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Wednesday, September 6

Wednesday, September 6

KEYNOTE PRESENTATIONS

8:30 AM - 9:15 AM

WELCOME TO RT17! A NEW ERA OF REAL-TIME SIMULATION AT OPAL-RT TECHNOLOGIES

Jean Bélanger
CEO & CTO, OPAL-RT TECHNOLOGIES

Jean built OPAL-RT with the vision of bringing high-end real-time simulation tools to all engineers and scientists. Today, under his direction and technological leadership, OPAL-RT has become a world-renown developer of state-of-the-art real-time simulators capable of simulating all types of mechanical and electrical systems. Before founding OPAL-RT, Jean led a successful career at Hydro-Québec and is a fellow of the Canadian Academy of Engineering.

9:15 AM - 10:40 AM

POWER SYSTEMS KEYNOTE

Abstract

The business of power generation and transmission is evolving at a faster pace than ever before, with systems growing larger and more interconnected while simultaneously being tailored to individual, highly specialized needs. This race to build tomorrow's energy grid will require a complex understanding of every moving part, not just what we build today but what we're designing for the future.

Wednesday's keynote will serve as a tour of the industry's greatest challenges and most exciting opportunities: new technologies integrating thousands of individual microgrids with national smart grids spanning continents, the evolution of the IEC architecture underpinning it all, and the market trends emerging across the globe, from Québec to China.

Étienne Leduc
Product Owner, HYPERSIM®
OPAL-RT TECHNOmtrLOGIES

Weihua Wang, MScE
Chief Representative, Technical Center Asia Pacific
OPAL-RT TECHNOLOGIES

Weihua Wang was born in Beijing, China in 1982. He received his M.Sc.E degree from University of New Brunswick, Canada in 2007. He joined OPAL-RT technologies in 2009, and is currently working as a simulation specialist and the chief representative of the Asia-pacific Technical Center.

Since 2010, Weihua has been involving in the development of the real-time model for the MMC. He developed and commissioned eight VSC-HVDC Hardware-in-the-loop test benches in the past 5 years. He also participated in or supervised the factory acceptance tests of the control and protection systems using real-time simulator for all FIVE MMC projects in China using OPAL-RT simulators (Nanhui in 2011, Nan'ao an Zhoushan in 2013, Xiamen and Lu-xi in 2015). He is currently participating in the project with CEPRI to build one of the largest HIL test bench to simulate the main backbone of the State Grid China, which includes more than 18 LCC or VSC based HVDC link.

His field of interests are real-time simulation of VSC-based HVDC systems, DC distribution networks and smart grids, as well as complex medium voltage drives.

Romain Guilbault
Studies, Modeling and Specialized Testing
OPAL-RT TECHNOLOGIES

Romain Guilbault was born in La Rochelle, France in 1989. He received his bachelor degree in engineering from École de technologie supérieure, Canada in 2015. He joined OPAL-RT technologies in 2016 and is currently working as a field application specialist, covering new protection technologies, wide area monitoring and communication protocols.

Even before working at OPAL-RT, Romain was part of a pioneer pilot project at Hydro-Québec, studying IEC 61850-9-2 related technologies and IEDs for 3 years. Since joining OPAL-RT, he has been involved in the continuous improvement of OPAL-RT approach and solutions regarding C37.118.2011, IEC 61850 and related standards. Romain also participated in the creation of trainings about IEC 61850 that were given four time within a year, in four different countries. He continues to work toward a better visibility of Real-Time simulation in future smart grid projects.

His fields of interests are relay testing, IED testing and protection scheme conception, Smart Grid and related protocols.

Vahid Jalili-Marandi, Ph.D.
Team Leader, ePHASORSIM
OPAL-RT TECHNOLOGIES

Vahid is a simulation specialist with focus on transient stability studies of large-scale power systems. His expertise includes parallel processing and high performance computation in power system application, electromagnetic and hybrid simulation, and numerical methods.

He received his Ph.D. degree in energy systems from the University of Alberta, Canada, in 2010. He joined OPAL-RT Technologies in September 2010 and founded ePHASORSIM as the real-time solver for transient stability simulation of large power systems. Since then he has been engaged in different aspects of the product including research and development, integration, modeling and marketing. Currently, he is ePHASORSIM's team leader.

Abstract:

The business of power generation and transmission is evolving at a faster pace than ever before, with systems growing larger and more interconnected while simultaneously being tailored to individual, highly specialized needs. This race to build tomorrow's energy grid will require a complex understanding of every moving part, not just what we build today but what we're designing for the future. Wednesday's keynote will serve as a tour of the industry's greatest challenges and most exciting opportunities: new technologies integrating thousands of individual microgrids with national smart grids spanning continents, the evolution of the IEC architecture underpinning it all, and the market trends emerging across the globe, from Québec to China.

The Right Tools for Sustaining the Evolution of the Smart Grid: HYPERSIM, Digital Real-Time Simulation

Part of the Power Systems Keynote

Innocent Kamwa, ing., Ph.D., FIEEE, FCAE,
Head - Power Systems and Mathematics
IREQ (HYDRO QUEBEC RESEARCH INSTITUTE)

Innocent Kamwa obtained his B.S. and Ph.D. degrees in Electrical Engineering from Laval University, Québec City in 1985 and 1989 respectively. He has been a research scientist and registered professional engineer at Hydro-Quebec Research Institute since 1988, specializing in system dynamics, power grid control and electric machines. After leading System Automation and Control program for years he became Chief scientist for smart grid in 2009, Chief of Power System and Mathematics in 2014, overseeing the Hydro-Quebec Network Simulation Centre known worldwide, and Acting Scientific Director of IREQ in 2016.

Dr. Kamwa has held an Adjunct professor position in Electrical Engineering at Laval University since 1990 and McGill University since 2011, mentoring over 35 graduate students. An associate editor of Inter. Journal on Electrical Power & Energy Systems, IEEE Transactions on Power Systems, and IEEE Power Systems Letters, he is also Editor-in-Chief of IET Generation, Transmission and Distribution since 2012. A Member of Cigré, Dr. Kamwa is currently the chair of IEEE stability subcommittee, Treasurer and Standard Coordinator of IEEE Electric Machinery Committee and past member (2009-2013) of the Fellow evaluation committee of IEEE Power Engineering Society. Dr. Kamwa's Honors include four IEEE Power Engineering best paper prize awards, three IEEE Power Engineering outstanding working group awards, a 2013 IEEE Power Engineering Society Distinguished Service Award, Fellow of IEEE in 2005 for "innovations in power grid control" and Fellow of the Canadian Academy of Engineering.

Abstract:

After revisiting the main grid modernization concepts, the speaker will scope the challenges facing utilities in the new context of energy transition and digital transition. Then he will outline some innovation projects developed at IREQ to support Hydro-Quebec in digesting new energy technologies, which pose many challenges while enabling tremendous opportunities: 1) Massive integration of renewable energy resources and distributed resources, 2) Adoption of power electronic equipment (FACTS, VSC-HVDC) allowing greater grid control, 4) Deployment of smart monitors and synchrophasors allowing greater network observation with more cybersecurity risk exposure and 5) Open access to energy markets, marked by enormous renewable power fluctuations over long distances and hundreds of daily transactions year-round.

Using practical use cases with added value taken from Hydro-Quebec operations, the speaker will make the case that Hypersim based simulation tools are major enablers for accelerating new technology energy adoption, by reducing the development cycle and minimizing commission time through hardware-in-the-loop proof-of-the-concept prototyping and testing. The presentation will be concluded by discussing some current developments at IREQ which leverage Hypersim HIL simulator in new products and applications such as simulation of interactions between Smart Grid and Telecom Grid, Co-simulation of large grids, faster-than-real-time simulation (up to 10x) for control and training, power-hardware simulator for distributed resources studies, and FPGA based simulation of MMC converters.

The Role of Microgrids in Grid Modernization Initiatives

Part of the Power Systems Keynote

Dr. Sima Seidi
Principal Consultant, Microgrids, Smart Grid and Distributed Generation, Tetra Tech Canada Inc.

Sima Seidi is an energy specialist with Tetra Tech Power Group in Mississauga, Ontario, specialized in modeling, control and financial analysis of Microgrids and Distributed Energy Resources. In addition to providing technical expertise, Sima conducts market assessment, develops business plans, establishes external collaborations and identifies business development opportunities within Tetra Tech. She currently leads the conceptual design of a community microgrid and has provided technical advisory in the area of microgrids to Tetra Tech clients including the New York Governor's Office of Storm Recovery. Prior to joining Tetra Tech, Sima completed her Ph.D. on Intelligent Control of Power Electronic-based Microgrid Systems from Queen's University, Canada, in 2014.

Abstract:

Multiple drivers including commercialization, falling cost, and government incentive programs have caused a paradigm shift in the energy sector towards renewable and distributed energy systems. Despite the numerous benefits including reduced emissions, reduced losses, and grid expansion deferral, the full potential of renewable energy systems can only be realized if a combination of advanced control and energy storage systems is adopted to optimize the operation and cope with their intermittent and variable nature.

Microgrids provide an attractive solution to the higher resiliency and clean energy targets of North American cities where the unfavorable climate change outlooks predict increased frequency of disasters such as Hurricane Sandy. Microgrids not only provide disaster mitigation but also enable renewable energy integration, higher energy efficiency, macrogrid support and customer participation during normal operational mode.

In this presentation, the necessity and contributions of microgrids in grid modernization initiatives will be discussed, and emerging innovative technologies and successful projects in North America will be reviewed.

Line Protection at the Speed of Light

Armando Guzman, Ph.D.,
Fellow Engineer
SCHWEITZER ENGINEERING LABORATORIES (SEL)

Armando Guzmán received his BSEE with honors from Guadalajara Autonomous University (UAG), Mexico. He received a diploma in fiber-optics engineering from Monterrey Institute of Technology and Advanced Studies (ITESM), Mexico, and his masters of science and PhD in electrical engineering and masters in computer engineering from the University of Idaho, USA. He served as regional supervisor of the Protection Department in the Western Transmission Region of the Federal Electricity Commission (the electrical utility company of Mexico) in Guadalajara, Mexico for 13 years. He lectured at UAG and the University of Idaho in power system protection and power system stability. Since 1993 he has been with Schweitzer Engineering Laboratories, Inc. in Pullman, Washington, where he is a fellow research engineer. He holds numerous patents in power system protection and metering. He is a senior member of IEEE.

Abstract:

Power system stability has driven the quest for faster transmission line protection. Faults must be cleared faster than the critical fault clearing time or else the system may lose transient stability and possibly black out. Faster fault clearing increases the amount of power that can be transferred. Faults launch traveling waves (TWs) that travel close to the speed of light. TWs can be used to provide ultra-high-speed protection. Technology advances allow us to develop line protective relays where the speed of light is the only factor that limits the relay operating time.

Cybersecurity in Power Grids

in the Power Systems Keynote

Lloyd Wihl
Director of Application Engineering
SCALABLE Network Technologies

Lloyd Wihl is Director of Application Engineering at Scalable Network Technologies in Los Angeles. He graduated in Engineering from McGill University, and is a recipient of the NASA achievement award. He has extensive experience in real-time simulation, and has led multi-million dollar projects in fields that include synthetic digitized battlefields, network-centric systems, cyber threat assessment, control systems for flexible robotic manipulators, air traffic management, intelligent transportation, and public safety.

Mr. Wihl has published several papers on cyber warfare synthetic environments, and had the vision for, and guided development of Scalable's Network Defense Trainer, which integrates cyber and kinetic domains.

Abstract:

The energy sector has become a major focus for targeted attacks and is now among the top five most targeted sectors worldwide. All communication lines are attack surfaces, and adding connectivity and automation to power grid systems has increased vulnerability while making cyber protection particularly challenging. Innovative simulation-based approaches to integrating cyber-attacks, network dynamics, and physical system response in order to answer 'what if' will be discussed.

11:10 AM - 12:00 PM

Digital Transformation: Disrupt or Be Disrupted!

Denis Gaudreault
Country Manager
Intel Canada Ltd.

As the Country Manager for Intel Canada Ltd., Mr. Denis Gaudreault is responsible for leading Intel's Canada teams, defining and implementing a unified cross-sales org & Business Unit strategy to drive business revenue and raising Intel relevance in the Canadian market.

As Intel's in-country senior executive, he is interfacing with government officials, key customers executives, major ecosystem partners and representing Intel on a number of Industry organizations and events. Denis regularly delivered keynotes, media briefings on Intel's and technology trends across TV, Radio interviews.

Since joining Intel in 2000, Denis has held a variety of positions during his career at Intel. Most recently as WW Director in the Government vertical at Intel HQ. His areas of expertise include technological developments, the

disruptive impact of technology, and the effect of both on corporate and Governmental strategies.

He holds an Engineering degree from Université du Québec a Chicoutimi and an MBA from Université du Québec a Montreal. He is married with 2 kids (21-18) and during his spare time left He is an avid reader and compete in Ironman triathlon.

Abstract:

The Digital Transformation revolution is characterized by a range of new technologies that would have major impacts on Business, Government and the Civil society at a pace never seen before. A new range of technologies that are fusing the physical, digital and biological world are at our door steps. They will transform everything we know and use for the years to come.

Our keynote will go through the major impacts of the Digital Transformation, give an overview of upcoming technologies and forces that are reshaping our world, highlight what leaders should do and where they should look for solutions to be part of this 4th Industrial revolution.

TRACK 1 - LARGE POWER SYSTEMS

1:00 PM - 1:30 PM

HQ Experiences in Case of Using Control System Replica interfaced With HYPERSiM Real-Time Simulator in Recent HVDC Upgrade Projects

Alpha Oumar Barry
IREQ
Canada

Alpha Oumar Barry received the B. A. Sc. in electrical engineering in 1982, from Université Laval, Quebec city, Qc, canada, and the M. A. Sc. in Power Electronics in 1985, from Université du Québec à Trois-Rivières, Trois-Rivières, Qc, Canada. He joined Hydro-Québec Research Institute in 1985, and since 1988, he is a research engineer at the Power System Simulation Laboratory department. His current interests include modelling, real-time and Offline simulations and testing of HVDC systems and FACTS. More recently, He has been in charge of the IREQ real-time testing in the upgrade of Control and protection System of Châteauguay and MTDCN "dc" projects.

Abstract:

HQ experiences in case of using Control System replica interfaced with Hypersim Real-time simulator in recent HVDC upgrade projects

Since the first commissioning of the Châteauguay back-to-back project in 1984, Hydro-Québec TransÉnergie (HQT) keeps promoting the approach of using replicas interfaced to real-time simulators to support commissioning, conduct various studies on HVDC/FACTS and optimize manufacturer's Control and Protection System (CPS), before operating these equipments on the field.

Recently, Hypersim, the HQ real-time digital simulator has been intensively used in the latest refurbishment of the CPS of HVDC, namely the Hydro-Quebec/National Grid multiterminal and the Madawaska "dc" projects, all conducted by ABB.

Simulations performed both "offline" and "real-time", at the manufacturer facilities and at IREQ (HQ) simulation laboratory, have been used to validate the upgraded CPS.

The interface and the communication signals between the replica and the real-time digital simulator, the network detailed model, the test program and the associated results are among the topics in this presentation.

1:30 PM - 2:00 PM

HIL-grid Model on OPAL-RT for Testing Future Grid Control Centers

Eric Glende
OVGU University,
Magdeburg, Germany

Since May 2016 scholarship holder at Chair of Electric Power Networks and Renewable Energy Sources.

Nov 2015 - April 2016 research assistant at the Fraunhofer IFF.

Dec 2015 graduation as Master of Science.

2014 - 2015 study of Electrical Engineering and Information Technology (Master) with focus Electrical Power Systems at the Otto-von-Guericke-University Magdeburg.

Nov 2013 graduation as Bachelor of Science.

2009 - 2013 study as Electrical Engineering and Information Technology (Bachelor) with the focus automation at the Ernst-Abbe-Hochschule Jena.

Abstract:

The increasing integration of renewable energy sources in the power system of Germany and the nuclear phase-out, confronts the energy supply with major challenges. The fluctuation of the feed in profiles aggravates the operational management. Therefore, innovative and fast operating controllable assets are necessary to keep the system stable. Furthermore, the existing grid control centers must be extended by new functions to react on the less of inertia and the rising dynamic. In this approach, a new concept of grid control centers with the use of a dynamic electrical grid model and an integrated HVDC hardware model will be investigated.

2:00 PM - 2:30 PM

The Use of Real-Time Simulation to De-risk and Manage HVDC and FACTS Schemes - Experiences on the French Transmission grid

César Martin
RTE
France

César MARTIN received Master's Degree in Engineering from Supélec, France, in 2012. Since 2013, he has been working at RTE's National Center for Grid Expertise in the development of electromagnetic transient tools. His current interests include models optimization and simulation software's interfaces.

2:30 PM - 3:00 PM

New Travelling Wave Fault Location at SEL and the Need for Advanced HIL Solutions

Armando Guzman
SEL Inc.
Canada

Armando Guzmán received his BSEE with honors from Guadalajara Autonomous University (UAG), Mexico. He received a diploma in fiber-optics engineering from Monterrey Institute of Technology and Advanced Studies (ITESM), Mexico, and his masters of science and PhD in electrical engineering and masters in computer engineering from the University of Idaho, USA. He served as regional supervisor of the Protection Department in the Western Transmission Region of the Federal Electricity Commission (the electrical utility company of Mexico) in Guadalajara, Mexico for 13 years. He lectured at UAG and the University of Idaho in power system protection and power system stability. Since 1993 he has been with Schweitzer Engineering Laboratories, Inc. in Pullman, Washington, where he is a fellow research engineer. He holds numerous patents in power system protection and metering. He is a senior member of IEEE

Abstract:

Power system stability has driven the quest for faster transmission line protection. Faults must be cleared faster than the critical fault clearing time or else the system may lose transient stability and possibly black out. Faster fault clearing increases the amount of power that can be transferred. Faults launch traveling waves (TWs) that travel close to the speed of light. TWs can be used to provide ultra-high-speed protection. Technology advances allow us to develop line protective relays where the speed of light is the only factor that limits the relay operating time.

3:30 PM - 4:00 PM

Assessment of the Mexican Interconnected Electric Power System Operation Considering non- Conventional Renewable Energies

Dr. Arturo R. Messina
National Polytechnic Institute of Mexico
Mexico

Arturo R. Messina received the M. Sc. degree (Honours) in electrical engineering from the National Polytechnic Institute of Mexico, in 1987, and the Ph. D. degree from Imperial College of Science Technology and Medicine, London, U. K., in 1991. Since 1997 he is a Professor at the Center for Research and Advanced Studies (Cinvestav), of the National Polytechnic Institute of Mexico.

He is an IEEE Fellow and an Associate Editor for the IEEE Transactions on Power Systems since 2012. His areas of interest include power system stability analysis and control, and the development and application of advanced measurement-based signal processing techniques to the study and characterization of inter-area oscillations in power systems.

Abstract:

Examining and analyzing the impact of increased penetration of wind and solar resources on the steady- and dynamic-state performance of the system requires the use of advanced analytical techniques covering steady-state, transient and long term behavior, as well as an accurate forecasting. Therefore, this talk regards the general modelling and solution approaches to assess the effects that large-scale integration of wind and PV power plants will cause on the steady- and dynamic-state operation of the Mexican Interconnected Electric Power System.

4:00 PM - 4:30 PM

AC Power Systems for Grid Simulation

Mahesh Thaker
Director of Engineering
AMETEK Programmable Power
USA

Abstract:

The paper presents a brief history and evolution of grid simulator equipment for grid tied inverters. It provides a brief background of key drivers for development of grid simulators. The paper further describes actual case studies using grid simulators by various industries and test labs. Results of the case studies and their implications are discussed. The presentation closes with a next evolution for intelligent grid simulators for HIL component

4:30 PM - 5:00 PM

Design and Implementation of a Modular Multilevel Converter Supported by HIL Simulation

Frédéric Colas
L2EP Ensam
France

Frédéric Colas was born in Lille, France, on October 17, 1980. He received a PhD in control system in 2007 from Ecole Centrale de Lille (France). Frédéric Colas is a member of the Laboratory of Electrical Engineering (L2EP) in Lille and is a Research Engineer at Arts et Métiers Paristech, 8 boulevard Louis XIV, 59046 Lille, France.

His field of interest includes the integration of dispersed generation systems in electrical grids, advanced control techniques for power system and hardware-in-the-loop simulation.

Abstract:

The Modular Multilevel Converter (MMC) is a power electronic structure used for high-voltage direct current (HVDC) power transmission applications as well as high voltage adjustable speed drives applications. MMC structure presents many advantages such as modularity, the absence of a high voltage DC bus and very low switching frequency. It presents also some disadvantages such as modeling complexity and control due to the large number of semiconductors to control. The main objectives of this paper is to describe the methodology used to design a laboratory MMC converter and its control system. This methodology is based on an intensive utilization of real-time simulation to develop and test the control algorithm. A per-unit approach has been used to be as realistic as possible compare to a full scale MMC, with a large number of SM (i.e. 640kV on the DC side, a rated power of 1GW and 400 sub-modules). The control part is based on a distributed micro-controllers structure. Comparisons of HIL simulation and experimental results will be highlighted.

TRACK 2 - POWER ELECTRONICS & ELECTRICS DRIVES

1:00 PM - 1:30 PM

ETAP - OPAL-RT Integrated Platform

Shervin Shokooh
COO, ETAP,
USA

Mr. Shervin Shokooh has 25 years of electrical engineering, product marketing management, and strategic planning. As the Chief Operating Officer of ETAP, he has expanded the company's direction by combining technical expertise with business execution knowledge for implementing innovative solutions.

His technical experience ranges from engineering and analysis to operation of electrical power systems. As a Senior Principal Engineering and ETAP Master Designer, he supports and guides the product development.

Shervin holds a Master of Science degree from University of Southern California specialized in Electrical Engineer & Power Systems and an MBA degree from University of California, Irvine. He is a member of IEEE and a registered Professional Engineer in the State of California.

AND

Fabian Uriarte
Software Engineer at ETAP

Mr. Fabian M. Uriarte holds a PE and PhD in Electrical Engineering from Texas A&M University in the area of parallel power system simulation. He is a book author and has published numerous papers in the area of high-performance transient solvers, microgrid control, smart grids, and shipboard power systems dynamics. He is currently a Principal Power Engineer at ETAP where his primary focus is to leverage new hardware and software technology, position ETAP in new market spaces, invent new applications, and bring-to-bear modern user-experiences for users.

Abstract:

In this presentation, we will present the new ePHASORSIM user interface via the ETAP software platform and describe how OPAL-RT's hardware-in-the-loop simulation systems can be offered as an advanced Operator Training Simulator (OTS) when integrated with ETAP Real-Time® Power Management System.

1:30 PM - 2:00 PM

Model-Based Systems Engineering of Synchrophasor Systems and Technologies

Luigi Vanfretti
ALSETLab
USA

Luigi Vanfretti (IEEE S'03-M'10-SM'13) received the Electrical Engineering degree from Universidad de San Carlos de Guatemala, Guatemala City, Guatemala, in 2005. He was also a Visiting Researcher with The University of Glasgow, Glasgow, Scotland, in 2005. He obtained the M.Sc. and Ph.D. degrees in electric power engineering from Rensselaer Polytechnic Institute, Troy, NY, USA, in 2007 and 2009, respectively. For his research and teaching work toward his Ph.D. degree, he was awarded the Charles M. Close Award from Rensselaer Polytechnic Institute.

He was with KTH Royal Institute of Technology, Stockholm, Sweden, as Assistant 2010-2013), and Associate Professor (Tenured) and Docent (2013-2017/August); where he established the SmarTS Lab and research group. He was also with Statnett SF, the Norwegian electric power transmission system operator, as consultant (2011 - 2012), and Special Advisor in R&D (2013 - 2016).

He joined Rensselaer Polytechnic Institute in August 2017, to continue to develop his research and develop his new laboratory and research team ALSETLab: http://alsetlab.com/

Dr. Vanfretti, served from 2009 to 2016 in the IEEE Power Engineering Society (PES) PSDP Working Group on Power System Dynamic Measurements, in different capacities, including as Chair from 2012016. In addition, from 2009 to 2014, he served as Vice-Chair of the IEEE PES CAMS Task Force on Open Source Software. He is an advocate and evangelist for free/libre and open-source software, member of the Open Source Modelica Consortium (OSCM) and Associate Member of the Free Software Foundation. His research interests are in the area of synchrophasor technology applications; and cyber-physical power system modeling, simulation, stability and control.

Abstract:

This talk starts by exploring how electrical power systems are increasingly becoming digitalized, leading to their transformation into a class of cyber-physical systems (a system of systems) where the electrical grid merges with ubiquitous information and communication technologies (ICT).

This type of complex systems present unprecedented challenges in their operation and control, and due to u nknown interactions with ICT, require new concepts, methods and tools to facilitate their operational design, manufacturing (of components), and testing/verification/validation of their performance.

Inspired by the tremendous advantages of the model-based system engineering (MBSE) framework developed by the aerospace and military communities, this talk will highlight the challenges to adopt MBSE for electrical power grids. MBSE is not only a framework to deal with all the phases of putting in place complex systems-of-systems, but also provides a foundation for the democratization of technology - both software and hardware.

The talk will illustrate the foundations that have been built by the presenter's research over the last 7 years, placed within the context of MBSE, with focus on areas of power engineering. Some of these foundations and contributions include the OpenIPSL, RaPId, SD3K, BableFish and Khorjin open source software developed and distributed online by the research group, and available at: https://github.com/ALSETLab

2:00 PM - 2:30 PM

Real-Time Control of Doubly Fed Induction Generator

Kader Chaker
SCAMRE Laboratory, ENP
Oran Algeria

Abdelkader Chaker is a Professor in the Department of Electrical Engineering at the ENP, in Oran Algeria. He received a Ph.D. degree in Engineering Systems from the University of Saint-Petersburg. His research activities include the control of large power systems, multimachine multiconverter systems, the unified power flow controller. His teaching includes neural process control and real time simulation of power systems. He is a director laboratory of recherché SCAMRE.

Abstract:

In this communication; we present a real time simulation method of wind power generator system with doubly fed induction generator (DFIG) using our OPAL RT digital real lab platform with the models build simulink. Those based on double variable speed operation of wind turbine is usually used to provide energy with best efficiency. Those based on double fed induction generators are widely used especially in high power fields thanks to different advantages it presents namely reducing the size of the converter, operating in a large set of speed; and the possibility of controlling independently the generated active and reactive powers.

Also this communication is an important contribution to rapid prototyping of high performance induction machine controllers since real time simulations are required by hardware in the loop applications.

2:30 PM - 3:00 PM

How to Use Real-Time Simulation for a Better, Modern and interactive Teaching Experience for Power System and Electric Motors

Danielle Nasrallah
OPAL-RT TECHNOLOGIES
Canada

Danielle Sami Nasrallah received the Engineer's diploma in electromechanical engineering and the Diplôme d'Etudes Approfondies in electrical engineering from École supérieure d'ingénieurs de Beyrouth (ESIB), Beirut, Lebanon in 2000 and 2002, respectively, and the Ph. D. degree in mechanical engineering from McGill University, Montréal, QC, Canada, in 2006. During her Ph. D. studies she worked on a part-time basis at Robotics Design as control and robotics engineer. She moved to Meta Vision Systems in 2006-2007 as a control and applications engineer. In 2008 she joined the electrical department of the Royal Military College of Kingston as an assistant professor and, in 2009, she was a visiting assistant professor at the American University of Beirut. From 2010 to 2014, she worked as a consultant in control and systems engineering. In 2014 she joined OPAL-RT Technologies where she is presently an expert in electrical applications and simulation. She kept also links with academia as she is a lecturer in the department of mechanical and industrial engineering at Concordia University.

Abstract:

Real-time simulation laboratories are introduced here to enhance the teaching experience and add the "User-In-The-Loop" concept. Students interact with the simulated systems in real-time via a panel and the "user-interaction-bandwidth" is taken into account. This allows for a better understanding of phenomena, and a visualization of critical system behaviors without the worry of damaging physical material. Additionally, no need for scaling down systems as it is the case for test benches. Hence, users deal with non-reduced systems which permits a better evaluation of real losses, time-constants, damping and dynamic aspects. Topics covered with these laboratories are: (i) synchronous and asynchronous machines, (ii) analysis of the swing equation for power systems in phase- and time- domain, and (iii) power electronics with AC-DC and DC-AC conversions.

3:30 PM - 4:00 PM

OPAL-RT Simulators in ABB MV Drives: Overview of Usage and Latest Developments

Mathieu Giroux
ABB
Switzerland

Mathieu Giroux received the M.Sc.A in Electrical Engineering from the Montreal Polytechnique, Canada, in 2007. He is currently R&D software operations team leader at ABB Switzerland for Medium Voltage Drives. The team responsibilities include control software release management, testing, and field support for all ABB MV drive products. His areas of interest are control of power converters, software testing, and real-time simulation. Mathieu started his career in 2007 at Opal-RT Technologies in Canada.

Abstract:

Opal-RT simulators are used in the ABB MV Drives organization since 2008. After 8 years of collaboration, we now count 10 simulators in operation in Switzerland, Poland, and India.

The presentation shows how the simulators are used in daily software R&D business activities such as software release testing and advanced field support.

A recent R&D activity is described where a simulator was used for the validation of new controls algorithms for a large ACS6000 36 MVA drive used in the world's first ice-breaker LNG tanker.

Finally, the newest simulator for the ACS5000 drive is introduced.

4:00 PM - 4:30 PM

Automatic verification Test Bench for MV Drives Based on "HIL" Simulation

Alain Dutrey
Schneider Electric
France

Alain Dutrey received the Diploma of Engineer from the Ecole Nationale Supérieure de l'Electronique et de ses Applications (E.N.S.E.A, Cergy-Pontoise) France, in 2012. He joined Schneider-Electric Drives activity as sub-contractor in September 2013 as Drives Control System engineer and joined Schneider-Electric in December 2016 as Motor Control engineer. He works on control topics at, Anticipation and Offer Definition level, focusing on Control algorithms, MV Offer, identification and signal processing using Model Based Design Approach, in order to enhance efficiency.

Abstract:

Altivar 6000 is a variable speed drive to address MV market. It joins the EcoStruxure at the same level than the ATV Process product range. In order to avoid huge investments from the start of the project, it has been decided to use OPAL-RT solutions to setup an automatic Hardware In the Loop test bench for unitary tests, system tests, and non-regression tests of control/command hardware and software. The control/command system from the full range is under test, linked to the real time environment running physical models of the MV Power system, motor, and application through dedicated interface emulation hardware. The bench lies on computer engineered environment for automatic configuration and test scripts running.

4:30 PM - 5:00 PM

High-Fidelity Power Motor Emulator for Testing Inverter and Control

Danielle Nasrallah,
OPAL-RT TECHNOLOGIES
Canada

Danielle Sami Nasrallah received the Engineer's diploma in electromechanical engineering and the Diplôme d'Etudes Approfondies in electrical engineering from École supérieure d'ingénieurs de Beyrouth (ESIB), Beirut, Lebanon in 2000 and 2002, respectively, and the Ph. D. degree in mechanical engineering from McGill University, Montréal, QC, Canada, in 2006. During her Ph. D. studies she worked on a part-time basis at Robotics Design as control and robotics engineer. She moved to Meta Vision Systems in 2006-2007 as a control and applications engineer. In 2008 she joined the electrical department of the Royal Military College of Kingston as an assistant professor and, in 2009, she was a visiting assistant professor at the American University of Beirut. From 2010 to 2014, she worked as a consultant in control and systems engineering. In 2014 she joined OPAL-RT Technologies where she is presently an expert in electrical applications and simulation. She kept also links with academia as she is a lecturer in the department of mechanical and industrial engineering at Concordia University.

Abstract:

Rotating machine models that are CPU-based and FPGA-based are presented here. The main application for these models is real-time simulation, which is an important part of power system and industrial drive development, as it minimizes time-to-market and allows engineers to test controllers and power electronics converters in the lab before field commissioning. The models covered are: synchronous, asynchronous including squirrel cage and doubly-fed, permanent-magnet and switch reluctance machines. Additionally, standard dq (fixed or variable) and finite-element analysis models are presented. For every machine, an example model is provided, featuring real-time challenges. Moreover, model validation with respect to offline variable-step solvers is demonstrated. Furthermore, PHIL/RCP applications in which motor models are used to interact with power electronics converters and controllers are given.

TRACK 3 - MICROGRID & CYBERSECURITY

1:00 PM - 1:30 PM

Cyber Threat Assessment and Mitigation for Power Grids

Lloyd Wihl
Director of Application Engineering
SCALABLE Network Technologies
USA

Lloyd Wihl is Director of Application Engineering at Scalable Network Technologies in Los Angeles. He graduated in Engineering from McGill University, and is a recipient of the NASA achievement award. He has extensive experience in real-time simulation, and has led multi-million dollar projects in fields that include synthetic digitized battlefields, network-centric systems, cyber threat assessment, control systems for flexible robotic manipulators, air traffic management, intelligent transportation, and public safety.

Mr. Wihl has published several papers on cyber warfare synthetic environments, and had the vision for, and guided development of Scalable's Network Defense Trainer, which integrates cyber and kinetic domains.

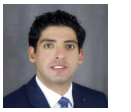
Abstract:

Increasing connectivity and automation in power grids has multiplied attack surfaces while making cyber protection particularly challenging. We present an innovative simulation environment that combines OPAL-RT with EXata, integrating realistic simulations of physical systems, control systems, cyber-attacks, protocol vulnerabilities, data communication timing and network dynamics, to analyze how cyber threats can affect physical system behavior, and the effectiveness of cyber protection schemes.

1:30 PM - 2:00 PM

Real-Time Simulation of Predictive Control of DC Vehicular Microgrids

Ali Mehrizi-Sani
Washington State University
USA



Ali Mehrizi-Sani received the B.Sc. degrees in electrical engineering and petroleum engineering from Sharif University of Technology, Tehran, Iran, both in 2005. He received the M.Sc. degree from the University of Manitoba, Winnipeg, MB, Canada, and the Ph.D. degree from the University of Toronto, Toronto, ON, Canada, both in electrical engineering, in 2007 and 2011. He is currently an Assistant Professor at Washington State University, Pullman, WA, USA. He was a Visiting Professor at Graz University of Technology, Graz, Austria, in Nov. 2014, Jan. 2016, and Nov. 2016. His areas of interest include power system applications of power electronics and integration of renewable energy resources. Dr. Mehrizi-Sani is an editor of IEEE Transactions on Power Systems, IEEE Transactions on Power Delivery, IEEE Transactions on Energy Conversion, and IEEE Power Engineering Letters. He is also an editor of Wiley International Transactions on Electrical Energy Systems (ITEES). He is the Chair of IEEE Task Force on Dynamic System Equivalents and the Secretary of the CIGRE Working Group C4.34 on Application of PMUs for Monitoring Power System Dynamic Performance. He was a recipient of the 2017 IEEE Mac E. Van Valkenburg Early Career Teaching Award, 2017 WSU EECS Early Career Excellence in Research, 2016 WSU VCEA Reid Miller Excellence in Teaching Award, 2011 NSERC Postdoctoral Fellowship, and 2007 Dennis Woodford prize for his M.Sc. thesis. He was a Connaught Scholar at the University of Toronto.

Abstract:

This work studies model predictive control (MPC) of a fuel cell-based DC microgrid for vehicular applications. This microgrid employs a unidirectional converter to control the output current of the fuel cell and a bidirectional converter to control the output voltage of the microgrid by regulating the battery current. The proposed MPC provides a fast transient response to the changes in the reference values of the control variables or system transients. It is also robust against parameter mismatch. The performance of the DC microgrid and its control loops are validated via real-time simulation case studies using OPAL-RT.

2:00 PM - 2:30PM

Real-Time Co-Simulation for Microgrids With OPAL-RT

Quoc Tuan Tran
CEA- INES
France

Prof. Quoc Tuan TRAN received his Ph.D. degree in Electrical Engineering and his "Habilitation à Diriger des Recherches" degree (Dr. Habil) from the Grenoble Institute of Technology (Grenoble INP), France, in 1993 and 2000, respectively.

He is actually professor at INSTN (Paris Saclay University), Scientific Manager and International Expert at the CEA/INES (Alternative Energies and Atomic Energy Commission/French National Institute for Solar Energy) and Teacher at Grenoble-INP and INSTN. His research interests are in the fields of smart-grid, microgrid, power system analysis, operations, electromagnetic transients, real time simulation, renewable energy (solar energy), electric vehicle, energy management and control.

He is (co)author of five books, and author of more than 180 publications in journals and conference proceedings. He has supervised 32 PhD students. He is a senior member IEEE.

Abstract:

Co-simulation of power system and communication network in support of design and Hardware in the Loop methods will have a key role. In this work, we construct a platform that combines real-time simulation models running in OPAL-RT with a network of ARM-based computers (Raspberry PIs), representing the agents. This real-time cyber-physical test platform is flexible to emulate the data transportation between agents, which are local controllers, corresponding to distance, rate of loss, etc. For conducting a test case, a distributed secondary control structure is proposed for implementing the frequency control of an islanded microgrid. The platform close to the operation of the real communication network and totally could be apply to various other tests of control, protection, etc. in smart grid considering the effect of ICT.

2:30 PM - 3:00 PM

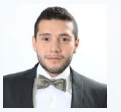
Real-Time Hardware-in-the-Loop Co-Simulation Platform for Microgrid Analysis

Martine Chlela
Ph.D. Candidate
Mcgill University
Canada

Martine Chlela received both B.Sc. and M.Sc. degrees in Electrical Engineering from University of Balamand, Lebanon, in 2012 and 2013 respectively. She is currently pursuing her PhD degree in power engineering at McGill University. She has been a power engineering intern at Electricité du Liban (EDL) in 2013. She has been a research intern at the Hydro-Quebec Research Institute (IREQ) since 2014, where she worked on projects pertaining to microgrids cyber security. Her current research interests include power systems operation and control, integration of renewable energy into power grids and cyber security.

AND

Carlos Mauricio Rangel
Modelling and Real-Time Simulation Engineer
OPAL-RT TECHNOLOGIES



Carlos M. Rangel received B.Eng degrees in Electrical and Electronic Engineering from University of Los Andes, Colombia in 2014. He is currently pursuing an M. Eng degree in power engineering at McGill University, Montreal, QC. He has been an intern at Opal-RT since October 2016. During his internship he has developed, tested, analyzed and validated models on HYPERSIM for renewable energy and machines' control. Also, he has helped in solving problems related to simulations of power system models. Mr. Rangel is an IEEE member.

Abstract:

A generalized real-time hardware-in-the-loop co-simulation platform interfacing hardware (OPAL5600, NI-cRIO digital controller) and software (RT-Lab, Matlab/Simulink, Ettercap, Python/Scapy, OPNET) to model and synchronize the microgrid constituting power system, information and communication network layers is developed. The OPAL-RT simulators provide interfaces to implement different communication protocols such as the TCP/IP and the IEC 61850 GOOSE protocol enabling advanced microgrid control capabilities. The co-simulation setup is used to: 1)demonstrate and validate the integration of an islanded microgrid controller and evaluate its performance using specific metrics and 2)model, quantify the impact and propose novel strategies to mitigate false data injection and Denial-of-Service cyber-attacks.

3:30 PM - 4:00 PM

Proven Strategies and Key Concepts to Develop Successful Microgrid Control Systems

Abdel Rahman
SEL
USA

Abdel Rahman Khatib, P.E. (Senior IEEE 2016, Member IEEE 1999), received his B.S. and M.S. in electrical power engineering from Military Technical College in Egypt. He received his Ph.D. in Electrical Engineering from Virginia Tech in 2002. Abdel Rahman is working as a senior power system engineer at Schweitzer Engineering Laboratories, Engineering Services, Inc. He has 7 years of Industrial experience focus on Power Management System (PMS) design, testing and commissioning for petrochemical and oil industries PMS. His current research interests are power system modeling, micro-grid power system load flow and dynamic stability, and power system protection. He has 12 years of university teaching experience in different counties. Abdel Rahman is a registered professional engineer in Washington, California, and Texas. He can be contacted at akhatib@selinc.com.

Abstract:

By using a combination of different case studies and important concepts this presentation will cover essential steps for successful microgrid control. A microgrid needs to provide resilient and reliable power. To do so, the complete microgrid control system—including devices, configuration, communications, and cybersecurity—must be stable, proven, and thoroughly tested before it is brought online. The concepts discussed in this presentation will help you reduce microgrid risks and avoid possible pitfalls.

4:00 PM - 4:30 PM

Modeling and Real-Time Simulation of Wind Power Systems Using RT-LAB Platform

Mounir Khiat
ENP
Oran, Algeria

Mounir KHIAT is a Professor in the Electrical Engineering Department at ENPOran-MA, Algeria. He received a doctorate degree in 2003. He is member of "SCAMRE" laboratory. His research activities include the control of large electric power systems, optimisation, Facts devices and HVDC systems, modelling and real time simulation of electrical power systems, renewable energy, smart grid and smart micro grid.

Abstract:

This paper proposes a synthesis in real time some the problem of integration a the wind power systems in the of electrical networks. The wind power systems has an impact growing on the power grid, because of difficulty of provide the production, of the limited capacity of the network, the risk of untimely disconnections of the aerogenerators and a degradation of the electric quality. The Rt-Lab platform is among the effective tool to simulate complex wind power systems and smart grid models with large numbers of high-speed switching devices at real time.

This study, describes the detailed modeling and simulation of a wind farm based on doubly-fed induction generators (DFIG), integrated in to the power grid. To perform the real-time simulation, the model of the studied wind farm was developed first in the Matlab /Simulink/SimPower System environment, then, it was rebuilt on environment Rt-Lab on the basis of eMEGAsim digital real time simulator of OPAL-RT to test its performance. Simulation results validate the capability of the platform to achieve rapid simulation of complex power systems. The details of the control strategy and system simulation results using Rt-LAB are presented and discussed.

4:30 PM - 5:00 PM

Shared Power System Models: Accelerating Microgrid Testing and Integration

Christopher Smith
MIT-LL
USA

Chris is a Technical Staff member in the Energy Systems group at MIT Lincoln Laboratory. He joined the Laboratory in 2012 and holds a BS in Computer Engineering and a MS in Electrical Engineering both from Virginia Tech. His early focus has been in power electronics and control systems. This has spanned the range of motor controls, electric vehicle traction drives, power factor correction, and grid tied inverters. Simulation and demonstration of these systems on small microgrids has been a recent focus area.

Abstract:

Microgrid controls integration has historically been a time-consuming and costly process. Real-time power system simulations - actuated by the commercial distributed energy resource controllers planned for final field deployment - has emerged as a practical tool to accelerate integration and assess complex controls interactions, but the simulation is only as good as the models. The Electric Power Hardware-in-the-loop Controls Collaborative is a new model repository set up to simplify modeling of microgrid controls and reduced overall integration time. The repository is organized for several simulation software tools and contains many devices and controllers often used in today's microgrids: battery and solar inverter controllers, generator controllers, relays and breakers, and load models, to name a few. The repository also includes test feeder definitions for the upcoming IEEE P2030.8 Standard for the Testing of Microgrid Controllers.

Thursday, September 7

Thursday, September 7

KEYNOTE PRESENTATIONS

9:15 AM - 10:40 AM

POWER ELECTRONICS AND POWER-HARDWARE-IN-THE-LOOP KEYNOTE

Abstract

It wasn't long ago that many considered power and electrical engineering to be distinct fields with little overlap or shared expertise. As energy grids become ever more dependent on complex power electronics to control and monitor operations, the sharing of expertise between these disciplines has become crucial in creating the next generation of power conversion tools.

Thursday's keynote will highlight the newest in technological innovations: wideband gap semiconductors, convertor design and circuit model implementation, as well as hint at what is being developed to meet current and future market needs. The academic and training benefits of PHIL testing will also be explored, emphasizing the importance of the human element in simulation and design.

Christophe Brayet
Products Director
OPAL-RT TECHNOLOGIES Inc.

With the support of his team, Christophe leads OPAL-RT's product vision and strategy, and strengthens the company's leadership position in the real-time simulation industry. He is responsible for the product road maps, as well as for capitalizing on new market opportunities.

Ben Black, Ph.D
Principal, Market Development Manager - Real-Time Test
National Instruments

Jerome Rivest, Ph.D
Eng., Technical Lead, Power Electronics and Advanced Control
OPAL-RT TECHNOLOGIES

Jeroen Van den Keybus
CTO
Triphase

Tarek Ould Bachir, Ph.D
Team Leader, eMEGASIM and Solvers
OPAL-RT TECHNOLOGIES

Tarek received a M.A.Sc. and Ph.D. degrees in electrical engineering from the École Polytechnique de Montréal, in Montreal, QC, Canada, in 2008 and 2013, respectively. He has been an FPGA Application Specialist with OPAL-RT and currently leads the eMEGASIM product and the Solvers teams.

Danielle Nasrallah
OPAL-RT TECHNOLOGIES
Canada

Danielle Sami Nasrallah received the Engineer's diploma in electromechanical engineering and the Diplôme d'Etudes Approfondies in electrical engineering from École supérieure d'ingénieurs de Beyrouth (ESIB), Beirut, Lebanon in 2000 and 2002, respectively, and the Ph. D. degree in mechanical engineering from McGill University, Montréal, QC, Canada, in 2006. During her Ph. D. studies she worked on a part-time basis at Robotics Design as control and robotics engineer. She moved to Meta Vision Systems in 2006-2007 as a control and applications engineer. In 2008 she joined the electrical department of the Royal Military College of Kingston as an assistant professor and, in 2009, she was a visiting assistant professor at the American University of Beirut. From 2010 to 2014, she worked as a consultant in control and systems engineering. In 2014 she joined OPAL-RT Technologies where she is presently an expert in electrical applications and simulation. She kept also links with academia as she is a lecturer in the department of mechanical and industrial engineering at Concordia University.

9:40 AM - 10:10 AM

Innovating in a IoT, IoP World

Greg Farthing
Vice President, Strategic Initiatives & Innovation, Power Grids
ABB Inc.

Since January 2017, Greg Farthing is Vice President, Strategic Initiatives & Innovation, Power Grids, ABB Canada. Prior to this role he has been holding the position of Vice President, Sales and Marketing, Power Products and Systems divisions, ABB Canada for 8 years.

In 1988, he joined Cummins Power Generation in Minneapolis, Minnesota as Area Manager and then as Sales and Marketing Manager for Eastern Canada. He later joined Cummins Eastern Canada in 1997 in the Energy Division as Sales and Marketing Manager.

Greg joined AREVA T&D Ca`nada in 1999 as Vice President of Sales & Marketing. In 2004, he was named President AREVA T&D Canada and President of AREVA T&D Canada's Board of Directors.

In 1992, he completed a certificate in Mechanical Engineering Building Systems from École Polytechnique de Montréal. He also completed his studies in Executive Management and Advance Management from McGill University in 2004 and 2005 respectively. In 2009, he completed ABB Senior Leadership Development Program from IMD International, Lausanne, Switzerland.

Abstract:

Greg Farthing will discuss how a multinational company like ABB stays on top of technological trends and continues to innovate to remain leaders in new and existing markets like battery energy storage, digital substations and microgrids. Their investment in R&D allows them to address and anticipate trends such as Internet of Things and People.

10:40 AM - 11:20 AM

Automotive Keynote

Hervé Pollart
Intelligent cars - business development manager
OPAL-RT TECHNOLOGIES Inc.

After 5 years working on the development of the controller for a world-renown automaker, Mr. Hervé POLLART moved on to working as a project leader on new automotive controller validation platforms. With over 10 years of experience in validation and controller simulation, Mr. Pollart is now responsible for developing the ADAS and intelligent car validation products, partnership and lead the development team for OPAL-RT Technologies.

AND

Pascal Remusan
Innovation Project Manager
Renault

As an Innovation Project Manager for Renault Group, Mr Pascal Remusan is responsible for developing the AD / ADAS validation by massive numerical simulation, defining the simulation tool chain and processes, managing the investments, the deployment of the solution and the correlation methods compared to physical testing.

In 2005, he joined Renault Group to manage the Quality of the prototypes during development and industrialization phases. Then he worked during several years on the numerical simulation for vehicle performance before joining AD/ADAS simulation department.

Abstract:

The automotive world is evolving. If we are to diminish our carbon footprint, future vehicles must convert to electric motors. But that alone won't be enough; we must also change the way we drive to have any significant impact on our footprint. Both vehicle and road safety must be improved. With that goal in mind, a new generation of smarter and smarter vehicles are being developed, which include both connected and autonomous vehicles. Thursday morning's keynote speech will address the challenges, our vision and our solutions for these two strategic fields.

TRACK 1 - POWER-HARDWARE-IN-THE-LOOP

11:20 AM - 12:00 PM

Aerospace & Defense Keynote

Alexandre Leboeuf
Systems Integration Team Leader
OPAL-RT TECHNOLOGIES Inc.

Alexandre has an engineering degree in electrical engineering with a specialization in health sciences from École de technologies supérieures (ETS), in addition to a Technical degree in Programming/Analysis. He has been at OPAL-RT since 2010. Alex has been Team Leader of Electronics Systems Integration since 2012, as well as Project Manager for most team projects since 2012.

Abstract:

With the numbers of flights worldwide on a constant rise, it can be easy to see the trend and the open possibilities for airframers and their suppliers in the near future. While these numbers climb, so will the tons of kerosene burnt. Additionally, travelers are requiring more in-flight entertainment and comfort than ever to help them endure the long flight hours.

Not unlike the automotive industry, the aerospace and defense industries are also surveying the progress in electrification and its benefits. Using increasingly more electrical systems to replace their heavy and cumbersome hydraulics counterparts, adding new entertainment systems in every seat, power plugs for important small electronic devices customers have a hard time putting away at takeoff, the new Navy's on-ship electro-magnetic guns for onboard safety (no more gun powder) and far reach, to name just a few. But as easy as it looks, looks can be deceiving! New equipment requires certifications and to obtain it, safety, stability and robustness must be proven. We will address a few of the tools that will be used for tomorrow's tests.

AND

Laurent Pieraut
President & CEO, CEO
CS Communication and Systems North America

Mr. Pieraut has been steering CS North America's growth since 2012. Before joining CS Communication & Systems, he worked for CGI, Rheinmetall Canada, CAE and Bombardier. He developed strong business experience in high tech areas both in Canada and internationally. At CS, he surrounded himself with a team capable of boosting CS Canada's stature in North America through sustained growth and diversification of its services and client base. With a degree in engineering from École Polytechnique de Montréal and an Executive MBA from McGill University and HEC Montréal, Mr. Pieraut has more than 25 years of experience in software development, project management, and business development in different areas of IT, technology, defence and aeronautics industries. As President and CEO, he promotes a leadership style based on results and teamwork.

Multi Electrical System Integrated Simulator (MESIS)

Marek Hicar, Ph.D
Electrical Engineer Specialist
Bombardier Aerospace, Advanced Systems

Marek Hicar (PhD.) received MSc. and PhD. degree in Heavy - Current Electrical Engineering and MSc. in Aeronautical Electrical Engineering from the Technical University in Kosice, Slovak Republic, in 2000 and 2005. In 2005, he joined the Honeywell, Advanced Technology group as Senior Research And Development Scientist for More Electric Aircraft (MEA). For Aviya Technologies (at Honeywell, Aerospace, in 2009 – 2010, he supported the A350 eCIB (Electronic Controls Integration Bench) program as a Systems Engineer. In 2010, he joined BOMBARDIER Aerospace for C SERIES program as the Systems Integrator (2010 - 2013) supporting the High Lift, Hydraulics and Electrical Systems. Currently, he is in the Advanced Systems group responsible for More Electrical Systems Simulation to study power quality and stability. In 2006, he received Honeywell Bravo Silver Award - Certificate Of Excellence And Appreciation for developing the MEA plant model and is SixSigma Plus Green Belt certified.

Abstract:

The MESIS project key objective is to analyze the integration of Advanced Electrical Systems (AES) that will bring the complete solution into Technology Readiness Level 6 using model based design practices applied to Real-Time Simulator. MESIS System Verification and Requirements Validation process / results will be used to confirm high maturity of system component requirements being tested. The goal of Model Development process is to evolve in model fidelity up to validation level against the system hardware representative test rigs. MESIS role is to identify issues related to the power quality factors, total harmonics distortion and to address electric system integration challenges.

Using OPAL-RT Simulators, simulation of Power Electronics in nano-second time step domain will enable monitoring of the Electric Power Distribution System performance and AES control loops to meet the operational and design requirements. Electronic Control Units - hardware-in-the-loop will be introduced to remove Virtual LRU model controllers (limited assumptions) and so fully validate Power Electronics within the aircraft level system model integrated environment.

1:00 PM - 1:30 PM

Vehicle-Grid Integration HIL for Designing Advanced Ancillary Services for Power Systems

Dr. Yutaka Ota
Associate Professor of Tokyo City University
Tokyo City University
Japan

Yutaka Ota received his Phd degree from Nagoya Institute of Technology, JAPAN, in 2003.

He has been a research associate of Nagoya Institute of Technology, and a project assistant professor of The University of Tokyo.

He is now an associate professor of Tokyo City University.

His current research interest is on designing advanced ancillary services for renewable integration to the power systems, energy storage application to the power systems, and vehicle-grid interface design and implementation.

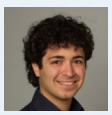
Abstract:

Power Systems Design Laboratory is developing a HIL environment for designing advanced ancillary services on the vehicle-grid interface. System configurations of the vehicle-grid integration HIL, consisted by AMETEK power amplifier, Triphase flexible inverter system, two battery energy storage test beds, and actual electric vehicles, and two OP5600 units, are explained in the presentation. Initial test results of synthetic inertia control and dynamic reactive power control, as advanced ancillary services, are also presented. The low-inertia power system model and the congested distribution feeder model with large-scale renewable energy sources and the electric vehicles are implemented to the Opal-RT units.

1:30 PM - 2:00 PM

Power-HIL and the KIT Energy Smart Home Lab Environment

Sebastian Hubschneider, M.Sc.
Research Associate
Karlsruhe Institute of Technology
Germany



Sebastian Hubschneider finished his studies of electrical engineering and information technology at the Karlsruhe Institute of Technology (KIT) in June 2015 with the academic degree Master of Science. During his time at the University, he specialized on power engineering with a focus on energy grids and the energy sector in general, including markets and economy.

Since July 2015, Sebastian works as a research associate at the Institute of Electric Energy Systems and High-Voltage Technology (IEH), KIT. His research focuses on Power Hardware-in-the-Loop systems in conjunction with energy grids and electrical equipment.

Abstract:

The power hardware-in-the-loop environment at the Institute of Electric Energy Systems and High-Voltage Technology (IEH), KIT, consists of an OP5607 driving a 30 kVA linear 4-quadrant-amplifier. Besides other electrical equipment and different devices under test (DUT) it includes the KIT Energy Smart Home Lab, a smart residential building comprising building automation, metering systems, sensors, intelligent appliances, distributed generation and a hybrid energy storage system. Additionally to our research regarding a precise DUT-independent loop-feedback with minimal lag, the paper will present the setup of the lab, the power hardware-in-the loop research environment, and first measurements using a simulated artificial mains network.

2:00 PM - 2:30 PM

Microgrid Testbeds & Controller Procurement

Przemyslaw Koralewicz
Senior Engineer
National Renewable Energy Laboratory (NREL)

Przemyslaw helps clients implement innovative power system projects featuring newly developed technologies and methods based on the latest research findings. He specializes in modeling and detailed analysis of complex systems including microgrids. He is responsible for preparation of real time simulator models that contestants are going to be using during Microgrid Procurement at NREL.

Przemyslaw gained his experience at ABB Research Center prior to joining NREL in August 2016. There, he excelled as control system architect and project manager for ABB special projects - converters based on ACS6000 - MV drive platform. He was a lead engineer for multi-megawatt grid simulator developed by ABB used for testing of various renewable resources. He also got wide experience in controller and power hardware in the loop simulations of power systems.

Abstract:

National Renewable Energy Laboratory supports microgrids developments around the world thus a technical procurement was prepared to select a microgrid controller that represents state-of-the-art in urban scale microgrid controls. As part of procurement every contestant's performance will be evaluated on power hardware in the loop testbed. The testbed is developed using Opal-RT realistic model of microgrid called BANSHEE and multiple real power equipment interfaced with Opal-RT using grid simulator. Contestants will have to show that they are able to optimally use available resources and that these are able to communicate efficiently using ModbusTCP and IEC61850 GOOSE messaging implemented in Opal-RT.

2:30 PM - 3:00 PM

A Power-Hardware-in-the Loop Test Bench for Electric Machine Emulation

Amitkumar K. S., Ph. D. Student,
Concordia University
Canada

Amitkumar K. S. received his Bachelor's degree in electrical and electronics engineering from Amrita School of Engineering, Bangalore, India in 2010 and Master's degree from the Indian Institute of Science, Bangalore, India in 2012. He has worked as an associate scientist at ABB GISL, India and as an Electrical Modeling and Simulation specialist at OPAL-RT India.

Amitkumar is currently pursuing his Ph. D. in the department of Electrical and Computer Engineering, Concordia, under the supervision of Prof. Pragasen Pillay. He is a recipient of the N. R. Khambati Memorial award for his Master's program at the Indian Institute of Science, India. He is also the recipient of the Concordia University International Award of Excellence ENCS and a merit scholarship from the Fonds de recherche du Québec - Nature et technologies (FRQNT) for his ongoing Ph. D. at Concordia.

Abstract:

Power-hardware-in-the-loop based emulator test benches are increasingly gaining popularity for the testing of electric drive systems. The machine emulator is basically a set of power electronic converters which are controlled in a manner so as to mimic the electrical performance of the machine. Several machines can be emulated allowing for the rapid testing and commissioning of the driving inverter, in an electric drive system, before the development of a prototype machine. The presentation will elucidate the challenges involved with motor emulation, such as control of the power converters, and aspects relating to machine modeling; with the aid of OPAL-RT simulators used for both hard-ware-in-the-loop and power-hardware-in-the-loop simulations.

3:30 PM - 4:00 PM

Status of Energy Lab 2.0 and Overview of PHIL Activities

Dr. Joern Geisbuesch
Head of PHIL Group, Institute for Technical Physics,
Karlsruhe Institute of Technology

Presently Joern is the head of the Power Hardware in the Loop Group of the Institute for Technical Physics at the Karlsruhe Institute of Technology and as such in charge of the 1 MVA Power Hardware in the Loop Laboratory of the Energy Lab 2.0. The Energy Lab 2.0 is a large scale research infrastructure to study future energy grids relying on decentral renewable generation. After obtaining his PhD degree from the University of Cambridge (UK) Joern has worked as a postdoctoral fellow at Cambridge and in research and academic positions at several internationally renowned institutions and organizations, such as the Collège de France, the University of Bonn and the National Research Council.

Abstract:

The presentation provides an overview of the progress of set-up of the Energy Lab 2.0 at the Karlsruhe Institute of Technology (KIT). The Energy Lab addresses a wide range of topics concerning decentralized renewable energy generation and new power system technologies. Therefore, when completed, it will substantially contribute to develop solutions for highly sustainable future energy system realizations. Main parts of the Energy Lab 2.0 infrastructure are introduced and their specifications and status of completion are discussed. A major component of the Energy Lab 2.0 is the Power-Hardware-in-the-Loop (PHIL) Laboratory. The focus of the conference contribution is on the 1 MVA PHIL system design and its completion. Moreover, the contribution provides insights into ongoing PHIL research work and objectives at the Institute of Technical Physics.

4:00 PM - 4:30 PM

How to Validate an Autonomous Car

Pascal Remusan
Innovation Project Manager
Renault

As an Innovation Project Manager for Renault Group, Mr Pascal Remusan is responsible for developing the AD / ADAS validation by massive numerical simulation, defining the simulation tool chain and processes, managing the investments, the deployment of the solution and the correlation methods compared to physical testing.

In 2005, he joined Renault Group to manage the Quality of the prototypes during development and industrialization phases. Then he worked during several years on the numerical simulation for vehicle performance before joining AD/ADAS simulation department.

TRACK 2 - AERO, AUTO, MARINE & AUTOMATION

1:00 PM - 1:30 PM

Preparing For The Challenges Of Verification And Validation Of Complex Software For Autonomous Systems

Amine Smires
CS Canada
Canada

After graduating from Mechanical Engineering in 2005 at Concordia University, Mr Amine Smires started his career internationally at EADS on the production assembly line of the Airbus A320 and A340.

Since joining CS Canada in 2007, he has actively participated to the growth of the company which increased its revenues every year by 20% to 30%.

Amongst his roles at CS Canada, he was the Program Manager for four years of large and complex Engine Controls programs for the Bombardier C-Series, the Airbus A320Neo & the Mitsubishi MRG.

Together with his team of 250 engineers located in Montreal, Toulouse, Craiova and Bangalore, Mr Smires was responsible of testing and certifying the Software in conformance with DO-178 standard.

More recently, he has moved into the Advanced Programs Business Line as a Business Development Manager. His main role is to develop and diversify the activities of the company into the Autonomous and Connected vehicle market.

Mr Smires is currently doing an executive MBA at Mcgill-HEC and will be graduating in 2019.

Abstract:

The high level of criticality associated with the technology of ADAS & autonomous driving demands a level of rigor in Verification and Validation (V&V) that is the hallmark of certification in the aerospace industry. CS has combined its very substantial experience in aerospace V&V with highly specialized knowledge of the automotive functional safety standard, ISO 26262, to offer automotive OEMs and their suppliers the practical "know-how" to meet both regulatory requirements and the expectations of consumers. In that context, CS helps its clients establish engineering processes integral to the delivery of products that have a critical dependence on complex software.

NADIA is a software tool developed by CS to help its automotive clients to both reduce V&V costs and allow system engineers to focus their efforts on aspects of the V&V process that depend most on their specialized knowledge. This tool transforms a human-readable V&V test plan into an executable test script that automatically tests automotive software in a SIL and HIL environment. NADIA is an alternative to using not-always-reliable offshore resources to manually write test scripts.

1:30 PM - 2:00 PM

Real-Time Cooperative Localization With Extended and Unscented Kalman Filters for Intelligent Vehicles

Farid Bounini, Doctorant
Université de Sherbrooke
Canada

FARID BOUNINI started his academic studies at Mouloud Mammeri University at Tizi Ouzou for five years, and awarded his Bachelor and Master degrees in Automatism "Systems Control". In 2013, he received his second master degree at Evry Val d'Essonne University in "Smart Aerospace and Autonomous Systems". He is currently a PhD student and a member of Vehicular Intelligence Laboratory (LIV) at Sherbrooke University. His main field is parallel architectures and real-time simulation of collaborative and autonomous vehicles, in collaboration with OPAL-RT Technologies Inc. and ESI-CIVITEC.

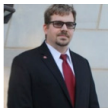
Abstract:

This paper describes a new method for real-time cooperative localization of intelligent vehicles. The strategy aims to improve the vehicles localization accuracy. The method aims to solve localization issues in a cluster of intelligent vehicles, equipped with low-cost navigation systems in an unknown environment. The method based on multiple forms of the Kalman filter derivatives to estimate the vehicles' nonlinear model vector state, in a local fusion node. Once the vehicles exchange their local estimate, then the Covariance Intersection algorithm is performed for merging the local vehicles' state estimate in the second node that overcomes the over-covariance issue, named global data fusion node. This strategy simultaneously exploits the proprioceptive and sensors—a Global Positioning System, and a vehicle-to-vehicle transmitter and receiver—and an exteroceptive sensor, range finder, to sense their surroundings for more accurate and reliable collaborative localization. The simulation scenario is built on the dedicated real-time simulator of collaborative and autonomous vehicles, named Pro-SiVIC/RTLAB.

2:00 PM - 2:30 PM

Describing the NCREPT Test Facility and Research With Regards to the Dyno and the Associated Driving Schedules

Chris Farnell
NCREPT Test Engineer
University of Arkansas
USA



Chris Farnell is the Test Engineer at the University of Arkansas's NCREPT test facility. He received a M.S. degree in Electrical Engineering from the University of Arkansas in 2017 and is currently pursuing a Ph.D. in Electrical Engineering at the University of Arkansas. Prior to obtaining his degree, Chris served in the United States Air Force as a Flying Crew Chief on the C-17A Globemaster III. His research interests include embedded system design, wireless sensor networks, FPGAs, and power electronics testing and design. Chris remains active in K-12 outreach activities.

Abstract:

A 100 kW dynamometer test stand was constructed at the National Center for Reliable Electric Power Transmission (NCREPT) to test traction drives for electric and hybrid vehicles, in particular, converters based on wide bandgap semiconductor devices. Researchers at NCREPT have developed a hardware-in-the-loop system using OPAL-RT equipment which allows for dynamic control of the dynamometer based on specified vehicle driving schedules and physical dimensions as well as simulated road conditions. NCREPT is located at the University of Arkansas and has the capability to test power electronic circuits at operating levels up to 13.8 kV and 6 MVA. This 7000 ft^2 laboratory facility provides the equipment, technical staff and instrumentation to test and evaluate power electronic circuits.

2:30 PM - 3:00 PM

Real-Time Application of Proprioceptive Tactile Sensing With Robotic Graspers

Bruno Belzile
McGill University
Canada

Bruno Belzile received the B.Eng. degree in mechanical engineering from Polytechnique Montréal, Montréal, QC, Canada, in 2011, where he also completed in 2016 his Ph.D. degree in mechanical engineering in the Robotics Laboratory. He currently works at the Robotic Mechanical Systems Laboratory at McGill University and holds a postdoctoral scholarship from the Fonds de recherche du Québec - Nature et technologies (FRQNT).

Abstract:

During his time at the Robotics Laboratory of Polytechnique Montreal, the author worked on finding a low-cost, efficient alternative to conventional tactile sensors, to be used with robotic graspers. To reach this goal, proprioceptive measurements from internal sensors located at the actuator were used with a model of the intrinsic stiffness of the mechanism. RT-Lab was used to design and implement real-time tactile sensing algorithms based on those two elements. Many built-in RT-Lab and Simulink signal processing tools were used to estimate in real time the contact location as well as adjusting the control scheme to the object grasped.

3:30 PM - 4:00 PM

A Novel Parallel Robot for Fast Pick-and-Place-Operations

Peyman Karimi Eskandary
McGill University
Canada

Peyman started his journey in mechanical engineering, on 2006, at University of Tehran, Iran, with the focus on robotics and dynamics. After receiving his Bachelor's, he pursued his master's at University of Waterloo, Canada. Then, he worked for two years at AVP Solutions, located in Toronto, on development and fabrication of the automated vision inspection machines. One more time, an interesting robotic project with professor Jorge Angeles at McGill University, dragged him to academia. These days, he is working on development of a fast pick-and-place robot, dubbed PMC, as well as a novel robotic actuator, called C-drive.

Abstract:

A novel architecture for a parallel-kinematics machine (PKM) was recently proposed for fast pick-and-place operations, involving three independent translations and one rotation about an axis of _xed direction. The single-loop kinematic chain was designed with unique features, like symmetry, isostaticity, and high rotatability of its gripper. The authors report the kinematics and dynamics modelling of the novel PKM, fully developed at McGill University's Centre for Intelligent Machines (CIM). The mathematical model is based on the concept of the natural orthogonal complement (NOC), also developed at CIM. This robot is controlled in real-time under RT-Lab. Validation of the mathematical model was conducted experimentally. The results verify the model and reveal the excellent performance of the novel architecture.

4:00 PM - 4:30 PM

The Importance of Electrical Fault Insertion in HILS Applications

Brennan Caissie
Pickering
USA

Brennan Caissie is an Applications Engineer for Pickering Interfaces, a market innovator in signal switching and conditioning for a broad range of applications and industries. His focus is supporting customers in implementing switching and simulation solutions for test applications.

Brennan holds a B.S. in Electrical and Computer Engineering from WPI and has previously worked as a Test Engineer for Bose.

Abstract:

Electronics test has been traditionally been a "go-no go" test strategy - Put good signals in, get good signals out - PASS, or put good signals in, get bad signals out - FAIL. Today's electronics circuitry is very firmware intensive, so the possibility of coding errors must also be checked. Such designs require a different strategy, more of a "No go-go" philosophy. In other words, if you put bad signals in, do you still get a satisfactory response? This is important for safety related electronics, where the circuitry must function as well as possible in adverse conditions.

This presentation will show the value of adding electrical fault insertion (FI) into your test strategy. They types of faults that can be inserted will be highlighted and some caveats of choosing the right FI will be discussed. Finally a real world application will be presented.

Who will benefit - Test engineers defining a test strategy as well as test engineering management, who will get a better understanding of the value of FI.

4:30 PM - 5:00 PM

Model-Based Design Using Substation Hardened Universal Relay

Jean Philippe Gagnon
GENTEC
Canada

Jean-Philippe Gagnon is an electrical engineer working for Gentec, a protective relay and IED manufacturer located in Quebec city, Canada. He received his Bachelor's degree in electrical engineering from University Laval. With a role of product manager, his current position at Gentec leads him to provide innovative solutions to resolve the challenges associated with the protection, control and monitoring of power systems. His interests are especially related to resolving specific P&C problems using innovative relay architectures with customizable DSP.

Abstract:

The changes inflicted to the power system by the installation of renewable energy and its interaction with the existing grid leads to think of new methods of protection, control, monitoring and automation. The design of solutions in a laboratory environment and possibilities are endless although those solutions can only exists if portable to the field. Only a handful of configurable device such as the ALP-Universal Detection Relay exists and we present a model-based approach with real cases and their benefits. An introduction to the device is also presented as well as the process workflow for designing custom solutions and algorithms. An overview of future application is also presented.

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