sweden); Oscar Samuelsson (IVL Swedish Environmental Research Institute, Sweden); Bengt Carlsson (Uppsala University, Sweden)
This paper presents a method for monitoring the sludge profiles of a secondary settler using a Gaussian Mixture Model (GMM). A GMM is a parametric probability density function represented as a weighted sum of Gaussian components densities. To illustrate this method, the current approach is applied using real data from a sensor measuring the sludge concentration as a function of the settler level at a wastewater treatment plant (WWTP) in Bromma, Sweden. Results suggest that the GMM approach is a feasible method for monitoring and detecting possible disturbances of the process and fault situations such as sensor clogging. This approach can be a valuable tool for monitoring processes with a repetitive profile.

Wed.AM2.C: Object-Oriented Technologies of Computer Modelling and Simulation of Complex Dynamical Systems

Room: C

Chairs: Yuri Senichenkov (State Saint Petersburg Polythecnic University, Russia), Lev Utkin (Peter the Great Saint-Petersburg Polytechnic University, Russia)

10:30 ***Method to Develop Functional Software for NPP APCS Using Complex Mathematical Modeling of NPP in SimInTech***

Alexander Shchekaturov (Moscow State Technical University named Bauman & 3V Services LLC, Russia); Ilya Kubenskiy, Konstantin Timofeev and Nikita Chernetsov (3V Services, Russia)

The SimInTech environment developed in Russia enables through-design of the algorithmic part of APCS for nuclear power plants (NPP), including the all-mode mathematical modeling of production process dynamics, debugging and optimizing control algorithms on an object model, generating functional software (FSW) as well as developing interfaces of the operator control panel. The article describes some of the main methods and approaches applied for the collective development of NPP APCS FSW. The implementation of the method during the development of APCS for Balokovo NPP-1 reactor compartment is presented as an example. Also, second example is design of an universal nuclear icebreaker (UNI) where methodology is used.

10:50 ***Object-Oriented Modeling with Rand Model Designer***

Yuri Senichenkov (Peter the Great St. Petersburg Polytecnic University); Yuri Kolesov (Peter the Great Saint Petersburg Polytechnic University, Russia)

Rand Model Designer is a modern tool for modeling and simulation hierarchical multicomponent event-driven dynamical systems. It utilizes UML-based object-oriented Model Vision Language for designing dynamical and hybrid systems, and large-scale multicomponent systems: control systems with "inputs-outputs", "physical" systems with "contacts-flows", and novel variable structure component systems, particularly "agent" systems. The Rand Model Designer tool attempts to combine the strengths of both directions: supporting the "physical modeling" suggested in Modelica language, while using object paradigm and states machine of UML language. RMD can build: a. Elementary continuous models described by NAE, ODE, DAE. b. Hybrid systems described using hybrid automata- UML state machines without parallel activities . Furthermore, RMD includes an option for keeping the specifications of any complex model as a class. c.Hierarchical multi-component models with components with the "input-output" and internal hybrid automata. d.Multi-component models with non-oriented "a la Modelica" components with two significant additions: •component hybrid automata may have continuous behavior, expressed as equation systems of any size and any type (NAE, ODE, DAE); •equations, corresponding to component hybrid automata are created "on the fly" during model running. e.Multi-component models with variable structure ("agent-based models"). Trial version of RMD 7 is available at www.mvstudium.com.

11:10 ***Rand Model Designer's Numerical Library***

Yuri Senichenkov (Peter the Great St. Petersburg Polytecnic University); Isakov Andrey (Peter the Great St. Petersburg Polytechnic University, Russia)

Numerical Libraries of visual simulation environments differ from those of specialized collections of software implementations of numerical methods by means of the heuristic control program designed for automatic selection of numerical methods, accuracy control, and identification the specific features of systems of algebraic,ordinary differential and differential-algebraic equations on a local trajectories of the event-driven dynamic systems. Rand Model Designer environment contains a traditional library of software implementation of numerical methods (Fortran programming language), and a control module (C ++ programming language), which allows selection of specific solution methods for systems of equations on a given trajectory. In addition to solution of equations on trajectories it is also necessary to analyze the structure of the equations, to simplify the construction of the system, eliminating the variable "links", to determine state "switch-points" of event-driven systems, to ensure consistent initial conditions and to reduce index for differential-algebraic equations, as well as to determine the initial approximations for iterative methods. In this article we have tried to thoroughly describe the process of building, conversion, and numerical solution of systems of equations generated by Rand Model Designer (RMD - www.mvstudium.com).

11:30 ***Adaptive Robust SVM-based Classification Algorithms for Multi-Robot Systems Using Sets of Weights***

Lev Utkin (Peter the Great Saint-Petersburg Polytechnic University, Russia); Vladimir Zaborovski (Peter the Great Saint-Petersburg Polytechnic University); Popov Serge (St. Petersburg State Polytechnical University, Russia)

Three adaptive iterative minimax multi-robot system learning algorithms are proposed under condition that every observation obtained from robots is set-valued, i.e., it consists of several elements. The set-valued data are caused due to a fact that robots in the system provide different measurements in a single system observation. The first idea underlying the algorithms is to use sets of weights or imprecise weights of a special form for all elements of training data. The second idea is to apply the imprecise Dirichlet model for iterative updating the sets of weights depending on the classification accuracy and for assigning new weights to robots for improving classifiers. The simplest first algorithm is a modification of the SVM in order to take into account set-valued data. The second algorithm is the AdaBoost with the modified SVM under set-valued data. The third algorithm is the modification of the AdaBoost with updating imprecise weights of robots.

11:50 ***Network-Centric Control Methods for a Group of Cyber-Physical Objects***

Vladimir Muliukha (Peter the Great St. Petersburg Polytechnic University & Russian State Scientific Center for Robotics and Technical Cybernetics, Russia); Alexey Lukashin (St. Petersburg State Polytechnical University, Russia); Alexander Ilyashenko (Saint-Petersburg State Polytechnical University, Russia); Vladimir Zaborovski (Regional University & Science Network, Russia)

In the paper we propose to use network-centric approach for a control task. Robots are described as cyber-physical objects that consist of two parts: mechatronic and informational. All cyber-physical objects are connected with each other using special multiprotocol nodes - devices that can route data between different types of computer networks (Ethernet, WiFi, 3G, LTE). Such network is described by hypergraph model, where central node is a hybrid cloud computer. While all robots are connected together, logical and computational tasks for cyber-physical objects are processed by this high performance node like in the central control system. Without a connection with central node robot switches into a multiagent mode.

12:10 ***Solving Stiff Systems of ODEs by Explicit Methods with Conformed Stability Domains***

Anton Novikov (Siberian Federal University & Intistute of Computational Modelling, Russia); Yury Shornikov (Novosibirsk State Technical University, Russia); Mikhail Rybkov andLyudmila Knaub (Siberian Federal University, Russia)

The Cauchy problem for a stiff system of ODEs is considered. The explicit m-stage first order methods of the Runge-Kutta type are designed with stability domains of intermediate numerical schemes conformed with the stability domain of the basic scheme. Inequalities for accuracy and stability control are obtained. A numerical algorithm based on the first-order method and the five-stage fourth order Merson method is developed. The algorithm is aimed at solving large-scale systems of ODEs of moderate stiffness with low accuracy. It has been included in the library of solvers of the ISMA simulation environment. Numerical results showing growth of the efficiency are given.

Wed.AM2.D: Energy Supply for Buildings & Data Analysis
Room: D
Chairs: Konstantinos Kyprianidis (Mälardalen University, Sweden), Petri Hietaharju (University of Oulu, Finland)

10:30 ***Peak Load Cutting in District Heating Network***
Petri Hietaharju and Mika Ruusunen (University of Oulu, Finland)
Simulations of different peak load cutting scenarios in district heating of buildings were performed. Decrease in percentages of 30%, 50%, and 70% in peak loads was analyzed for the two modelled apartment buildings. Simulation results show that even 70% peak load cuts are possible in individual buildings. However, results also reveal that for some buildings 30% peak load cuts would require compromising with the indoor temperature. Therefore, it is important to take into account the different heat storing capacities available in each of the buildings. In future, systems with multiple buildings will be studied to effectively utilize individual heat storing capacities to cut city level peak loads. Simulations presented in this article show that better energy efficiency in district heating can be achieved by predicting the energy consumption and utilizing thermal mass of a building.

10:50 ***Modular Model Predictive Control Concept for Building Energy Supply Systems: Simulation Results for a Large Office Building***
Barbara Mayer (FH JOANNEUM GmbH & FH JOANNEUM GmbH, Austria); Michaela Killian and Martin Kozek (Vienna University of Technology, Austria)
This paper proposes a modular predictive control concept (MPCC) designed for a flexible usage in energy supply systems (ESS) building automation. One appropriate model predictive controller (MPC) is added for each cooling and heating supply circuit to the individual building's control structure. A specifically developed mixed-integer MPC is applied for those circuits considered as hybrid systems incorporating switching aggregates (heat pump, chiller) with latency times and stratified storage. The resulting MPCC is capable of maximising the usage of renewable energy sources at minimum cost as well as efficiently managing switching aggregates with active storage while providing the energy demand of the consumption zone. Suitable modelling of the linear and hybrid systems is demonstrated and validated on the example of a large office building in Austria. Furthermore, a simulation study shows the performance of the resulting MPC concept compared to a rule-based controller.

11:10 ***Study of Different Climate and Boundary Conditions on Hygro-Thermal Properties of Timber-Framed Envelope***
Filip Fedorik and Raimo Hannila (University of Oulu, Finland); Antti Haapala (University of Eastern Finland, Finland)
The present paper deals with a study of different climate effects and defining boundary conditions on mould growth risk inside building envelope. The case structure represents a common envelope of timber-framed single-family house. Weather conditions from Utsjoki, Oulu and Joensuu are considered in the analysis representing climate gradients wet and dry, coastal and inland conditions during a period of 6 years. Mould growth initiation and progression require a sufficiently high humidity at suitable temperature range. Coastal regions characteristically have humid and warm climate that causes higher risk for mould growth than the more dry inland locations. The most unfavourable conditions for mould growth were seen in the coldest and the northernmost location. Hygro-thermal simulation also presented significant differences in key interior boundary conditions that, considering standard approach, may be interpreted as potential structural health issues.

11:30 ***Evaluation of Structural Costs in Building. Simulation of the Impact of the Height and Column Arrangement***
Javier Ferreiro-Cabello and Esteban Fraile-García (University of La Rioja, Logroño, Spain); Emilio Jiménez Macías and Eduardo Martinez de Pison Ascacibar (University of La Rioja, Spain)
Modeling is a useful tool for decision making in the project phases. In the case of reinforced concrete structures we must be able to locate representative parameters in order to optimize costs. This paper assesses the impact of the column arrangement and building height. The variation of the costs for the foundation and two floor interaxis are discussed. The results are assessed by the ratio of cost per square meter executed. The optimization of the geometry of the building is determined by the interais distances and the selected structural thickness. In the case studied the arrangement of the pillars in a 6x6 meters grid using 4 heights offers the best economic results.

11:50 ***Semi Discrete Scheme for the Solution of Flow in River Tinnelva***
Susantha Dissanayake and Bernt Lie (University College of Southeast Norway, Norway); Roshan Sharma (University College of South east Norway, Norway)
The Saint-Venant equation is a mathematical model which could be used to study water flow in an open channel, river etc. The Kurganov-Petrova (KP) method, which is a second order scheme, is used to solve the Saint-Venant equations with good stability. Water flow of a river between two hydropower stations in Norway has been simulated in this study using MATLAB and OpenModelica. The KP scheme has been used to discretize the Saint-Venant equations in spatial domain, yielding a collection of Ordinary Differential Equations (ODEs). These are then integrated with time using the variable step-length solvers in MATLAB: ode23t, ode23s, ode45, and fixed step-length solvers: The Euler method, the second and fourth order Runge Kutta method (RK2 and RK4). In OpenModelica built-in, variable step-length DASSL solver has been used. From the simulation, it was observed that all solvers produce more or less similar results. Volumetric flowrate calculation indicated numerical oscillation with variable step-length solvers in MATLAB. The results indicated that it is reasonable to match the order of the space and time discretization.

12:10 ***Preprocessing Methods for Load Profile Clustering***
Anna Frost (Mälardalen University & Svenska Energigruppen AB, Sweden)
Different averaging and normalizing processes are surveyed and tested on real world load pattern time series before clustering. The averaging and normalizing was done for three different temporal resolutions. The processed data is clustered with the k-means clustering algorithm and evaluated with the silhouette value and the Davies-Bouldin index. The results vary a lot, though normalizing by max- and min-values of the data to linearly map it to $[0,1]$ shows the worst performance of the normalization methods in general. Higher temporal resolution did not improve the results. No clear difference was found between averaging with the mean or the median.

Wed.AM2.E: Industrial Processes: Capture Processes, Manufacturing

Room: E

Chairs: Gasper Music (University of Ljubljana, Slovenia), Juhani Heilala (VTT Technical Research Centre of Finland Ltd, Finland)

10:30 ***Simulation of Glycol Processes for CO2 Dehydration***

Lars Øi and Birendra Rai (University College of Southeast Norway, Norway)

Water must be removed from CO2 prior to transport or storage to avoid corrosion and hydrate formation. Absorption into triethylene glycol (TEG) followed by desorption is the traditional gas dehydration method, and is expected to be the preferred method for large scale CO2 dehydration. There is no agreement on the level of accepted water content after dehydration, and the specifications vary normally in the range between 5 and 500 ppm (parts per million by volume). In literature, it is claimed that use of solid adsorbents is necessary to reduce the water content to below 30 or 10 ppm. In this work, simulations in Aspen HYSYS demonstrate that it is possible to obtain below 1 ppm water using a traditional glycol dehydration process including an extra stripping column. The models Peng-Robinson (PR) and Twu-Sim-Tassone (TST) with updated parameters in Aspen HYSYS version 8.0 are used. A Drizo process using a stripping gas which is later condensed and recirculated is also simulated, and this process also achieves a water content below 1 ppm.

10:50 ***Cost Optimization of Absorption Capture Process***

Lars Øi and Cemil Sahin (University College of Southeast Norway, Norway)

In this work, a CO2 absorption process using aqueous monoethanol amine (MEA) as solvent for a post combustion capture plant was simulated using Aspen HYSYS. Focus was on energy saving and cost optimization. An Aspen HYSYS spreadsheet was used for equipment dimensioning, cost estimation and cost optimization. A standard process and a vapor recompression process for 85 % CO2 removal were simulated using the Li-Mather thermodynamic model. The energy consumptions and the total cost were calculated and compared. Cost optimum process parameters were calculated from sensitivity analysis. The vapor recompression process was shown to be both energy and cost optimum. With 20 years calculation period, the cost optimum absorber packing height was 16 meter, optimum temperature approach was 14 K and optimum recompression pressure was 130 kPa. The optimum values varied only slightly when different cost factors were changed. With 10 years calculation period, the optimum values for the same parameters were 16 meter, 17 K and 140 kPa.

11:10 ***Principal Component Analysis Applied to CO2 Absorption by Propylene Oxide and Amines***

Wathsala Nayanarajini Jinadasa, Maths Halstensen, Carlos Pfeiffer and Klaus J-Jens (University College in South East Norway, Norway); Sara Ronasi (Norner AS, Norway);Carlos Barreto (Norner Research AS, Norway)

Carbon dioxide absorption by mixtures of propylene oxide / polypropylene carbonate at 600C was monitored by Raman spectroscopy at 20, 40 and 60 bar in a 2 L autoclave reactor. Multivariate preprocessing techniques were used to process raw Raman spectra and Principal Component Analysis was performed. Simulation data from the Peng-Robinson equation of state were used to model the absorbed CO2 amount and spectroscopic signals. Results showed that Principal Component Analysis can be used to explore the dynamics of the system at different pressure levels and to track the CO2 absorption. A similar analysis was carried out to monitor CO2 absorption by four different amines at room temperature and pressure in a batch reactors. The CO2 content was determined from titration and was used to model the spectroscopic data. Principal Component Analysis proved to be able to identify CO2 absorption capacity in the amines. This feasibility study confirms that Raman spectroscopy together with multivariate analysis can effectively report chemical information and dynamics in these CO2 absorption systems and hence can be used for developing regression models for online monitoring and control.

11:30 ***Fuzzy Modelling of Air Preparation Stage in an Industrial Exhaust Air Treatment Process***
Ales Sink (Inea, Slovenia); Gasper Music (University of Ljubljana, Slovenia)
The paper is focused on practical aspects of advanced nonlinear identification method when applied to a real industrial process. Fuzzy identification is used to model the air preparation stage within a system for reducing nitrogen oxides (NOx) emissions in exhaust air, which comes from the dryers and ovens in a factory of automotive catalytic converters. The system for NOx emissions reduction efficiently operates only in predetermined temperature and air flow ranges of the exhaust air. Due to those conditions, exhaust air from the dryers and ovens must be prepared in advance by controlling the fan speed and fresh air and exhaust air dampers positions. At the same time operating conditions of dryers and ovens should be maintained within defined ranges. Currently used control system of the exhaust air preparation shows some deficiencies, so a feasibility study of possible improvements has been carried out. Modelling presented in this paper was used to evaluate and compare control solutions. The results show such an improvement is feasible and with minor changes of the controller parameters and supervisory logic settings, the proposed control system can be ready for the implementation on the real process.

11:50 ***Interactive Visual Analytics of Production Data - Predictive Manufacturing***
Juhani Heilala, Paula Järvinen and Pekka Siltanen (VTT Technical Research Centre of Finland Ltd, Finland); Jari Montonen (VTT, Technical Research Center of Finland, Finland); Markku Hentula and Mikael Haag (VTT Technical Research Centre of Finland Ltd, Finland)
Manufacturing creates a lot of data, and this is increasing due to digitalization of manufacturing, industrial Internet of Things (IIoT) and needs for product traceability as well as predictive maintenance. Typically data from production material flow is not analyzed and thus the improvement potential is not found. There is need for interactive analytics tools that can turn raw data from heterogeneous data sources e.g. starting from sensor data, manufacturing IT systems, (e.g. Enterprise Resource Planning, ERP, Manufacturing Execution System, MES and Supervisory Control And Data Acquisition, SCADA), into meaningful information and predictions—and presented on easy-to-use interfaces. This paper presents a feasibility study focusing on interactive visual analytics of manufacturing data set carried out at VTT Technical Research Centre of Finland Ltd.

12:10 ***Concept for Mathematical Models for Subprocesses in the Manufacture of Particleboards***
Carina Pöll and Martin Riegler (Kompetenzzentrum Holz GmbH, Austria); Felix Breitenecker (Vienna University of Technology, Austria)
In this paper a concept for modelling selected subprocesses of the manufacturing process of particleboards is presented. First, the entire process is described briefly, and then special attention is on the stages drying and pressing. Afterwards models for the dryer and press from literature are discussed. Furthermore, a concept for the planned models of the selected stages is presented. The future objective is to use the developed models of different stages of the manufacturing process to control the process using statistical models. Thus the impact of potential measures can be simulated. Finally there is a short conclusion including an outlook on future work.

Wednesday, September 14, 13:30 - 14:15, Wed.PM1.A

Plenary, Room: A, Chairs: Bernt Lie (University College of Southeast Norway, Norway), Markku Ohenoja (University of Oulu, Finland)

Simulating the composition of the atmosphere

Adjunct Professor Harri Kokkola

Atmospheric Research Centre of Eastern Finland
Finnish Meteorological Institute, Finland.
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Climate models are an essential tool when estimating how climate will change in the future. The atmospheric core of these models simulates the circulation of the atmosphere by solving fundamental physical equations of conservation of motion, mass, and energy as well as the equation of state. However, climate is affected also by several other processes than the atmospheric circulation and to get an accurate projection of future climate, it is necessary to incorporate all these processes in the model. Such processes are e.g. cloud formation (warm clouds, ice clouds), cryosphere (ice/snow), land surface (soil, reflectance), biosphere (ecosystems, agriculture), ocean (heat transport). These processes are calculated with individual submodels which are coupled to the core atmospheric model and they are also coupled to each other so that they interact. However, machine learning methods and emulator techniques are emerging in the climate science. We have investigated the potential of these methods to decrease the error coming from simplifications of aerosol processes in global aerosol models. Our results show that machine learning methods can significantly increase the accuracy of coarse aerosol models without significantly increasing their computational burden.

Biography

Harri Kokkola is the group leader of Atmospheric Modeling group at the Research Centre of Eastern Finland, Finnish Meteorological Institute. He is working on atmospheric modeling and aerosol-cloud interactions. The main focus in his research is global scale aerosol-climate modeling and has been one of the main developers of the aerosol-chemistry-climate model ECHAMHAMMOZ. His research group has developed an aerosol microphysics module SALSA which has been implemented in a cloud scale model, an air quality model as well as regional and global climate models. They are also actively involved in AeroCom project which is an open international initiative of scientists interested in the advancement of the understanding of the global aerosol and its impact on climate.

Wednesday, September 14, 14:20 - 15:20

Wed.PM2.A: Panel: Future Energy Systems

Room: A

Chairs: Erik Dahlquist (Mälardalen University, Sweden), Cristian Nichita (University of Le Havre, France)

A thermal power station or a coal fired thermal power plant is by far, the most conventional method of generating electric power with reasonably high efficiency. Technology has reached very high levels and environment is in focus in many ways. Bioenergy takes an increasing portion of the production: a wide variety of materials are used as fuels. Oil and gas hold a very strong position in overall energy usage. Biofuels provide new competing alternatives. CO2 capture has taken a high role in research. Is it important also in practise? Are we going to bioeconomy? Is the thermal power a necessity in our energy balance?

Sustainable or renewable energy is considered as a future source of energy, but it is already strong in many forms: water power is well integrated in the energy system; solar and wind are getting more popular; geothermal, wave and tide energy can be locally very important. Electricity is increasingly popular both in solar and wind power. To what level it is sufficient? Efficiency is not very high in solar panels. Wind power cannot reach sufficient operating hours. We need storages but can we find practical solutions? Solar thermal power plants, especially concentrating technology, provide higher efficiency. There are many feasible solutions to thermal storage. What to use? How to design a system? What is needed in control? There are unavoidable disturbances.

Where do we use energy? Industry needs high reliable levels. Is the nuclear power a solution? Adaptation is easier in domestic use, but how to do it? Heating and cooling take the highest part. Solar energy can help but needs storage. Geothermal can be used as storage. What is the potential of buildings as storages? Do we need small scale CHP? District heating systems are good solutions to bring the thermal energy to buildings. Smart grids have studied mainly for electricity. What do we need for smart thermal grids? In northern areas, we have consumption peaks. Can we cut them with smart adaptation? Traffic is under change: electricity is gaining popularity; interesting biofuels have been introduced; fuel cells are considered as a future option in the way to the hydrogen economy. How to integrate these with sustainable energy? How to choose an operable portfolio from the increasing alternatives of energy production?

Wed.PM2.B->F: Poster Session

2:20 ***Fault Tolerant Control for a Rotary Wing Aircraft***
Gulay Unal and Emre Kiyak (Anadolu University, Turkey)
In this study, a fault tolerant control strategy for a rotary wing aircraft is proposed in the presence of actuator faults. A linear mathematical model which is derived from nonlinear model using MATLAB/Simulink. Observer based state estimation approach which is widely used in fault tolerant area. Generalized Observer Scheme (GOS) based Unknown Input Observer (UIO) is utilized to detect and isolate the actuator faults. In fault-free condition, Linear Quadratic Tracking (LQT) is preferred to stabilize the quadrotor to obtain faster system response. When it comes to faulty case, LQT cannot handle compensation of steady-state error owing to power loss in actuator. Therefore Linear Quadratic Regulator (LQR) with integral action is selected by fault diagnosis unit to compensate steady-state error due to actuator fault. Simulation results are presented to demonstrate the performance of the proposed fault tolerant control strategy.

2:40 ***Actuator Fault Tolerant Control for a Rotary Wing Aircraft***
Emre Kiyak and Ahmet Ermeydan (Anadolu University, Turkey)
Quadrotor is the one of the most popular rotary wing aircraft in control problems. There may be some problems in this system. In this case, quadrotor will not fly and do its duty effectively. In this study, a fault tolerant control strategy for a quadrotor is proposed in the presence of actuator faults. A linear mathematical model which is derived from nonlinear model. Observer based state estimation approach which is widely used in fault tolerant area. Here, this approach is used to detect and isolate faults in a quadrotor system. Generalized Observer Scheme (GOS) based Unknown Input Observer (UIO) is used for the isolation. Simulation results are presented to demonstrate the performance of the proposed fault tolerant control strategy.

Wed.PM2.C: Object-Oriented Technologies of Computer Modelling and Simulation of Complex Dynamical Systems

Room: C

Chairs: Yuri Senichenkov (State Saint Petersburg Polythecnic University, Russia), Anton Novikov (Siberian Federal University & Intistute of Computational Modelling, Russia)

2:20 ***Modelling and Operation Framework for Robotics in High Performance Cloud Computing Environment***

Alexey Lukashin (St. Petersburg State Polytechnical University, Russia); Vladimir Muliukha (Peter the Great St. Petersburg Polytechnic University & Russian State Scientific Center for Robotics and Technical Cybernetics, Russia); Vladimir Zaborovski (Regional University & Science Network, Russia)

Modern computing infrastructure such as cloud computing and high performance computing are opening new opportunities for modelling systems. This paper presents approach to model robotic operations by using actor systems in a distributed environment. Another option of presented approach is a possibility to control robots in a real world to support cyber-physical systems from a computation part. We also describe cyber-physical approach for robot operations and propose implementation of information system to control robots in physical world from a computing cloud. In this paper cloud based framework based on actor systems is presented and described process of evaluation robot behaviour from simulation and lab experiment to real robot control from international space station.

2:40 ***Numerical Algorithm for Design of Stability Polynomials for the First Order Methods***

Evgenyi Novikov (Institute of computational modeling SB RAS, Russia); Mikhail Rybkov (Siberian Federal University, Russia); Anton Novikov (Siberian Federal University & Intistute of Computational Modelling, Russia)

The coefficients determination algorithm for stability polynomials of degree up to m=35 is developed. The coefficients correspond to explicit Runge-Kutta methods of the first accuracy order. Dependence between values of a polynomial at the points of extremum and both size and form of the stability domain is shown. Numerical results are given. The proposed algorithm for design of stability domains increases efficiency of explicit methods. Furthermore, it allows to develop algorithms of alternating order and step for solving problems of moderate stiffness. If the solution behavior of a problem which is to be solved is known, then it is possible to design an integration algorithm with the stability domain suitable for the given class of problems.

Wed.PM2.D: Art and Archaeology

Room: D

Chairs: Felix Breitenecker (Vienna University of Technology, Austria), Niki Popper (dwh Simulation Services, Austria)

2:20 ***Modelling of a New Compton Imaging Modality for an In-Depth Characterisation of Flat Heritage Objects***

Patricio Guerrero Prado (Université de Versailles Saint-Quentin-en-Yvelines & IPANEMA, France); Serge Cohen (IPANEMA CNRS/MCC/UVSQ, France); Maï Nguyen-Verger(University of Cergy-Pontoise, France); Laurent Dumas (Université de Versailles Saint-Quentin-en-Yvelines, France)

Objects having a flattened geometry, such as those encountered in heritage, have always been difficult to be analysed with conventional X-ray tomography methods due to their anisotropic morphology. To overcome the limitations of classical tomography for such samples, we envisage a new imaging modality based on Compton scattering. While Compton effect is usually considered as noise in tomography, in Compton scatter tomography the conditions are set such that this becomes the imaging agent of the image formation process. Our interests are, firstly, to avoid the relative rotation between the object, the source and the detector, and secondly, to be able to obtain in-depth data even when the sample is supported by some deep or dense material by exploiting only back-scattered photons. To replace the information provided by multiple projections angles in classical tomography, we make use of the relation between the energy loss of the scattered photons and its scattering angle, the Compton equation. Modelling of this new modality, image formation and object reconstruction through a filtered back-projection algorithm of a Radon transform on a half-space is presented. The feasibility of this concept is supported by numerical simulations.

2:40 ***Falsification by Modelling and Simulation for Investigations in Hallstatt Archaeology***

Felix Breitenecker (Vienna University of Technology, Austria); Niki Popper (dwh Simulation Services, Austria); Johannes Tanzler (TU Vienna, Austria); Gabriel Wurzer (Vienna University of Technology, Austria)

The prehistoric salt mines of Hallstatt in Austria are subject of great interest for archaeologists. Salt mining activities are dated to 1458-1245 B.C. in the Bronze Age. Modelling and simulation as 'virtual computational experimental archaeology' can contribute important insights into different areas of archaeology as an addition to traditional experimental methods used to find answers for certain questions arising from archaeological findings, e.g. how tools were used or simply why things were the way they were. In a cooperative project between the Natural History Museum Vienna and the Vienna University of Technology, questions regarding prehistoric short-term mechani-cal processes and long-term logistic processes and population dy-namics are analysed by modelling and simulation. This contribu-tion presents three case studies, where modelling and simulation is used to get insight into the prehistoric working processes and underlines a special property of simulation in the area of archae-ology: while classical modelling and simulation aims for verifica-tion of a certain assumptions, modelling and simulation in ar-chaeology partly aims for falsification of assumptions.

Wed.PM2.E: Security and Military

Room: E

Chairs: Bernt M. Åkesson (Finnish Defence Research Agency, Finland), Marcel Müller (University of Applied Sciences Würzburg-Schweinfurt, Germany)

2:20 ***Simulating the Effect of a Class of Sensor Fuzed Munitions for Artillery on a Multiple Target Element System***
Henri Kumpulainen and Bernt M. Åkesson (Finnish Defence Research Agency, Finland)
This paper presents a method for analyzing the effect of a class of artillery-launched sensor fuzed munitions on a target, which is a system consisting of several target elements and a fault logic. The target elements are armored vehicles and the munitions are designed specifically to attack single vehicles. We consider munitions which may contain one or two submunitions. We want to address the following questions: what is the probability of disabling the system given the number of ammunition, and similarly, how much ammunition is needed for disabling the system with a given confidence level. The proposed method is based on Markov chains rather than Monte Carlo simulation.

2:40 ***Modelling and Simulation of a Paraglider Flight***
Marcel Müller and Abid Ali (University of Applied Sciences Würzburg-Schweinfurt, Germany); Alfred Tareilus (Gleitschirmfreunde Unterfranken, Germany)
This paper presents a simulation model of a paraglider flight. We present simulations of a paraglider launch using a vehicle unreeling winch and the subsequent descent under different environmental wind conditions. The physics behind the paraglider trajectory, as well as its twist angle is governed by a complex interplay between gravity and drag force. Differential equations are developed by balancing forces and torques acting on the system. The model allows to compare different flight situations in an easy way and find out the best possible parameters, which can be used for further steps for example optimization of the towing process.

3:00 ***Firing Accuracy Analysis of Electromagnetic Railgun Exterior Trajectory Based on Sobol's Method***
Dongxing Qi, Ping Ma and Yuchen Zhou (Control and Simulation Center, Harbin Institute of Technology, P.R. China)
Firing accuracy is an important index in the performance evaluation of electromagnetic railgun (EMRG). Based on a Six-DOF (degree of freedom) computer model of exterior trajectory, Sobol's method, a global sensitivity analysis approach, is utilized to analyse the influence of multiply model input with uncertainty on the strike accuracy of EMRG projectile. The method utilizes the firing data error and the dispersion error of the projectile, and the input data are sampled by Latin Hypercube Sampling. Furthermore, an example is given, in which Sobol's method is applied in the analysis and calculation of the exterior trajectory. First-order sensitivity and total sensitivity of each factor are obtained, and then we identify the impact mechanism and interaction of different input parameters having on firing accuracy. Finally the results verify that the method is feasible and effective in the process of accurate analysis of EMRG exterior trajectory.

Wednesday, September 14, 15:50 - 17:50

Wed.PM3.A: Gasification and Power Plants

Room: A

Chairs: Britt M.E. Moldestad (University College of Southeast Norway, Norway), Juha Kuronen (Fortum Oyj, Finland)

3:50 ***Riser of Dual Fluidized Bed Gasification Reactor: Investigation of Combustion Reactions***
Rajan Thapa and Britt M.E. Moldestad (University College of Southeast Norway, Norway)
The riser of a dual fluidized bed gasification reactor heats bed materials by burning residual char particles coming from gasification part of the reactor. A validated Computational Particle Fluid Dynamic (CPFD) model is applied to simulate combustion of char particles in a riser of dual fluidized bed gasification reactor in a demonstration plant with 8MWfuel capacity. The plant is located in Güssing, Austria. The three dimensional model is used investigate combustion reaction as a function of bottom, primary and secondary air feed rates. The results show there is a still possibility to improve combustion reaction by optimizing air feed rates, which can maximize the bed material temperature without increasing additional char particles feed.

4:10 ***Screening of Kinetic Rate Equations for Gasification Simulation Models***
Kjell-Arne Solli, Rajan Thapa and Britt M.E. Moldestad (University College of Southeast Norway, Norway)
The energy from biomass can be utilized through the thermochemical conversion process of pyrolysis and gasification. The process involves solid phase and fluid phase interactions. Computational Particle Fluid Dynamics (CPFD) tools are most commonly used for simulations. The chemical processes involved is described by reaction rate expressions and equilibrium constants. These expressions are often not well studied, but rather adapted from previous studies in lack of better knowledge. Methodology and tools are presented to aim in the selection and optimization of rate expressions for a particular process. Simulation tools for reactions in batch or plug-flow conditions are shown suitable to study selected chemical reactions in detail. Results from one such study is compared to CPFD as well as CSTR results of a gasification process. The reaction scheme for the simulation model could be simplified.

4:30 ***Model Predictive Control for Field Excitation of Synchronous Generators***
Thomas oyvang and Bernt Lie (University College of Southeast Norway, Norway); Gunne Hegglid (Skagerak Energi AS, Norway)
This paper describes a Model Predictive Control (MPC) system for voltage control through field excitation of hydroelectric generating units. An attractive feature of MPC is its capability to handle Multiple Input, Multiple Output (MIMO) systems and nonlinear systems taking constraints into account. The system under study is a power system based on detailed models from Matlab's SimPowerSystems and parametrized according to the Nordic model from the Norwegian Transmission System Operator (TSO), Statnett. The primary role of the field excitation control system is to quickly respond to voltage disturbances occurring in the power system. The control system is tested for both first-swing transient stability and long term voltage stability.

4:50 ***Modelling and Dynamic Simulation of Cyclically Operated Pulverized Coal-Fired Power Plant***
Juha Kuronen (Fortum Oyj, Finland)
Pulverized coal-fired power plants are increasingly operated cyclically for the compensation of fluctuating load in the electric grid caused by intermittent production of wind and solar power plants. Dynamic simulation is a powerful tool for investigating the transient behavior of a power plant that is operated cyclically. New solutions, e.g. process changes and control strategies can be tested with a computer-aided dynamic simulation software. This paper introduces a model and dynamic validation of a commercial pulverized coal-fired power plant that is used in grid load compensation. The model is developed using dynamic simulation software Apros, and it includes all the main processes and control loops of the plant, but also some significant simplifications have been made compared to the real plant process. The model is validated against measurement data from the plant. Simulated dynamic validation cases include typical load changes that are used in grid load compensation. The model can be used for further investigations regarding flexibility and controllability of the reference plant.

5:10 ***Agglomeration Detection in Circulating Fluidized Bed Boilers Using Refuse Derived Fuels***
Nathan Zimmerman and Konstantinos Kyprianidis (Mälardalen University, Sweden); Carl-Fredrik Lindberg (ABB Corporate Research, Sweden)
The formation of agglomerates in a refuse derived fuel (RDF) fired circulating fluidized bed (CFB) boiler has been investigated by implementing a dynamic model of the combustion process. The nature of refuse derived fuel, which is complex in composition, leads to an increased tendency for agglomerate formation. Notwithstanding the fact that a robust control scheme is essential in preventing the decrease in boiler efficiency from accelerated agglomerate formation. Therefore, a mechanism for detecting agglomeration through a physical model by looking at the minimum fluidization is presented. As agglomerates form between the fuel ash and bed sand the average diameter of the sand will increase and therefore the minimum fluidization velocity. Samples of bed material have been sieved and measured from a 150 MW circulating fluidized bed boiler fired with refuse derived fuel to determine bed material size distribution. The findings have been correlated and match an increase in the minimum fluidization velocity during a seven day sampling period where the bed material size distribution increases above the average sand diameter.

5:30 ***Parametric CFD Analysis to Study the Influence of Fin Geometry on the Performance of a Fin and Tube Heat Exchanger***
Shobhana Singh, Kim Sørensen and Thomas Condra (Aalborg University, Denmark)
Heat transfer and pressure loss characteristics of a fin and tube heat exchanger are numerically investigated based on parametric fin geometry. The cross-flow type heat exchanger with circular tubes and rectangular fin profile is selected as a reference design. The fin geometry is varied using a design aspect ratio as a variable parameter in a range of 0.1-1.0 to predict the impact on overall performance of the heat exchanger. In this paper, geometric profiles with a constant thickness of fin base are studied. Three-dimensional, steady state CFD model is developed using commercially available Multiphysics software COMSOL v5.2. The numerical results are obtained for Reynolds number in a range from 5000 to 13000 and verified with the experimentally developed correlations. Dimensionless performance parameters such as Nusselt number, Euler number, efficiency index, and area-goodness factor are determined. The best performed geometric fin profile based on the higher heat transfer and lower pressure loss is predicted. The study provides insights into the impact of fin geometry on the heat transfer performance which help escalate the understanding of heat exchanger designing and manufacturing at a minimum cost.

Wed.PM3.B: Modeling, Simulation, Control and Optimization in Transportation
Room: B
Chairs: Lars Eriksson (Linköping University, Sweden), Mika Pylvänäinen (University of Oulu, Finland)

3:50 ***A Model of a Marine Two-Stroke Diesel Engine with EGR for Low Load Simulation***
Xavier Llamas and Lars Eriksson (Linköping University, Sweden)
A mean value engine model of a two-stroke marine diesel engine with EGR that is capable of simulating during low load operation is developed. In order to be able to perform low load simulations, a compressor model capable of low speed extrapolation is also investigated and parameterized for two different compressors. Moreover, a parameterization procedure to get good parameters for both stationary and dynamic simulations is described and applied. The model is validated for two engine layouts of the same test engine but with different turbocharger units. The simulation results show a good agreement with the different measured signals, including the oxygen content in the scavenging manifold.

4:10 ***Safe Active Learning of a High Pressure Fuel Supply System***
Mark Schillinger, Benedikt Ortelt and Benjamin Hartmann (Bosch Engineering GmbH, Germany); Jens Schreiter, Mona Meister and Duy Nguyen-Tuong (Robert Bosch GmbH, Germany); Oliver Nelles (University of Siegen, Germany)
When modeling technical systems as black-box models, it is crucial to obtain as much and as informative measurement data as possible in the shortest time while employing safety constraints. Methods for an optimized online generation of measurement data are discussed in the field of Active Learning. Safe Active Learning combines the optimization of the query strategy regarding model quality with an exploration scheme in order to maintain user-defined safety constraints. In this paper, the authors apply an approach for Safe Active Learning based on Gaussian process models (GP models) to the high pressure fuel supply system of a gasoline engine. For this purpose, several enhancements of the algorithm are necessary. An online optimization of the GP models' hyperparameters is implemented, where special measures are taken to avoid a safety-relevant overestimation. A proper risk function is chosen and the trajectory to the sample points is taken into account regarding the estimation of the samples feasibility. The algorithm is evaluated in simulation and at a test vehicle.

4:30 ***Simulation Model of a Piston Type Hydro-Pneumatic Accumulator***
Juho Alatalo, Toni Liedes and Mika Pylvänäinen (University of Oulu, Finland)
Hydro-pneumatic accumulators are used to improve the features of different kinds of hydraulic systems and they are common in industry and mobile applications. In order to include functionality of accumulators to hydraulic system models, an accurate yet light simulation model of hydro-pneumatic accumulator is needed. In this paper a simulation model of a piston type hydro-pneumatic accumulator is presented. The simulation model takes into account of the behavior of friction, nitrogen gas and hydraulic fluid. The simulation model was validated by comparing the simulation results to measurement results obtained from laboratory tests, and strong correlation was found between them. The model is suitable for researchers as well as for engineers in designing work in industry.

4:50 ***The Effect of Pressure Losses on Measured Compressor Efficiency***
Kristoffer Ekberg and Lars Eriksson (Linköping University, Sweden)
While measuring the compressor behavior at different load points in for example a gas stand, the inlet and outlet pressures are not always measured directly before and after the compressor. The friction inside the pipes and the physical piping configuration affect the measured compressor efficiency, due to the induced change of fluid enthalpy. If the measured pressures at the end of the inlet and outlet pipes are not the same as the actual pressure before and after the compressor, the acquired compressor map does not give the right description of it as an isolated component. The main contribution of this paper is the analysis of the impact of gas stand energy losses due to pipe friction on the compressor map. As a result the paper suggests a way to take the pressure losses in the inlet and outlet pipes into account. The suggested model takes pipe friction, diffuser, nozzle and pipe bends into account. The potential measurement error in compressor efficiency due to energy losses in the pipes in this experiment is 2.3% (percentage points) at maximum mass flow of air through the compressor.

5:10 ***Numerical Efficiency of Inverse Simulation Methods Applied to a Wheeled Rover***
Thaleia Flessa, Euan McGookin, Douglas Thomson and Kevin Worrall (University of Glasgow, United Kingdom)
A control method based on Inverse Simulation is applied to a four wheel rover. The method calculates the required inputs to achieve a desired, specified response; a trajectory in this case. Inverse Simulation considers the complete system dynamics to calculate the control input using an iterative, numerical Newton - Raphson scheme. Two methods for applying Inverse Simulation are presented, one based on a Differentiation scheme and one on Integration. The paper provides an insight into how the scheme formulation and selected parameters affect both methods' performance when applied to a rover. The selection of system outputs to control, their effect on each scheme's Jacobian, whether it is square or over-determined and the best method to factorize this Jacobian are investigated. The influence of the discretisation step and the convergence tolerance is also examined using two different sets for both schemes and in conjunction with the type of Jacobian used. The comparison is made in terms of the resulting trajectory, the execution time, and the quality of the calculated control input.

5:30 ***Analysis of Optimal Diesel-Electric Powertrian Transients during a Tip-In Maneuver***
Vaheed Nezhadali and Lars Eriksson (Linköping University, Sweden)
Optimal transients of a hybrid powertrain are calculated with the aim to give a smooth and time efficient acceleration. It is shown that there is a trade-off between time and driveline oscillations where high oscillations can be avoided by slightly longer acceleration time and proper control of the electrical and diesel power sources. During a low oscillation acceleration, there is still the possibility to reduce the amount of total consumed electrical and fuel energy. This is investigated by calculation of optimal controls during acceleration for a fixed time while penalizing the usage of energy in a low oscillation acceleration. The balance between electrical and diesel energy usage during the acceleration is also investigated. The results show that to avoid extreme transients by optimal control, a multidimensional formulation of the objective function including different properties should be considered.

Wed.PM3.C: Complex Systems

Room: C

Chairs: Siu Kang (Yamagata University & RIKEN Brain Science Institute, Japan), Karim Benyamna (ITMO University & St. Petersburg National Research University of Information Technologies, Mechanics and Optics, Russia)

3:50 ***Flat Patterns Extraction with Collinearity Models***

Leon Bobrowski (Bialystok University of Technology, Bialystok, Poland); Paweł Zabielski (Faculty of Computer Science, Bialystok University of Technology, Poland)

The term collinear (flat) pattern means in this article, a set of a large number of feature vectors located on (or near) a plane in multidimensional feature space. Flat patterns extracted from large data set can provide a basis for modeling a local interactions in selected sets of features. Collinear patterns can be discovered in given data set through minimization of some kind of the convex and piecewise linear (CPL) criterion functions. The proposed method of discovering collinear patterns can be compared with the methods based on the Hough transformation used in computer vision for detection lines and curves in pictures.

4:10 ***Wind Speed Prediction Based on Incremental Extreme Learning Machine***

Elizabeta D Lazarevska (University "Ss. Cyril and Methodius" Skopje & Faculty of Electrical Engineering and Information Technologies, Macedonia, the former Yugoslav Republic of)

There are many research papers dealing with forecasting the wind speed, since such knowledge is necessary in a number of applications, such as agriculture, modern transportation, and wind energy production. This paper presents an alternative approach to forecasting the wind speed based on incremental extreme learning machine. The wind speed is modelled by means of available meteorological data such as total solar radiation, ambient temperature, humidity, barometer pressure, etc. The applied modeling algorithm belongs to the class of extreme learning machine methods, which are gaining an increasing interest in the scientific and research community. The conducted research has clearly showed that the extreme learning machine does not depend notably on the selection of the activation function for the hidden neurons. However, the random selection of the hidden layer parameters significantly influences its approximation capacity and generalization property. The paper offers a simple solution to the problem. The presented model based on incremental extreme learning machine method offers an alternative approach to modeling the wind speed and the simulation results show clearly its advantages and very good performance indices. The extreme learning machine method indeed possesses the attributes of extreme simplicity, extremely good approximation performance, and extremely fast computation.

4:30 ***Comparison of Different Models for Residuary Resistance Prediction***

Elizabeta D Lazarevska (University "Ss. Cyril and Methodius" Skopje & Faculty of Electrical Engineering and Information Technologies, Macedonia, the former Yugoslav Republic of)

The available models of residuary resistance are polynomial formulae based on regression analysis, which all suffer from great involvement with too many parameters and coefficients that heavily depend on vessel's speed. The paper presents several unconventional models of residuary resistance based on fuzzy logic and neural network techniques. First, two fuzzy models are built on the basis of different hull parameters and different Froude numbers. These models are identified by a modification of Sugeno and Yasukawa identification algorithm. Next, a neuro-fuzzy model of residuary resistance was build, based on statistical learning theory. The model presents a fuzzy inference system of Takagi and Sugeno type that uses an extended relevance vector machine for learning its parameters and number of fuzzy rules. Finally, a neural network approach was applied to build three different models of residuary resistance based on extreme learning machine techniques. The first model applies classic extreme learning machine, and the other two implement incremental extreme learning machine philosophies. The obtained models are validated and compared to each other for their generalization performance and approximation capability, and although they all possess excellent approximation capabilities, the neural model based on incremental extreme learning machine has shown the best simulation results.

4:50 ***Methodology and Procedures of Cyber-Physical-Socio Systems Integrated Modelling and Simulation***

Boris Sokolov (SPIIRAS & St. Petersburg Institute for Informatics and Automation of the Russian Academy of Sciences, St. Petersburg National Research University of Information Technologies, Mechanics and Optics, Russia); Karim Benyamna (ITMO University & St. Petersburg National Research University of Information Technologies, Mechanics and Optics, Russia); Rafael Yusupov (SPIIRAS & St. Petersburg Institute for Informatics and Automation of the Russian Academy of Sciences, Russia); Mikhail Ignatjev (Saint-Petersburg State University of Aerospace Instrumentation (SUAI), Russia)

The main objects of our investigation are cyber-physical-socio space and systems (CPSS). The CPSS is the fusion of the physical space, the cyber space, and the socio space. The problem of CPSS integrated modelling and simulation is actual modern problem. The decision of this problem involve interdisciplinary researches of specialists in mathematics, economics, biology, physics, and computer technologies. Therefore, the paper presents results of research in the field of CPSS modelling and multi-agents simulation. Different types of models (analytical-simulation, logical algebraic, logical-linguistic models etc.) can be used for description and study of main attributes of cyber-physical-socio space and systems.

5:10 ***Synaptic Learning of the Resonator Network Interacting with Oscillatory Background and Noise***

Taishi Matsumura (Yamagata University, Japan); Tatsuo Kitajima and Tetsuya Yuasa (Yamagata University & Graduate School of Science and Engineering, Japan); Siu Kang(Yamagata University & RIKEN Brain Science Institute, Japan)

Rhythmic activities were widely observed in many brain regions. Human EEG recording revealed several frequency modulation of the oscillation reflecting internal brain states such as attentional modulation in visual systems. On the other hand, in vivo intracellular recordings suggested that individual neurons showed persistent membrane fluctuations and global oscillation was originated from population activity of the neuronal fluctuations. Furthermore, it was found that some types of neuron showed membrane resonance in their subthreshold level. However, functional roles of the subthreshold resonance in a recurrent neural network is still unknown. So here, we computationally examined the behavior of resonator network driven by external inputs and organized through the spike-timing-dependent plasticity (STDP) under oscillatory background and noise. As a result, it was shown how the resonator network modified its responsiveness depending on frequency modulation and its connectivity through the STDP.

Wed.PM3.D: Evolutionary computation

Room: D

Chairs: Michal Pluhacek (Tomas Bata University in Zlin, Czech Republic), Riku-Pekka Nikula (University of Oulu, Finland)

3:50 ***Simulating the Effect of Adaptivity on Randomization***

Adam Viktorin (Tomas Bata University in Zlin & Faculty of Applied Informatics, Czech Republic); Roman Senkerik (Tomas Bata University in Zlín, Faculty of Applied Informatics, Czech Republic); Michal Pluhacek (Tomas Bata University in Zlin, Czech Republic)

This paper compares the development of multi-chaotic system during the optimization process on three classical benchmark functions - Rosenbrock, Rastrigin and Ackley. The multi-chaotic system involves five different randomizations based on discrete chaotic maps (Burgers, Delayed Logistic, Dissipative, Lozi and Tinkerbell) and the probability of their selection is adjusted according to the development of the optimization task. Two variants of Differential Evolution (DE) are used in order to simulate the effect of adaptivity on the randomization probability adjustment process. First non-adaptive variant is DE with rand/1 mutation strategy and the second adaptive variant is novel Success-History based Adaptive DE (SHADE).

4:10 ***Self-adaptive of Differential Evolution Using Neural Network with Island Model of Genetic Algorithm***

Linh Tao (Shibaura Institute of Technology & Omiya Campus, Japan); Hieu Pham (Ministry of Science and Technology, Vietnam); Hiroshi Hasegawa (Shibaura Institute of Technology, Japan)

A new evolutionary algorithm called NN-DEGA that using Artificial Neural Network (ANN) for Self-adaptive Differential Evolution (DE) with Island model of Genetic Algorithm (GA) is proposed to solve large scale optimization problems, to reduce calculation cost, and to improve stability of convergence towards the optimal solution. This is an approach that combines the global search ability of DE and the local search ability of Adaptive System with Island model of GA. The proposed algorithm incorporates concept from DE, GA, and Neural Networks (NN) for self-adaptive of control parameters. The NN-DEGA is applied to several benchmark tests with multi-dimensions to evaluate its performance. It is shown to be statistically significantly superior to other Evolutionary Algorithms (EAs), and Memetic Algorithms (MAs).

4:30 ***Single Swarm and Simple Multi-Swarm PSO Comparison***

Michal Pluhacek (Tomas Bata University in Zlin, Czech Republic); Roman Senkerik (Tomas Bata University in Zlín, Faculty of Applied Informatics, Czech Republic); Adam Viktorin(Tomas Bata University in Zlin & Faculty of Applied Informatics, Czech Republic); Ivan Zelinka (VŠB - Technical University of Ostrava, Czech Republic)

This paper presents a comparative study between the original single swarm PSO with linear decreasing inertia weight and basic multi-swarm variant. The alternative population topology (multi-swarms) is a topic that is getting increased attention from the research community in recent years. We present evidence that it might be very beneficial to divide the population into two sub-swarms with partially restricted communication. The size of the sub-swarms is chosen with respect to previously published study on this top. The scaling of the methods is compared for 3 different dimensional settings. The results are statistically evaluated and discussed. The paper concludes with proposals for future research.

4:50 ***An Improved Kriging Model Based on Differential Evolution***

Xiaobing Shang (Control and Simulation Center, Harbin Institute of Technology); Ping Ma (Control and Simulation Center, Harbin Institute of Technology, P.R. China); Ming Yang(Control and Simulation Center, Harbin Institute of Technology (HIT), P.R. China)

Kriging model is a commonly interpolate approximation method which is widely used in the computer simulation in the past decade. The fitting accuracy is one of the fundamental problems in the research of kriging model, which can be summarized in two aspects, the accurate estimation of model's parameters and approximate form selection of kriging model. In order to solve the existed problems, an improved parameter estimation method of kriging model base on differential evolution (DE) algorithm is set out in the present paper. Firstly, establish the objective function of DE algorithm depends on the estimation of the model's accuracy, and get the optimum solution of model's parameters under the initial condition. Then, a variety of regression function and correlation function in kriging models are selected to compare the fitting accuracy. Finally, the simulation case for outer ballistic data on electromagnetic railgun is examined to determine whether the improved method has priority over traditional one in the approximation accuracy.

5:10 ***A Simulation Model of a School's Evacuation***

Dins Lolans (Riga Secondary School No. 80, Latvia); Aleksandr Korolko (School, Latvia); Valdis Abrams (Riga Secondary School No. 80, Latvia); Natalja Kucerenko (Secondary School Nr 80, Riga, Latvia)

This research paper describes a simulation model that was implemented in a real time environment as an efficiency evaluation software tool. Currently, according to experts, all efficiency evaluation software tools for an evacuation process in Latvia rely on field experiments. This has been shown to result in an inefficient allocation of human resources. Consequently, a simulation model for a school's evaluation was required that does not rely on field experimentation. Employing (a) the data provided by the school's administration and (b) simulation modeling methodology, a decision support system for an evaluation of an evacuation process was developed and tested. This system supplies the school's administration with information about the problem areas in the current evacuation process. The simulation process results are analyzed in a data collection environment (graphs, diagrams, tables etc.) that was developed using the JAVA programing language. The hypothesis of a successful simulation model was tested employing the Mann-Whitney criteria and found to be credible. Based on the findings, a number of recommendations were developed for increasing the efficiency of the evacuation process in buildings sharing the layout of the school tested here. With necessary adjustments, the developed software can be recommended for implementation beyond Latvia.

Wed.PM3.E: Parallel and Integrated Simulation

Room: E

Chairs: Bernt Lie (University College of Southeast Norway, Norway), Daniel Rippel (BIBA - Bremer Institut für Produktion und Logistik GmbH at the University of Bremen, Germany)

3:50 ***Note on Fire Simulation Efficiency Realized on Computer Cluster***

Lukas Valasek and Jan Glasa (Institute of Informatics, Slovak Academy of Sciences, Slovakia)

Current fire simulation systems are capable to simulate fires in complex environments and utilize huge computational power of contemporary computers. This paper deals with realization of fire simulation using parallel MPI version of Fire Dynamics Simulator. In order to test the impact of choice of strategies for allocation of computational resources of computer cluster on efficiency of fire simulation, two allocation strategies are used to realize several parallel simulations of a corridor fire on the HPC cluster at the Institute of Informatics of Slovak Academy of Sciences in Bratislava (Slovakia). The tests confirm a great potential of parallelization to reduce the execution time of fire simulation. However, the tests also showed that the greater number of computational meshes (used computational cores) does not necessarily reduce the execution time of simulation. The obtained results also indicate different speed-up and parallel efficiency of realized parallel simulations in regard of the used allocation strategies.

4:10 ***API for Accessing OpenModelica Models From Python***

Bernt Lie (University College of Southeast Norway, Norway); Sudeep Bajracharya, Alachew Mengist, Lena Buffoni, Arun Kumar, Martin Sjölund and Adeel Asghar (Linköping University, Sweden); Adrian Pop (Linköping University & SICS East, Sweden); Peter Fritzson (Linkoping University, Sweden)

This paper describes a new API for operating on Modelica models in Python, through OpenModelica. Modelica is an object oriented, acausal language for describing dynamic models in the form of Differential Algebraic Equations. Modelica and various implementations such as OpenModelica have limited support for model analysis, and it is of interest to integrate Modelica code with scripting languages such as Python, which facilitate the needed analysis possibilities. The API is based on a new class ModelicaSystem within package OMPython of OpenModelica, with methods that operate on instantiated models. Emphasis has been put on specification of a systematic structure for the various methods of the class. A simple case study involving a water tank is used to illustrate the basic ideas.

4:30 ***Domain-Specific Modelling of Micro Manufacturing Processes for the Design of Alternative Process Chains***

Daniel Rippel and Michael Lütjen (BIBA - Bremer Institut für Produktion und Logistik GmbH at the University of Bremen, Germany); Michael Freitag (BIBA - Bremer Institut für Produktion und Logistik GmbH at the University of Bremen & University of Bremen, Germany)

In the context of an industrial production of micro components, the planning and configuration of process chains constitutes a major factor of success for the involved companies. Besides very small tolerances and high quality requirements, high production speeds have to be achieved. Moreover, so called size-effects introduce additional uncertainties to the planning process. While the modelling methodology "Micro - Process Planning and Analysis" provides a series of tools and methods to achieve a detailed planning and configuration of process chains in micro manufacturing, the high level of detail requires a comparably large amount of manual work, as well as a broad knowledge about available processes. Particularly in micro manufacturing, several processes can be substituted to achieve specific forms and shapes, while providing their own advantages and disadvantages for the overall production system. This article describes an extension to the methodology, which enables an automatic selection of suitable processes using geometry focused annotations. While these annotations only add minor efforts to the modelling process, they can be used to derive alternative process chains. Particularly for production systems offering a broad range of processes, this extension reduces the efforts in modelling alternative chains.

4:50 ***Classification of OpenCL Kernels for Accelerating Java Multi-agent Simulation***

Pitipat Penbharkkul and Worawan Diaz Carballo (Marurngsith) (Thammasat University, Thailand)

Java-based multi-agent simulation (MAS) can be offloaded to graphical processing units (GPU) and other OpenCL accelerators to achieve many hundred-fold speedups. However, the performance gain from the accelerated code depends strongly on whether the computation (kernels) have been scheduled to the appropriate devices. Thus, accelerating Java MAS may not lead to a sustainable speedup. This paper proposes a method for a kernel classifier to specify suitable devices to execute OpenCL kernels. The classifier can identify suitable OpenCL devices for kernels based on the static and dynamic characteristics of the code of the kernels. Kernels are grouped by their suitability for particular devices using the multiclass support virtual machine technique. After that, kernels are scheduled to an appropriate task queue. Kernel scheduling based on the proposed technique is compared against the first-come-first-serve (FCFS) technique and against oracle scheduling when handling eight kernels. Our results show that, using the proposed method, all kernels finished execution 45 percent sooner than using the FCFS technique. However, the overall execution time was 22.5 percent longer than with oracle scheduling. Our results seem to confirm that kernel classification techniques might contribute towards sustainable high performance in accelerated Java-based MAS models.

5:10 ***Loadbalancing on Parallel Heterogeneous Architectures: Spin-image Algorithm on CPU and MIC***

Ahmed Eleliemy (University of Basel, Switzerland); Mahmoud Fayze (Fujitsu and Ain Shams University, Saudi Arabia); Rashid Mehmood (King AbdulAziz University, Saudi Arabia); Iyad Katib (King Abdulaziz University, Saudi Arabia); Naif Aljohani (University of Southampton, United Kingdom)
Presenter: Antti Koistinen (University of Oulu, Finland)

Loadbalancing of computational tasks over heterogeneous architectures is an area of paramount importance due to the growing heterogeneity of HPC platforms and the higher performance and energy efficiency they could offer. This paper aims to address this challenge for a heterogeneous platform comprising Intel Xeon multi-core processors and Intel Xeon Phi accelerators (MIC) using an empirical approach. The proposed approach is investigated through a case study of the spin-image algorithm, selected due to its computationally intensive nature and a wide range of applications including 3D database retrieval systems and object recognition. The contributions of this paper are threefold. Firstly, we introduce a parallel spin-image algorithm (PSIA) that achieves a speedup of 19.8 on 24 CPU cores. Secondly, we provide results for a hybrid implementation of PSIA for a heterogeneous platform comprising CPU and MIC: to the best of our knowledge, this is the first such heterogeneous implementation of the spin-image algorithm. Thirdly, we use a range of 3D objects to empirically find a strategy to loadbalance computations between the MIC and CPU cores, achieving speedups of up to 32.4 over the sequential version. The LIRIS 3D mesh watermarking dataset is used to provide performance analysis and optimization.

Thursday, September 15, 09:00 - 09:45, Thu.AM1.A

Plenary, Room A, Chairs: Kauko Leiviskä (University of Oulu, Finland), Tomas Björkqvist (Tampere University of Technology, Finland),

Using the Power of Simulation to bring Bottom Line Benefits to the Mining, Minerals and Metals Operations

Roy Calder

Director, Technical Sales, Global Solutions
SimSci by Schneider Electric, Warrington, United Kingdom
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While today's economic climate for the Mining, Metals and Minerals (MMM) industries may not be at its best, the industry is still faced with the need to deliver products cost effectively, at the correct specification, while maintaining a high level of safety for the plant and the personnel. For many years the MMM industry has lagged behind the Hydrocarbon Processing Industry (HPI) with regard the use of Simulation, however as the level of investment has grown over the years the need to ensure cost effective design, allied to improvements in delivery time the use of Simulation has become an integral part of the design, construction and commissioning of new plants across the globe. One area Simulation applications are proving themselves is in the area of Operational Safety. The HPI has long used Simulation based Operator Training Simulators to ensure safe operations and this is being carried over with increasing uptake happening in the MMM industry. In the future as the MMM industry becomes increasingly sophisticated at the same time facing the difficulties of shrinking bottom lines it is clear that Simulation will become fundamental in delivering the tools and solutions that will enable the industry to ensure growth in its bottom line in years to come. Schneider-Electric has had a long history in the MMM industry and this paper will highlight how the acquisition of Invensys has brought a completely new perspective to the industry and, most importantly, allows MMM companies to grow their Bottom Line.

Biography

BSc in Chemical Engineering, 1984, University of Strathclyde, Glasgow, then wide ranging industrial experience as: 1) in South Africa as a Metallurgist on Westonaria Gold mine, 2) SASOL in Rosebank as a Process Engineer, 3) L'Air Liquide, 4) INHER SA as Divisional Head, Process Engineering in 1991, where he managed the SULZER Chemtech Agency delivering process plant in multiple industries, 5) Process Sales Director, BHR, UK, 6) SimSci Division of INVENSYS, now Schneider-Electric. Currently Director of Technical Sales, SimSci regional team, 80 strong, on Simulation in engineering and operations community of industries as varied as Oil Production, gold and coal mining and the power industry. The team directly serve the EURA (Europe, Russia and Africa) activities of SimSci. Written numerous papers and presented at World Petroleum Congress, ERTC, SAICHE, AICHE, IChemE & DECHEMA events as well as numerous industrial symposiums. He is joint holder of a patent on the application of Structured Packing in Wax Separation. He is devoted to Rugby, though no longer playing, and heads the Mini and Junior Section of his local club of some 300 budding young players.

Thursday, September 15, 10:15 - 12:15

Thu.AM2.A: Modelling and Simulation in Applied Energy-II

Room: A

Chairs: Erik Dahlquist (Mälardalen University, Sweden), Tomi Thomasson (VTT Technical Research Centre of Finland Ltd., Finland)

10:15 ***Modeling of Black Liquor Gasification***

Erik Dahlquist (Mälardalen University, Sweden); Muhammad Naqvi (Mälardalen University, Sweden); Eva Thorin and Jinyue Yan (Mälardalen University, Sweden); Konstantinos Kyprianidis (Mälardalen University, Sweden); Philip Hartwell (BioRegional MiniMills Ltd., United Kingdom)

The energy situation in process industries and power plants is changing. It is becoming interesting to perform system analysis on how to integrate gasification into the pulp & paper industry and into the CHP systems in power plant applications to complement with production of chemicals aside of heat and power. The potential chemicals are methane, hydrogen, and methanol. It is interesting to estimate the potential to introduce combined cycles with gas turbines and steam turbines using both black liquors and other types of biomass like pellets, wood chips etc. To perform such type of analysis, it is vital to have relevant input data on what gas composition we can expect from different types of feedstock. In this paper, we focus on wood pellets and black liquors as feedstock for integrated gasification systems. The experimental results are correlated into partial least squares models to predict major composition of the synthesis gas produced under different conditions. These quality prediction models are then combined with physical models using Modelica for the investigation of dynamic energy and material balances for complete plants. The data can also be used as input to analysis using e.g. ASPEN plus and similar system analysis tools.

10:35 ***Cascade Optimization Using Controlled Random Search Algorithm and CFD Techniques for ORC Application***

Ramiro Ramirez (UNIFEI - Universidade Federal de Itajubá, Brazil); Edna Da Silva (Mälardalen University, Sweden); Konstantinos Kyprianidis (Mälardalen University, Sweden)

The methodology for performance optimization of a cascade using CFD techniques for ORC (Organic Rankine Cycle) application are presented. The turbine ORC cascade is parameterized to achieve the maximum efficiency while using different organics fluids. The main objective of this work is to attain a maximal Cl/Cd ratio from a preliminary design. The CRSA (Controlled Random Search Algorithm) was chosen for the optimization process integrated with CFD techniques, using schemes with automatic building of parameterized geometries and meshes via "script files" interpreted by the commercial software ICEM-CFD®. Finally, for the numerical calculation of the fluid flow, the commercial software FLUENT® is used with the fluids properties, the real gases model, the turbulence model and the boundary conditions being set through "journal files". In this paper, R245fa and Toluene are used as working fluids, chosen for their characteristics curves being very different, directly influencing the behavior of the fluid during its expansion process. The results show that the methodology allows for making corrections in the initial design of the cascade shape. It will be necessary to introduce the camber function to correct for the separation of the boundary layer in the trailing edge, which is a proposal for future work.

10:55 ***Functionality Testing of Water Pressure and Flow Calculation for Dynamic Power Plant Modelling***

Timo Yli-Fossi (Tampere University of Technology, Finland)

Water pressure and flow rate calculation in dynamic boiler models is challenging because of stiff system dynamics meaning that time constants of model states vary by several orders of magnitude. Furthermore, strong interconnections between pressures and flow variables may cause instability problems in simulation runs. This study presents a method to implement and test dynamic thermal power plant water-steam system models. A dynamic water-steam system model is presented. The model is applied for testing of the functionality of the presented computation model. Computational performance was tested using different numerical solvers. Also sensitivity to changes in initial values of system states and model parameters was tested. The results indicate that a workable way to make flexible models was found.

11:15 ***Initial Results of Adiabatic Compressed Air Energy Storage (CAES) Dynamic Process Model***
Tomi Thomasson and Matti Tähtinen (VTT Technical Research Centre of Finland Ltd., Finland)
The amount of wind and solar generation has seen exponential growth during the recent decades, and the trend is to continue with increased pace. Due to the intermittency of the resources, a threat is posed on grid stability and a need created for regulation. One solution to control the imbalance between supply and demand is to store the electricity temporarily, which in this paper was addressed by implementing a dynamic model of adiabatic compressed energy air storage (CAES) with Apros dynamic simulation software. Based on literature review, the existing models due to their simplifications do not allow transient situations e.g. start-ups to be studied, and despite of its importance, part-load operation has not been studied with sufficient precision. The implemented model was validated against analytical calculations (nominal load) and literature information (part-load), showing considerable correlation. By incorporating the system with wind generation and electricity demand, the grid operation of CAES was studied. To enable this, the start-up and shutdown sequences based on manufacturer information were approximated in dynamic environment, as far as is known, the first time. The initial results indicate that the modularly designed model offers an accurate framework for numerous studies in the future.

11:35 ***Performance of Electrical Power Network with Variable Load Simulation***
Ahmed Al Ameri and Cristian Nichita (University of Le Havre, France)
Today's system operators face the big challenge of constructing simulation of systems that make efficient select of generation resources under variable load profiles. This paper describes IEEE five bus system modeling which simulated under Simulink. The real power load model designed to allow different load profile types (residential, commercial and industrial) connecting to load buses. The main purpose of this paper is to demonstrate the performance of power network based on load profile modeling as a means for enhance Distribution Network Operators (DNOs) decision in power systems. In this paper IEEE five bus system is used as a test bed. The results are shown with constant and variable load model. The results indicate the effectiveness of this flexible load profile model applied to the five bus system.

Thu.AM2.B: Industrial Processes: Mining, Metal and Oil Industry

Room: B

Chairs: Vito Logar (University of Ljubljana, Slovenia), Pekka Siirtola (University of Oulu, Finland)

10:15 ***Modeling and Portfolio Optimization of Stochastic Discrete-Event System through Markovian Approximation: An Open-Pit Mine Study***

Roberto G. Ribeiro (Federal University of Minas Gerais - UFMG, Brazil); Saldanha Rodney (Programa de Pós-Graduação em Engenharia Elétrica - UFMG, Brazil); Carlos Andrey Maia (Universidade Federal de Minas Gerais, Brazil)

Operation in an open-pit mining is a complex task with stochastic nature. Usually, this kind of system is analyzed by means of DES (Discrete Event System) simulation. This work considers optimizing the investment in new projects in such a way to reach maximum production of an open-pit mine. When a DES model is associated with an optimization problem, the time taken to run such model is a crucial aspect. In order to analyze the project impacts in a reasonable time, this work presents a DES markovian model which represents a load-haulage cycle. The results obtained were compared with the results acquired from validated simulation models which represent the same system. In the optimization context, the complexity is exponential. Therefore, this work proposes a formulation that considers the inter-relationship between projects, which aims to help decision makers. Instead of trying all the possible projects combinations, the proposed method searches for identifying the set of projects that produces good feasible solutions based on performance measure from designed DES model.

10:35 ***Automatic Recognition of Steel Plate Side Edge Shape Using Classification and Regression Models***

Pekka Siirtola, Satu Tamminen, Eija Ferreira and Henna Tiensuu (University of Oulu, Finland); Elina Prokkola (SSAB, Finland); Juha Röning (Oulu University Secure Programming Group, Finland)

In the steel plate production process it is important to minimize the wastage piece produced when cutting a mother steel plate to the size ordered by a customer. In this study, we build classification and regression models to recognize the steel plate side edge shape, if it is curved or not and the amount of curvature. This is done based on time series data collected at the manufacturing line. In addition, this information needs to be presented in a way that enables fast analysis and long-term statistical monitoring. It can then be used to tune the parameters of the manufacturing process so that optimal curvature can be found and the size of the wastage piece can be reduced. The results show that using the classification and linear regression methods, the side edge shape can be recognized reliably and the amount of curvature can be estimated with high accuracy as well.

10:55 ***Analytical Approximations and Simulation Tools for Water Cooling of Hot Rolled Steel Strip***

Aarne Pohjonen (University of Oulu, Finland); Vesa Kyllönen (VTT, Finland); Joni Paananen (Univrsity of Oulu, Finland)

Analytical approximations that can be used together with the numerical codes to obtain estimates on the temperature distribution inside the cooled steel strip/plate are discussed. While numerical simulations can give accurate answer after the time required for calculations, the analytical approximations show how thickness and cooling rate affect the temperature distribution. We also present development of graphical user interface interaction with numerical codes for the use in designing and tuning of water cooling schedule for hot rolling strip and plate mill. Interaction of the numerical codes with user friendly front ends have been developed for the following tools: a heat conduction simulation tool for hot strip mill, a tool for calculating phase transformations for user defined cooling paths and a tool for calculating the required cooling water to cool a steel strip to a desired temperature. The functionality and interaction of the tools with the numerical codes is described.

11:15 ***From Iterative Balance Models to Directly Calculating Explicit Models for Real-time Process Optimization and Scheduling***
Tomas Björkqvist, Olli Suominen and Matti Vilkko (Tampere University of Technology, Finland); Mikko Korpi (Outotec (Finland) Oy, Finland)
Optimal utilization of complex processes usually needs real-time operation optimization and scheduling, especially in cases when the production line consists of both continuously and batch wise operated unit processes. This kind of real-time optimization requests process models enabling execution decades faster than real-time. Mostly iterative balance calculation is slow for these cases. This paper presents a method for converting an iterative balance model to a direct calculating model suitable for process operation optimization. The method is demonstrated with the first unit process in the copper smelting line, the flash smelting furnace. The solution was implemented as a direct calculation function which calculation time fulfilled the requirement of scheduling use.

11:35 ***Simulation of Control Structures for Slug Flow in Riser during Oil Production***
Roshan Sharma and Ole Brastein (University College of South east Norway, Norway)
The occurrence of slug flow is a common problem arising in the oil well riser pipeline. To eliminate such slug flow, various control structures along with state estimation are designed and compared in this paper. Nonlinear model based predictive scheme are compared with classical PI controllers for three different control structures. One of the control structure is based on controlling the mass of the liquid in the riser pipeline, for which, an Unscented Kalman Filter is designed to estimate the mass. The simulation results show that the model based controllers perform relatively better than the classical controllers. Although computationally expensive, the control algorithm used in this paper for model based control still makes it real time implementable.

11:55 ***Mixing and Segregation of Two Particulate Solids in the Transverse Plane of a Rotary Kiln***
Sumudu Karunarathne (University College of Southeast Norway, Norway); Chameera Jayarathna (Tel-Tek, Norway); Lars-Andre Tokheim (University College of Southeast Norway, Norway)
Mixing of two granular phases in a rotary kiln was investigated through CFD simulations using a two-dimensional transverse plane based on the Eulerian approach and the kinetic theory of granular flows. Simulations were performed transverse with the aim to investigate mixing of two particulate solids, CaCO3 and Al2O3, under the rolling mode. Simulation results indicated particle segregation rather than mixing during the plane rotation. Volume fractions and velocity contours of each phase were examined to understand the mixing and segregation. Particles with lower density and small particle diameter are collected in the middle section of the bed, while particles with a higher density and larger particle diameter get collected at the bottom of the rotating cylinder. Variations in densities and particle sizes of solid particles were identified as the main causes of the particle segregation. Further studies are required to examine the effect of degree of filling on mixing performance and how the use of lifters may improve the mixing efficiency.

Thu.AM2.C: Discrete Event Simulation

Room: C

Chairs: Emilio Jiménez Macías (University of La Rioja, Spain), Mikko Harju (Nokia, Finland)

10:15 ***Modeling and Simulation of Train Networks Using Max-Plus Algebra***

Jari Böling (Åbo Akademi University, Finland); Hazem Al-bermanei (Turku University of Applied Sciences, Finland)

Max-plus algebra provides mathematical methods for solving nonlinear problems that can be given the form of linear problems. Problems of this type, sometimes of an administrative nature, arise in areas such as manufacturing, transportation, allocation of resources, and information processing technology. Train networks can be modelled as a directed graph, in which nodes correspond to arrivals and departures at stations, and arcs to travelling times. A particular difficulty is represented by meeting conditions in a single-track railway system. Compared to earlier work which typically include numerical optimization, max-plus formalism is used throughout this paper. The stability and sensitivity of the timetable is analyzed, and different types of delays and delay behavior are discussed and simulated. Interpretation of the recovery matrix is also done. A simple train network with real world background is used for illustration.

10:35 ***Simulation Metamodeling Using Dynamic Bayesian Networks with Multiple Time Scales***

Mikko Harju and Kai Virtanen (Aalto University, Finland)

The utilization of dynamic Bayesian networks (DBNs) in simulation metamodeling enables the investigation of the time evolution of state variables of a simulation model. DBN metamodels have previously described the changes in the probability distribution of the simulation state by using a time slice structure in which the state variables are described at common time instants. In this paper, the time slice structure is extended by selecting the time instants of the DBN separately for each state variable. In this way, a more accurate metamodel representing multiple time scales of the variables is achieved. Furthermore, the construction is streamlined by presenting a dynamic programming algorithm for determining the key time instants for individual variables. The construction and use of the DBN metamodels are illustrated by an example dealing with the simulated operation of an air base.

10:55 ***Size Rate of an Alternatives Aggregation Petri Net Developed Under a Modular Approach***

Juan Ignacio Latorre (Public University of Navarre, Spain); Emilio Jiménez Macías, Julio Blanco and Mercedes Pérez (University of La Rioja, Spain)

Petri nets allow describing formal models of discrete event systems, which might show counterintuitive behaviors (Example of Emilio that evolves slower with more resources). The design of a discrete event system, composed by known subsystems, requires the definition of the interrelations between them. This feature can be modeled in the structure of the Petri net by arcs and link transitions. The choice of the best configuration might be a hard problem to solve due to the foreseeable combinatorial explosion. In order to alleviate the computer resources required for exploring the different feasible combinations of the subnets, a single model with exclusive entities can be developed by an alternatives aggregation Petri net. In this paper the construction of such a model with four subnets and certain precedence constrain is discussed. Also, a reduction in the size of the amount of required information for describing the alternative structural configurations is calculated for different sizes of the subnets

11:15 ***Transformation of Petri Net Models by Matrix Operations***

Juan Ignacio Latorre (Public University of Navarre, Spain); Emilio Jiménez Macías and Juan Carlos Saenz-Diez (University of La Rioja, Spain); Eduardo Martínez-Cámara(University of La Rioja, Logroño, Spain)

Petri nets constitute a modeling paradigm able to describe discrete event systems characterized by features such as parallelism, precedence, concurrence, and synchronization. Petri nets are applied extensively and successfully for modeling systems belonging to a broad range of fields. In this context, transformation of Petri net models constitutes a process with diverse applications, such as simplifying the model for developing structural analysis or for performance evaluation, as well as comparing different models, describing nets whose structure changes over time, or merging models with exclusive entities. The transformation of the structure of a Petri net can be carried out from different points of view. In this paper, this transformation is developed by means of matrix operations. A list of matrix operations is presented and the preservation of some significant properties of the Petri net is discussed as a practical tool for transforming Petri net models by operations in the incidence matrices

11:35 ***Performance Evaluation of Alternative Traffic Control Schemes for an Arterial Network by DES Approach-Overview***

Jennie Lioris (IFSTTAR, France); Pravin Varaiya and Alexander Kurzhanskiy (California PATH, UC Berkeley, USA)

Evaluation aspects of alternative traffic signal control strategies for an arterial network are studied.Traffic évaluation in a signalized road network is modelled in this paper as a Store and Forward (SF) network of queues. The system state is the vector of all queue lengths at all intersections. The signal control at any time permits certain simultaneous turn movements at each intersection at pre-specified saturation rates. Two control categories, open loop and traffic-responsive policies are compared under fixed and time-varying demand. The behaviour of the underlying SF queuing network model manifesting asynchronous features over time while involving concurrence and uncertainity elements is modelled according to an event-driven approach. Simulations, explicitly modelling nondeterministic behaviour, associated with analysis are used as mathematical framework for performance evaluation.Subsequently, various metric measurements such as queue bounds, delays, trajectory travel times quantify the actual policy. Moreover, aggregate behaviour as in a macroscopic queuing model can also be prompted. Experiments are performed using real data for a section of the Huntington-Colorado arterial adjacent to the I-210 freeway in Los Angeles. Lastly, the meso-micro simulation issues resulting from the employed decision tool, PointQ, are compared with microsimulation and mesosimulation forms of other traffic simulation programs.

Thu.AM2.D: Best Practices and New Trends in Control Education

Room: D

Chairs: Kai Zenger (Aalto University & School of Electrical Engineering and Automation, Finland), Tiina Komulainen (Oslo and Akershus University College of Applied Sciences & Faculty of Technology, Art and Design, Norway)

10:15 ***Experiences and Trends in Control Education: A HiOA/USN Perspective***

Tiina Komulainen (Oslo and Akershus University College of Applied Sciences & Faculty of Technology, Art and Design, Norway); Alex Alcocer (Oslo and Akershus University College of Applied Sciences, Norway); Finn Haugen (University College of Southeast Norway, Norway)

Global trends in higher education including e-learning, massive open online courses, and new teaching methods have positively affected control education. Control course contents have evolved due to changes in industrial practices and increasing availability of affordable computer hardware and software. Continuous development efforts on virtual remote and real laboratories have made hands-on tasks more accessible and affordable. In this article, we share our experiences on undergraduate and graduate control education at University College of Southeast Norway (USN), and Oslo and Akershus University college of Applied Science (HiOA). First, we present an overview of the course contents in our institutions, and then, we give examples on development of real and virtual laboratories, online course materials, new learning platforms and teaching methods.

10:35 ***Challenges and New Directions in Control Engineering Education***

Kai Zenger (Aalto University & School of Electrical Engineering and Automation, Finland)

The paper discusses the changes and challenges in the current teaching of Automatic Control systems. Modern society has developed into a phase where the traditional process industry is not at all the only area where dynamic modelling, understanding the feedback, control engineering, autonomous systems and generally the discipline of Automatic control have to be mastered. That gives a huge challenge to the teaching of automatic control in general, especially when fewer and fewer students are entering engineering schools and as the basic skills in mathematics and physics seem to be decreasing everywhere. On the other hand, automation (to be understood broadly including automatic control and control engineering, autonomous systems etc.) as a discipline is in a state of change: it seems to be hidden in other engineering fields, and there seems to be opinions that it should actually be taught within specific application areas, e.g. in electrical engineering, machine design, chemical process engineering etc. In the old school of control engineering the idea is actually vice versa: automatic control is seen as a general, mathematically and physically well-defined discipline, which can they be applied in various application areas and engineering fields. The societal and industrial viewpoints must also be considered.

10:55 ***Constructive Assessment Method for Simulator Training***

Laura Marcano and Tiina Komulainen (Oslo and Akershus University College of Applied Sciences & Faculty of Technology, Art and Design, Norway)

Industrial operator's assessment is a very controversial subject within the scientific community, since it is a great challenge to determine the most suitable, objective and effective way to give feedback to the operator's performance. This paper presents a proposal on assessment methods for simulation training. The development is based on results from simulator training courses given in Oslo and Akershus University College of Applied Sciences (HiOA) 2010 - 2014. The results and course evaluation were analyzed to identify where to apply new methods that could lead to an improvement. The method suggested consists on an automatic assessment procedure, which will give to the simulator course participants fast feedback during the simulator session and help the students to achieve the learning outcomes. The suggested methods will be tested in the simulator training courses at HiOA on spring 2017.

11:15 ***Learning Heat Dynamics Using Modelling and Simulation***
Merja Mäkelä, Hannu Sarvelainen and Timo Lyytikäinen (Kymenlaakso University of Applied Sciences, Finland)
In the education of energy and power plant engineers, the learning of heat transfer, its dynamics and process control plays an important role. Deeper touch in dynamic process phenomena in our vibrant times may sometimes be a challenge for students and teachers. Modelling and simulation make a continuously increasing tool as a learning method, in various kinds of application fields. In engineering, using pilot or production plants, by modelling the systems, getting results from simulations and comparing the results to real life data, the intended learning outcomes can be achieved in a varying and motivating way. This paper presents a pilot heat exchanger which was mostly constructed by a few students of energy technology and supervised by their teachers. Some basic physical and identified process models of the heat exchanger are introduced, as well as their simulation results. This heat exchanger is widely used in the basic heat transfer and control system studies of higher education. Positive learning and teaching experiences were already achieved in the design and commissioning phase. As a result, the heat exchanger system offers a multifunctional learning environment with modelling and simulation activities in practice-oriented engineer studies.

11:35 ***OO Modelling and Control of a Laboratory Crane for the Purpose of Control Education***
Borut Zupancic and Primož Vintar (University of Ljubljana, Slovenia)
The paper deals with modelling, simulation and control of a laboratory crane for the purpose of control education. There were many similar activities in the past with realisations in causal modelling environments such is Matlab-Simulink. However we wanted to model and control the set-up also in the OO and multi-domain environment Dymola-Modelica using library components instead of mathematical equations to show all the advantages of such approach. The combination with some causal structures to solve certain problems is also discussed. The model was properly validated with some open and closed loop experiments. These results confirm the applicability of the model and the efficiency of the mentioned approach in modern control engineering courses.

11:55 ***A New Approach Teaching Mathematics, Modelling and Simulation***
Stefanie Winkler (Vienna University of Technology & TU Wien, Austria); Andreas Koerner (Vienna University of Technology & Institute for Analysis and Scientific Computing, Austria); Martin Bicher and Felix Breitenecker (Vienna University of Technology, Austria)
This paper introduces two different e-Learning environments. Both are used at the Vienna University of Technology to support the courses and exercises in mathematics. There are different level of courses. On the one hand there is a refresher course to support new students who might had some time off before starting their study as well as flatten different school levels of mathematics. On the other hand there are regular mathematical courses in the first two to three semester. Due to the fact improves and advanced possibilities the environment offered during the last years the system enables including of simulation examples into the system. In 2006 the research group Mathematical Modelling and Simulation (MMS) developed a individual web-server to provide students with simulation examples. This server was used in the lectures as well as for practice at home. In the last year also a combination of Moodle and this web application was used to perform test. This paper should give a short introduction in both systems and compare their advantages and disadvantages. In the outlook a new possibility is presented to combine the advantages of both presented systems.

Thu.AM2.E: Communication and Security
Chairs: Alessandro Vizzarri (University of Rome Tor Vergata, Italy), Yoji Morita (Kyotogakuen University, Japan)

10:15 ***Efficiency of QEs in USA through Estimation of Precautionary Money Demand***
Yoji Morita and Shigeyoshi Miyagawa (Kyotogakuen University, Japan)
FRB adopted "quantitative monetary easing" three times as QE1 (2008m11,2010m06), QE2 (2010m11,2011m06) and QE3 (2012m09,2014m12). In this paper, we showed that "Reserve at the FRB" is effective to the economy through a transmission path in a stock market in QE1, effective through housing price channel in QE2 and QE3, and effective through an exchange rate channel in QE3, where impulse responses in VAR model are calculated with variables: "reserve, stock prices, exchange rate, industrial production, cpi(core or housing price)" in monthly data of USA. Furthermore, we investigated the behavior of M2 money in QEs periods. Decomposing M2 money into transaction money demand and precautionary one, we estimated precautionary money demand as a function of industrial production, business condition denoted by napm and reserve at the FRB. We showed that increasing "Reserve at the FRB" is comparatively effective in QE1 rather than in QE2 and QE3 through the behavior of napm.

10:35 ***Simulation of HTTP-based Services over LTE for QoE Estimation***
Alessandro Vizzarri (University of Rome Tor Vergata, Italy); Fabrizio Davide (Università di Roma Tor Vergata, Italy)
Long Term Evolution (LTE) enables bandwidth consuming HTTP applications as video streaming. Mobile Network Operator (MNO) is committed to guarantee acceptable levels of Quality of Service (QoS) and Quality of Experience (QoE) perceived by the end user. A correlation between the transport informations with the application informations is an important approach to be adopted by the MNO. This correlation is more useful if a second entity, as the Over The Top (OTT), cooperates for the content delivery process. In the scientific literature different mathematical models are used in order to correlate QoE to the QoS. This paper aims to analyse them in case of of HTTP-based Web services as HTTP web browsing and HTTP video streaming. Different scenarios are simulated using OPNET simulation software tool. They can differ if the service is fully managed by the MNO (MNO-managed class) or if OTT cooperates with own content (OTT-managed). This is the case of YouTube. Results are analysed through regression k-means clustering techniques.

10:55 ***Simulation of VoLTE Services for QoE Estimation***
Alessandro Vizzarri (University of Rome Tor Vergata, Italy); Fabrizio Davide (Università di Roma Tor Vergata, Italy)
One the most important features of a Long Term Evolution (LTE) system is the high transmission data rate both in downlink and in uplink. This is not sufficient for a good Quality of Experience (QoE) perceived by the end user. The Mobile Network Operator (MNO) has to adopt appropriate techniques for an effective management of the Quality of Service (QoS) not only for bandwidth-consuming applications as video streaming but also for voice application as Voice Over LTE (VoLTE). These techniques can be based on the QoE/QoS correlation especially in case of a delay-sensitive application as VoLTE. This paper formulates a method for the QoE estimation starting from QoS informations available at network level. Different scenarios are simulated using OPNET software tool. Results are statistically analyzed using regression cluster analysis techniques

11:15 ***Simulation of Data Communication System Taking Into Account Dynamic Properties***
Galina Antonova (Trapeznikov Institute of Control Sciences Russian Academy of Sciences, Russia); Vadim Makarov (Trapeznikov Institute of Control Sciences Russian Academy of Sciences & National Research Nuclear University MEPhI, Russia)
This paper continues the study, presented at the 8th EUROSIM Congress on Modeling and Simulation and devoted to creation of algorithm and simulation model of network functioning, taking into account dynamic characteristics of the network in condition of change relationship signal/noise. For adequately represent of the state of the real network i.e. possible changes of topology due to the link failures and disabling individual nodes, simulation algorithm was augmented. It is possible to expand the model's capabilities, presented at the 8th Congress as simulation model of Information Flow on Transport Layer of Open System Interconnection-Model. The current version of the model realizes input of the adjacency matrix, describing the network topology, the algorithm of the path search by Dijkstra on the network level, simulating of the loss of connection. So the main goal of the new paper is to bring the structure of the model to the structure of the real network and to check the possibility of transferring a given amount of information in conditions of interference by means of evaluation of coefficient of readiness for Data Communication System.

11:35 ***Security Threats and Recommendation in IoT Healthcare***
Hanim Eken (Gazi University, Turkey); Cansu Eken (Ankara University, Turkey)
The Internet of Things (IoT) devices have become popular in recent year. All devices connect network and communicate each other. Therefore all devices become smart. They are used for some systems such as e-Health, e-Energy, e-Home, smart city, smart car etc. IoT device collect data for systems in order to analyze data and give right decision. Thus, attackers attack IoT systems. This paper gives an introduction to IoT healthcare systems and applications, the related security and privacy challenges. This paper tends to analyze the security threats in different layers of the IoT, and give recommendation owing to provide security and privacy.

Thursday, September 15, 13:15 - 14:00, Thu.PM1.A
Plenary: Alexey Popov, Room A, Chairs: Emilio Jiménez Macías (University of La Rioja, Spain), Antti Koistinen (University of Oulu, Finland)

Online Simulation Platform for Biophotonic Applications

Alexey Popov [1] , Alexander Bykov [1] , Alexander Doronin [2] , Hannu Sorvoja [1], and Igor Meglinski [1]

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Currently optical methods are gaining ground for biomedical applications such as cancer and cardiovascular diagnostics, dermatology, ophthalmology, pharmaceutical research, cosmetics and healthcare industry. Benefits of optical techniques are their non-invasiveness, ability for remote monitoring and access to biological objects from cell to body level, to name a few. Light irradiation dose, measurement volume, sensitivity of optical modalities are of crucial importance in biomedical diagnostics before implementing the developed techniques in in vivo research and clinical trials. An essential part of the preliminary studies is use of phantoms and simulations for optimal configuration of the setup and refining the measurement procedure. Up to now, such simulations were performed in every lab using own codes and local resources. We report about the next step in the computational diagnostics, an online computational platform for the needs of biomedical optics and bio-photonics. The results of imitation of human skin reflectance spectra and the corresponding skin colors are provided by the calculations.The platform can ease research in a number of areas and can be used for professional and educational purposes.

Biographies

Alexey Popov, D.Sc. (Tech.) is a Senior Researcher and Docent in Optoelectronics and Measurement Techniques Laboratory at the University of Oulu, Finland. He graduated from the Physics Department of M.V. Lomonosov State University (Russia) with M.Sc. degree in 2003 and was awarded with PhD degree in 2006. He received his D.Sc. (Tech.) degree from the Faculty of Technology of the University of Oulu (Finland) in 2008. He is an author of 90 papers in international peer reviewed journals and SPIE proceedings and ca. 100 presentations at major international conferences, symposia and workshops including 15 invited lectures. Currently, he is a Senior Researcher and Docent in the Optoelectronics and Measurement Techniques Laboratory at the University of Oulu; a member of SPIE and a Faculty Advisor of the SPIE Student Chapter of the University of Oulu, Northernmost and 1st in Finland.

Alexander Bykov, Ph.D. (Phys.) and D.Sc. (Tech.), born in 1981, is curently a Postdoctoral Researcher at the Optoelectronics and Measurement Techniques Laboratory, University of Oulu. He has over ten-year experience in research in the fields of photonics and biomedical optics. He received M.Sc. diploma in Physics at the M.V. Lomonosov Moscow State University in 2005 and Ph.D. in 2008 from the same university. In 2010, he received D.Sc.(Tech.) degree from the Faculty of Technology at the University of Oulu and continued as a postdoctoral researcher at the Optoelectronics and Measurement techniques laboratory. He is an author and co-author of over 60 scientific papers published in refereed international journals and book chapters, cosupervisor of undergraduate and postgraduate students.

Alexander Doronin is a Postdoctoral Associate in Computer Science working in Computer Graphics Group, Yale University, USA. His research interests are interdisciplinary and lie at the interface between Computer Science, Physics, Optics and Biophotonics focusing on Physically-Based Rendering, Development of realistic material models, Monte Carlo modeling of light transport in turbid media, Color Perception, Translucency, Appearance and Biomedical Visualization.

Hannu Sorvoja, D.Sc. (Tech.), born in 1966, is currently a Laboratory Manager at the Optoelectronics and Measurement Techniques Unit, University of Oulu. He has over twenty-year experience in research in the fields of biomedical engineering. He received M.Sc.(Tech.) in Electrical Engineering 1993, Lic.Sc.(Tech.) in 1998, and D.Sc.(Tech.) 2006, all from the Faculty of Technology at the University of Oulu, and continued as a professor and a postdoctoral researcher. He is an author and co-author over 40 scientific papers published in refereed international journals or conferences and three patents. In addition, he has supervised over 30 M.Sc.(Tech.) and Lic.Sc.(Tech.) theses.

Professor Igor Meglinski, Ph.D. is Head of Optoelectronics and Measurement Techniques Laboratory, Faculty of Information Technology and Electrical Engineering, University of Oulu. He has over 20 years experience in biomedical optics, biomedical engineering, medical physics, and sensor technologies. He is an author and coauthor of over 200 research papers in the peer reviewed scientific journals, proceedings of international conferences and book chapters, and over 400 presentations at the major international conferences and symposia, including over 200 invited lectures and plenary talks. His research interests lie at the interface between physics, medicine, and biological sciences, focusing on the development of new non-invasive imaging/diagnostic techniques and their application in medicine and biology, material sciences, pharmacy, food, environmental monitoring, and health care industries. For the last ten years, he has been a Principal Investigator and/or Coordinator for over 60 research projects, supported by various funding bodies, including UK NHS trust, NATO, Royal Society, U.S. CRDF, New Zealand Ministry of Business, Innovation & Employment, Maurice Wilkins Centre (MWC), New Zealand Ministry of Foreign Affairs and Trade, A*STAR (Singapore), Federal Agency for Science and Innovations (Russia), Weizmann Institute of Science (Israel) and industrial partners including Procter & Gamble, Philips, General Electrics, Unilever and other (with a total cumulative budget of over $16M). Prof. Meglinski is a Fellow of the Institute of Physics (London, UK) and Fellow of SPIE.

Thursday, September 15, 14:05 - 15:05

Thu.PM2.A: Panel: Intelligent Systems and IoT in Future Automation

Room: A

Chairs: Esko K. Juuso (University of Oulu, Finland), Lars Eriksson (Linköping University, Sweden)

In industry, intelligent systems have been developed for integrating data and expertise to develop smart adaptive applications. Recently, big data, cloud computing and data analysis has been presented as a solution for all kinds of problems. This provides feasible new things in global business and digitalisation in new applications. Can we take this as a general solution for automation? Are sensors only for collecting data to clouds? However, e.g. condition monitoring introduces huge volumes of data. Wireless solutions are improving fast: 3G, 4G, 5G. But can we transfer signals to clouds and store the data? Is this too much? Where is the expertise? Obviously, local calculations are needed. Are they based on intelligent systems? Also the security of the automation becomes increasingly important in distributed systems.

Transport systems are analysed as discrete event systems to find bottlenecks and avoid risks. Urban traffic is becoming an important area. Autonomous driving is a hot topic. What is needed to embed this in the urban traffic? Are there analogies with industrial systems? Mechatronics is an essential part in machines and many process devices. IoT with sensor development and access to traffic information opens up many opportunities for planning and control of transport through optimization.

What are the main differences between industrial systems and transport systems? Can we use similar control solutions? What can we learn from other areas? Can we find analogies? What is common? Where do we have differences? What kind of models do we need? What should the control education include?

Thu.PM2.B: Modelling Tools-I

Room: B, Chairs: Niklas Paganus (Fortum Power and Heat Ltd., Finland), Adrian Pop (Linköping University & SICS East, Sweden)

2:05 ***Automatic Generation of Dynamic Simulation Models Based on Standard Engineering Data***
Niklas Paganus (Fortum Power and Heat Ltd., Finland); Marko Luukkainen (VTT Technical Research Centre of Finland Ltd., Finland); Karri Honkoila (Fortum Power and Heat Ltd., Finland); Tommi Karhela (VTT Technical Research Centre of Finland Ltd.)
Dynamic process simulation is used to mitigate risks, reduce costs and improve safety in plant engineering. Traditionally, simulation models are created manually from engineering source data. Benefits of utilising simulation are recognised by the industry, but simulation is not exploited to its full potential due to its current laborious nature. Engineering software interoperability improves efficiency in engineering workflows. Required manual work is reduced, enabling faster and more robust design to be conducted. In process industry and power generation, the ISO 15926 standard is being adopted as a neutral engineering data classification. In this paper, work conducted by authors in integrating the dynamic process simulation software Apros into the engineering workflow by automatically creating simulation models based on standard engineering data is reported. A case study was conducted to demonstrate the implemented features. Process engineering data in the Proteus XML format was used as the source data for simulation model generation. The case study shows that the implemented features reduce manual work required, lowering the threshold for utilising simulation.

2:25 ***Industrial Evaluation of an Efficient Equation Model Debugger in OpenModelica***
Åke Kinnander (Siemens Turbo Machinery AB, Sweden); Martin Sjölund (Linköping University, Sweden); Adrian Pop (Linköping University & SICS East, Sweden)
The ease of use and the high abstraction level of equation-based object-oriented languages (EOO) such as Modelica has the drawback that programming and modeling errors are often hard to find. To address this problem, we have earlier developed an advanced equation model debugger in the OpenModelica tool. The aim of this paper is to perform an independent investigation and evaluation of the OpenModelica equation model debugger on industrial models. The results turned out to be mainly positive, the debugger located several kinds of errors such as division by zero, chattering, etc. It remains to further evaluate the debugger on larger industrial models.

2:45 ***A Simulation Model Validation and Calibration Platform***
Shenglin Lin, Wei Li and Xiaochao Qian (Control and Simulation Center, Harbin Institute of Technology (HIT), P.R. China); Ping Ma (Control and Simulation Center, Harbin Institute of Technology, P.R. China); Ming Yang (Control and Simulation Center, Harbin Institute of Technology (HIT), P.R. China)
The simulation model validation and calibration (SMVC) is a complicated work, including uncertainty description, many simulation experiments execution and complex data analysis etc. Moreover, there are many uncertainty factors such as model form assumptions and solution approximations, random variability of model inputs, etc. need to be considered when requiring a precise model. For assisting the SMVC effectively, this paper develops a software platform to validate and calibrate the simulation models when some quantities may be affected by uncertainty. First, an unprecedented process model, which includes uncertainty description, simulation experiment design, model validation and model calibration, is presented to explicate the procedures of SMVC under uncertainty. In the process model, many new model validation and calibration algorithms under uncertainty are applied based on our previous work. Second, the design of platform is divided into two parts, which consist of structure design and function design, and the software technique based on strategy pattern is introduced to integrate and maintain the SMVC algorithms. Then this platform is implemented according to its expected uses and key design requirements. Finally, application example of model validation and calibration of a flight vehicle kinematic control system is illustrated how to use the platform.

Thu.PM2.C: Planning and scheduling

Room: C, Chairs: Andreas Koerner (Vienna University of Technology & Institute for Analysis and Scientific Computing, Austria), Juliana Sagawa (Federal University of São Carlos & BIBA - Bremer Institut für Produktion und Logistik, Brazil)

2:05 ***A Simulation Model for the Closed-Loop Control of a Multi-Workstation Production System***

Juliana Sagawa (Federal University of São Carlos & BIBA - Bremer Institut für Produktion und Logistik, Brazil); Michael Freitag (BIBA - Bremer Institut für Produktion und Logistik GmbH at the University of Bremen & University of Bremen, Germany)

In this paper, we propose a simulation model with a PI controller to analyze and control the dynamics of a multi-workstation production system. The formulation is based on dynamic modelling and control theory, and the model was implemented in Matlab and Simulink. Exploratory tests were carried out, and the results indicated some relationships between the values of the parameters of the controller and the values of the output variables, that is, the levels of work in process. They also showed that the proposed model has the potential of providing managerial directions on how to dynamically adjust the capacity, aiming to smooth the operation of the shop floor and to keep the work in process close to the desired levels.

2:25 ***Creating Social-aware Evacuation Plans Based on a GIS-enable Agent-based Simulation***

Kasemsak Padungpien and Worawan Diaz Carballo (Marurngsith) (Thammasat University, Thailand)

In disaster preparedness, agent-based simulation (ABS) is an effective tool for aggregating information on evacuees affected by disasters. An agent usually imitates a household; and its actions are normally specified by decision models based on risk perception and social elements. Assigning socially connected households to the same shelters can better utilise resources. However, by pre-assigning specified regions to shelters, social connections are often omitted when developing evacuation plans at policy level. Thus, this paper presents a method to create social-aware evacuation plans. A GIS-enabled ABS is used to estimate evacuation demand and group evacuees according to their social connection data prior to assign them to the nearest shelters. The evacuation plans generated by the proposed method are compared against the travel-cost optimisation plans solved by using a linear model. The results obtained from a case study show that the social-aware evacuation plans offer a slightly better utilisation of shelter capacity; take similar time to evacuate households; yet could save nearly three hours to achieve complete evacuation. These results seem to confirm the competitiveness of social-aware evacuation plans as an option for evacuation planning at policy level.

Thu.PM2.D: Artificial Neural Networks

Room: D, Chairs: Leon Bobrowski (Bialystok University of Technology, Bialystok, Poland), Niki Popper (dwh Simulation Services, Austria)

2:05 ***Developing New Solutions for a Reconfigurable Microstrip Patch Antenna by Inverse Artificial Neural Networks***
Ashrf Aoad (Akşemsettin mh.- OkumuşAdam Sok.-Burak Ap. No:7/4- Fatih & Electrical and Electronics Engineering, Turkey); Murat Simsek (Istanbul Technical University, Turkey)
This paper presents the use of inverse artificial neural networks (ANNs) to develop and optimize a reconfigurable 5-fingures shaped microstrip patch antenna. New solutions are produced by using three accurate prior knowledge inverse ANNs with sufficient amount of training data where the frequency information is incorporated into the structure of ANNs. The proposed antenna can operate with four modes, which are controlled by two PIN diode switches with ON/OFF states, and it resonates at multiple frequencies between 2-7 GHz. The complexity of the input/output relationship is reduced by using prior knowledge. Three independent methods of incorporating knowledge in the second step of the training process with a multilayer perceptron (MLP) in the first step are demonstrated and their results are compared to EM simulation.

2:25 ***Dynamic Artificial Neural Network (DANN) MATLAB Toolbox for Time Series Analysis and Prediction***
Khim Chhantyal (University College of Southeast Norway, Norway); Minh Hoang and Håkon Viumdal (University of Southeast Norway, Norway); Saba Mylvaganam (University of Southeast Norway)
MATLAB® Neural Network (NN) Toolbox can handle both static and dynamic neural networks. To use this MATLAB® NN Toolbox, in cases where recurrent neural networks occur is not straight forward. We present a Dynamic Artificial Neural Network (DANN) MATLAB toolbox capable of handling fully connected neural networks for time-series analysis and predictions. Three different learning algorithms are incorporated in the DANN MATLAB toolbox: Back Propagation Through Time (BPTT) an offline learning algorithm and two online learning algorithms; Real Time Recurrent Learning (RTRL) and Extended Kalman Filter (EKF). In contrast to existing MATLAB® NN Toolbox, the presented DANN MATLAB toolbox has a possibility to perform the optimal tuning of network parameters using grid search method. Three different cases are used for testing three different learning algorithms. The simulation studies confirm that the developed DANN MATLAB toolbox can be easily used in time-series prediction applications successfully. Some of the essential features of the learning algorithms are seen in the graphical user interfaces discussed in the paper. In addition, installation guide for the DANN MATLAB toolbox is also given.

2:45 ***Flow Rate Estimation Using Dynamic Artificial Neural Networks with Ultrasonic Level Measurements***
Khim Chhantyal (University College of Southeast Norway, Norway); Håkon Viumdal and Minh Hoang (University of Southeast Norway, Norway); Saba Mylvaganam (University of Southeast Norway); Geir Elseth (Statoil, Norway)
Accurate estimation of flow in drilling operations at inflow and outflow positions can lead to increased safety, optimized production and improved cost efficiency. In this paper, Dynamic Artificial Neural Network (DANN) is used to estimate the flow rate of non-Newtonian drilling fluids in an open channel Venturi-rig that may be used for estimating outflow. Flow in the Venturi-rig is estimated using ultrasonic level measurements. Simulation study looks into fully connected Recurrent Neural Network (RNN) with three different learning algorithms: Back Propagation Through Time (BPTT), Real-Time Recurrent Learning (RTRL) and Extended Kalman Filter (EKF). The simulation results show that BPTT and EKF algorithms converge very quickly as compared to RTRL. However, RTRL gives more accurate results, is less complex and computationally fastest among these three algorithms. Hence, in the experimental study RTRL is chosen as the learning algorithm for implementing Dynamic Artificial Neural Network (DANN). DANN with RTRL learning algorithm is compared with Support Vector Regression (SVR) and static ANN models to assess their performance in estimating flow rates. The comparisons show that the proposed DANN is the most accurate model among three models as it uses previous inputs and outputs for the estimation of current output.

Thu.PM2.E: Biological Systems and Health

Room: E

Chairs: Gorazd Karer (Faculty of Electrical Engineering, University of Ljubljana, Slovenia), Sabri Pllana (Linnaeus University, Sweden)

2:05 ***Artificial Neural Networks Application in Intraocular Lens Power Calculation***
Martin Sramka (Czech Technical University in Prague, Czech Republic); Alzbeta Vlachynska (Tomas Bata University, Czech Republic)
This text deals with intra-ocular lens (IOL) power calculations during the cataract surgery. At present, IOL power calculated by formulas are usually able to provide acceptable results for the majority of the patients. Problem appears when any of input parameters has value which is not normal in population distribution. Then the patient post-operative refraction result can inconsiderable deviate from intended target. This work describes approach how to preoperatively indicate, which samples of patient could be problematic in accurate IOL calculations, by classification of Artificial Neural Networks (ANN). Small and long eyes are used to test ability of ANN to classify input samples, which are taken from pre-operative measurements, to several groups, which represents probable post-operative result. In our experiment ANN classifies samples into two groups. First group is for data samples with probable result in positive ranges of diopter and second group is for negative ranges. Accuracy of ANN in this case is 94.1 %.

2:25 ***Tuning of Physiological Controller Motifs***
Tormod Drengstig, Geir Risvoll, Daniel Tveit, Peter Ruoff and Kristian Thorsen (University of Stavanger, Norway)
Genetic manipulation is increasingly used to fine tune organisms like bacteria and yeast for production of chemical compounds such as biofuels and pharmaceuticals. The process of creating the optimal organism is difficult as manipulation may destroy adaptation and compensation mechanisms that have been tuned by evolution to keep the organisms fit. The continued progress in synthetic biology depends on our ability to understand, manipulate, and tune these mechanisms. Concepts form control theory and control engineering are very applicable to these challenges. From a control theoretic viewpoint, disturbances rejection and set point tracking describe how adaptation mechanisms relate to perturbations and to signaling events. In this paper we investigate a set regulatory mechanisms in the form of biochemical reaction schemes, so-called controller motifs. We show how parameters related to the molecular and kinetic mechanisms influence on the dynamical behavior of disturbance rejection and set point tracking of each controller motif.

2:45 ***Modelling of Target-Controlled Infusion of Propofol for Depth-of-Anaesthesia Simulation in Matlab-Simulink***
Gorazd Karer (Faculty of Electrical Engineering, University of Ljubljana, Slovenia)
Total intravenous anaesthesia (TIVA) is an anaesthesiologic technique, where substances are injected intravenously. The anaesthesiologist adjusts the injection of intravenous anaesthetic agents regarding the depth of anaesthesia. In the paper, we present a model of an anaesthetic agent, namely propofol, influencing the depth of anaesthesia. The influence of propofol is linked to the concentration of the drug in the appropriate compartment. First, the modelling of pharmacokinetics of propofol is introduced. The 3-compartmental model and the effect-site model are presented, the relevant model parameters are given. Next, the model is verified by comparing the simulation results to the data file that was recorded by the Orchestra Base Primea infusion workstation during a medical procedure, which lasted about 40 minutes. The simulation results are presented and the predictive quality of the model is evaluated. The presented model for Matlab-Simulink provides a basic tool for further researching the dynamics of anaesthetic depth. Despite the fact that more data must be obtained in order to properly validate the model, the presented model provides a basis for running simulations and testing various scenarios of propofol administration and is usable for developing and testing closed-loop control approaches for automatic control of depth of anaesthesia.

Thursday, September 15, 15:10 - 16:10

Thu.PM3.A: Virtual Reality & Visualization

Room: A, Chairs: Juhani Heilala (VTT Technical Research Centre of Finland Ltd, Finland), Tiina Komulainen (Oslo and Akershus University College of Applied Sciences & Faculty of Technology, Art and Design, Norway)

3:10 ***3D Virtual Fish Population World for Learning and Training Purposes***
Bikram Kawan and Saleh Alaliyat (Norwegian University of Science and Technology, Norway)
This paper presents the potential use of the 3D virtual world of fish population for training and educational purposes, especially for who are new to fish farming industry. Virtual Reality is the proven technology which is emerging everyday with new methods and implementation. We simulate the fish swimming behavior based on the social rules that are derived from flocking behavior of birds. The simple relation we proposed to represent fish birth and death resembles the biological ecosystem of fish in the sea. The experiment results from different case studies we carried out show the realistic fish population dynamics. The system user interface gives the users the ability to change the system parameters for different cases to see the real-time effect. We have proven the great potential of this framework to simulate many complex environments by going through many case studies.

3:30 ***Virtual Reality Simulators in the Process Industry - A Review of Existing Systems and the Way towards ETS***
Jaroslav Cibulka (Oslo and Akershus University College og Applied Sciences, Norway); Tiina Komulainen (Oslo and Akershus University College of Applied Sciences & Faculty of Technology, Art and Design, Norway); Peyman Mirtaheri (Oslo and Akershus College of Applied Sciences, Norway); Salman Nazir (Buskerud and Vestfold University College, Norway); Davide Manca (Politecnico di Milano, Italy)
Simulator training with Virtual Reality Simulators deeply engages the operators and improves the learning outcome. The available commercial 3D and Virtual Reality Simulator products range from generic models for laptops to specialized projection rooms with a great variety of different audiovisual, haptic, and sensory effects. However, current virtual reality simulators do not take into account the physical and psychological strain involved in field operators' work in real process plants. Collaborative training using Extreme Environments Training Simulators could enhance the learning process and provide a more realistic perception of the time and effort needed to carry out demanding operations in Extreme Environments. We suggest developing the following features for an optimal ETS experience and safe learning environment: immersive 3D virtual environments, mixed-reality features, automated assessment, and a monitoring system for the physiological and psychological condition of the trainees.

Thu.PM3.B: Modelling Tools-II

Room: B

Chairs: Niklas Paganus (Fortum Power and Heat Ltd., Finland), Adrian Pop (Linköping University & SICS East, Sweden)

3:10 ***Powertrain Model Assesment for Different Driving Tasks through Requirement Verification***
Anders Andersson (Swedish National Road and Transport Research Institute, Sweden); Lena Buffoni (Linköping University, Sweden)
For assessing whether a system model is a good candidate for a particular simulation scenario or choosing the best system model between multiple design alternatives it is important to be able to evaluate the suitability of the system model. Verifying the system against the requirements through simulation allows to reduce the risk of modelling errors, resolve ambiguities in requirement specification and makes it easy to test and compare the performance of different system models. In this paper we present a methodology for verifying system behavior through requirements in a Modelica environment and illustrate it on a powertrain model use-case.

3:30 ***Comparing Modelling and Simulation Approaches for Structural Dynamic Systems by Means of the ARGESIM Benchmarks***
Felix Breitenecker (Vienna University of Technology, Austria); Andreas Koerner (Vienna University of Technology & Institute for Analysis and Scientific Computing, Austria)
Modelling and simulation of structural dynamic systems is getting more and more important in advanced modelling theory and application. Up to now the description of the structural dynamic changes and of the state events scheduling these changes are defined in a grey zone between mathematical model description and model implementation. For review and for a basis for basis for proper standardisation, SNE, EUROSIM's membership journal, has set up in its benchmark series a new benchmark dealing with this topic: SNE ARGESIM Benchmark C21 'State Events and Structural Dynamic Systems'. Simulationists are invited to propose and publish template solutions, showing the broad variety of approaches in modelling and implementation using proper simulation tools.

3:50 ***A Novel Credibility Quantification Method for Welch's Periodogram Analysis Result in Model Validation***
Yuchen Zhou, Ke Fang, Kaibin Zhao and Ping Ma (Control and Simulation Center, Harbin Institute of Technology, P.R. China)
Welch's periodogram is widely used in frequency domain validation. However, Welch's analysis results just shows whether the time series passed the consistency test in each discrete frequency point, which isnot a quantitative credibility evaluation result and may not help the evaluation expert to grade credibility level of simulation system. Based on Welch's periodogram and consistency test approach, a novel credibility quantification method using weight density function is proposed. Furthermore, the frequency analysis and credibility quantification process is provided. Finally, the credibility quantification of radiated noise in ship acoustic feature simulation indicates the method proposed is effective for periodic time series with complicated spectrum.

Thu.PM3.C: Power Transmission and Three-Phase Systems

Room: C

Chairs: Robert Lis (Wroclaw University of Science and Technology, Poland), Glaucio L. Ramos (Federal University of São João Del-Rei, Brazil)

3:10 ***Voltage Stability Assessment of the Polish Power Transmission System***
Robert Lis (Wroclaw University of Science and Technology, Poland)
PSE S.A. is the sole Transmission System Operator in Poland responsible for the provision of reactive power resources for maintaining the voltage within predefined limits. In this context, scope of the current study is to quantify the voltage stability limits of the Polish Power System and identify the determining factors which may lead to voltage instability incidents. The idea of P-V and Q-V curve is used to determine the maximal reactive margin at load buses to avoid voltage instability. Sometimes the voltage stability study may be limited to identify the violation of the bus voltage constraints. In this paper the p-q curve for the critical bus voltage magnitude is created. Using this p-q curve the probability of the critical voltage violation is estimated for uniformly distributed active and reactive power at a given load bus. The p-q curve is created on the basis of bus impedance, which can be measured or calculated. To illustrate the usefulness of p-q idea the simple numerical example is presented. The paper describes also the importance of reactive power control basing on the failures and control problems in the PPS during a dry summer period. A detailed description of the operational difficulties is provided.

3:30 ***Hardware-in-the-Loop Emulation of Three-Phase Grid Impedance for Characterizing Impedance-Based Instability***
Tuomas Messo, Tomi Roinila, Jussi Sihvo, Tommi Reinikka and Roni Luhtala (Tampere University of Technology, Finland)
The amount of grid-connected power electronic converters is increasing as the world's energy sector shifts toward sustainable sources. Reduced power quality and instability has been reported which have been shown to be caused by grid-connected converters. Accurate modeling tools are required to characterize the conditions for instability and to design stable power-electronics-based power systems. Methods to reduce the risk of instability include modeling studies using a circuit simulator and hardware-in-the-loop studies (HIL). Instability may occur when inverter control system starts interacting with grid impedance. However, a very wide impedance-bank is required in the laboratory to test inverter stability when grid impedance is expected to vary substantially over time. This paper proposes a method to emulate the grid impedance behavior in a hardware-in-the-loop setup which eliminates the need for bulky passive components and would allow arbitrary grid impedance to be emulated. As a result, the inverter can be tested with a changing grid impedance to find out the exact conditions for unstable behavior. Moreover, the grid impedance can be changed online to emulate the behaviour of a real time-varying power grid.

3:50 ***dSPACE Implementation for Real-Time Stability Analysis of Three-Phase Grid-Connected Systems Applying MLBS Injection***
Tomi Roinila, Tuomas Messo, Aapo Aapro, Roni Luhtala, Tommi Reinikka and Jussi Sihvo (Tampere University of Technology, Finland)
Renewable resources such as solar and wind are most commonly connected to a utility grid through inverters. The stability and system characteristics of such systems can be defined by the ratio of grid impedance to the inverter output impedance. Since the impedances vary over time with numerous operation conditions, real-time measurements are required to verify the stability. The impedance measurement technique based on maximum-length-binary-sequence (MLBS) injection and Fourier techniques has been proven to be an efficient option for online analysis of grid-connected systems. This paper shows how a hardware-in-the-loop simulation based on dSPACE can be implemented for stability analysis of a grid-connected inverter using the MLBS injection. The method makes it possible to modify the inverter control characteristics and grid conditions online, thereby providing means for various stability and control design studies for grid-connected systems. We have presented a measurement example based on a three-phase grid-connected inverter and used this example to demonstrate the implementation.

Thu.PM3.D: Mechatronics and Robotics
Chairs: Hiroyuki Kano (Tokyo Denki University, Japan), Mika Pylvänäinen (University of Oulu, Finland)

3:10 ***Spline Trajectory Planning for Path with Piecewise Linear Boundaries***
Hiroyuki Kano (Tokyo Denki University, Japan); Hiroyuki Fujioka (Fukuoka Institute of Technology, Japan)
We consider a problem of trajectory planning for path with piecewise linear boundaries. The trajectory is constructed as smoothing splines using normalized uniform B-splines as the basis functions. The boundary constraints are treated as a collection of inequality pairs by right and left boundary lines, and are formulated as linear inequality constraints on the so-called control point vector. Smoothing splines are constructed as an approximation of a piecewise linear centerline of the given path, where the given entire time interval is divided into subintervals according to the centripetal distribution rule. Other constraints as initial and terminal conditions on the trajectory can be included easily, and the problem reduces to convex quadratic programming problem where very efficient numerical solvers are available. The effectiveness of the proposed method is confirmed by an example of fairly complex path with piecewise linear boundaries. Also an example is included to demonstrate its usefulness for trajectory planning in an environment with obstacles.

3:30 ***A Harvest Vehicle with Pneumatic Servo System for Gathering a Harvest and Its Simulation Study***
Katsumi Moriwaki (Daido University, Japan)
A series of works such as harvesting and transporting in a farm is one of such works with so care as not to damage the harvest in order to maintain the value of harvests. We are developing an autonomous cart for gathering a harvest with the bed to be controlled to keep in horizontal level, in order to avoid harvests gathered in particular area of the bed and to keep away from being damaged in harvests. It is proposed a method of control of a harvest vehicle with maintaining the horizontal level of the bed of the cart with air cylinder suspension systems.

3:50 ***Interactive Modeling and Simulation of Micromirror MEMS Devices***
Sarbast Rasheed (American University of Iraq, Sulaimani, Iraq)
This paper presents an interactive software package for the modeling and simulation of micro-electromechanical system (MEMS) devices utilizing the MATLAB high-level programming language and its interactive environment. The package provides a dynamic analysis and frequency responses of a 1-D torsional micromirror electrostatically actuated with staggered vertical comb-drives. Applying a frequency sweep to the micromirror equation, the torsional mode natural frequency may be estimated. The developed package consists of several graphical user interfaces used for modeling MEMS devices and it is convenient and easy to use and change as it involves multiple runs designed to investigate the effects of different system parameters, initial conditions, and model changes.

Thu.PM3.E: Bioprocesses and IoT

Room: E

Chairs: Sabri Pllana (Linnaeus University, Sweden), Ari Jääskeläinen (Savonia University of Applied Sciences, Finland)

3:10 ***How Does Modern Process Automation Understand the Principles of Microbiology and Nature***

Ari Jääskeläinen, Risto Rissanen, Asmo Jakorinne, Anssi Suhonen, Tero Kuhmonen and Tero Reijonen (Savonia University of Applied Sciences, Finland); Anneli Heitto and Elias Hakalehto (Finnoflag Oy, Finland); Eero Antikainen (Savonia University of Applied Sciences, Finland)

Biotechnology deals with processes that are based on naturally occurring, mainly organic chemistry phenomena. As part of these processes are different microbes, which require conditions that should always be maintained optimal. For control engineering and process control these are demanding cases to adjust and measure various variables in order to reach the desired outcomes. The problems are almost impossible to be solved otherwise than through close cooperation between experts from various fields. Future biorefineries will work according to the principles of Nature, using microbes and enzymes for upgrading wastes and other biomass into biofuels, other bioenergy substances, organic platform chemicals, and organic fertilisers. A mobile biorefinery pilot plant was engineered and manufactured in Finland and tested in Finland, Poland and Sweden with various biowastes within ABOWE project. National and international teams learned to co-operate well in this milieu where biological components (biomass, microbes and enzymes) met with metal hardware, sensors and computerised control. The main purpose of the ABOWE Biorefinery pilot plant tests was to give a reliable proof of concept on the industrially important substances producible in a sustainable way. This goal was achieved successfully, and several overall difficulties were overcome during the testing in three countries.

3:30 ***The Internet of Things for Aging and Independent Living: A Modeling and Simulation Study***

David Perez, Suejb Memeti and Sabri Pllana (Linnaeus University, Sweden)

Population aging is affecting many countries, Sweden being one of them, and it may lead to a shortage of caregivers for elderly people in near future. Smart interconnected devices known as the Internet of Things may help elderly to live independently at home and avoid unnecessary hospital stays. For instance, a carephone device enables the elderly to establish a communication link with caregivers and ask for help when it is needed. In this paper, we describe a simulation study of the care giving system in the Vaxjo municipality in Sweden. The simulation model can be used to address various issues, such as, determining the lack or excess of resources or long waiting times, and study the system behavior when the number of alarms is increased.

Thursday, September 15, 16:15-16:45

Closing Session, Room A

Final Proceedings

Publication of revised papers

The Presidency period 2016 – 2019

EUROSIM 2019 Congress & Venue

Meetings

Monday, September 12, Room D, 17:00-18:30, FinSim Annual Meeting

Tuesday, September 13, Room F, 10:15 – 10:45, Career development in the world of technology
Chair: Rafal Sliz, University of Oulu, IEEE Finland Section

This brief workshop covers everything non-technical that can help you in your career. Why are networking and soft skills so important? What can you do to boost your career and stay up-to-date in a fast-changing (technical) environment? What does IEEE provide for its members as part of lifelong learning and professional development? This workshop will help you understand the power of networking and give you an opportunity to learn and share your thoughts and ideas about your career in the technical world.

Tuesday, September 13, Room F, 12:45 – 13:45, SIMS Board

Tuesday, September 13, Room D, 17:50 – 18:40, SIMS Annual Meeting

Tuesday, September 13, 20:30 – , Young Professionals Meetup event
Chair: Rafal Sliz, University of Oulu, IEEE Finland Section

This event will allow students and young professionals taking part in the Eurosim 2016 conference to mingle, network, and connect. This gathering will be held in one of the oldest bars in Oulu - Keltainen Aitta, located at the Oulu Market Square, allowing participants to exchange their knowledge and experiences in a less formal atmosphere. The event will be sponsored by IEEE and refreshment drinks will be provided. If you want to spend time in a friendly atmosphere and extend your professional network, do not hesitate to join our meetup event.

Wednesday, September 14, Room F, 12:30 – 13:30 Eurosim Executive Board

Wednesday, September 14, Room F, 16:15 – 18:00 Eurosim Board

Thursday, September 15, Room F, 10:15 – 10:45, EUROSIM Technical Committees