AGENDA

RT SPOTLIGHT
GLOBAL REACH, LOCAL PRESENCE

OPAL-RT’S 1st Local Conferences on Real-Time Simulation

SEPTEMBER 26-27, 2019
SAN FRANCISCO | USA

DIAMOND SPONSORS
NATIONAL INSTRUMENTS

GOLD SPONSORS
SCALABLE NETWORK TECHNOLOGIES

SILVER SPONSORS
doble®

www.opal-rt.com/event/rt-spotlight-san-francisco
<table>
<thead>
<tr>
<th>TIME</th>
<th>ACTIVITY</th>
<th>PRESENTER(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 AM – 9:00 AM</td>
<td>Registration &amp; Breakfast</td>
<td></td>
</tr>
<tr>
<td>9:00 AM – 10:15 AM</td>
<td>Part 1 - Workshop on OPAL-RT’s HIL tools usage for Electrical Power train simulation including RT-LAB, eHS and Electrical Motor library</td>
<td>Derek Boychuk, Customer, Solutions Architect, OPAL-RT TECHNOLOGIES</td>
</tr>
<tr>
<td>10:15 AM – 10:45 AM</td>
<td>BREAK</td>
<td></td>
</tr>
<tr>
<td>10:45 AM – 12:00 PM</td>
<td>Part 2 - Workshop on OPAL-RT’s HIL tools usage for Electrical Power train simulation including RT-LAB, eHS and Electrical Motor library</td>
<td>Derek Boychuk, Customer Solutions Architect, OPAL-RT TECHNOLOGIES</td>
</tr>
<tr>
<td>12:00 PM – 1:00 PM</td>
<td>LUNCH - SPONSORED BY NATIONAL INSTRUMENTS</td>
<td></td>
</tr>
<tr>
<td>1:00 PM – 2:00 PM</td>
<td>Workshop on OPAL-RT’s Scripting using Python RT-LAB</td>
<td>Vincent Lapointe, Product Manager, OPAL-RT TECHNOLOGIES</td>
</tr>
<tr>
<td>2:00 PM – 3:15 PM</td>
<td>Part 1 - Workshop on EV powertrain HIL on NI Veristand including eHS and Electrical Motor library</td>
<td>Myriam Desranleau, Field Applications Engineer, OPAL-RT TECHNOLOGIES</td>
</tr>
<tr>
<td>3:15 PM – 3:45 PM</td>
<td>BREAK</td>
<td></td>
</tr>
<tr>
<td>3:45 PM – 5:00 PM</td>
<td>Part 2 - Workshop on EV powertrain HIL on NI Veristand including eHS and Electrical Motor library</td>
<td>Myriam Desranleau, OPAL-RT, Field Applications Engineer</td>
</tr>
</tbody>
</table>
FRIDAY, SEPTEMBER 27TH, 2019

<table>
<thead>
<tr>
<th>TIME</th>
<th>ACTIVITY</th>
<th>PRESENTER(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 AM – 9:00 AM</td>
<td>Registration &amp; Breakfast</td>
<td></td>
</tr>
<tr>
<td>9:00 AM – 9:30 AM</td>
<td>Welcome to RT Spotlight, San Francisco Opening ceremony, Electrical powertrain HIL, where does OPAL-RT stand and where is OPAL-RT going?</td>
<td>Pierre-Francois Allaire &amp; Maxim Beaudoin, OPAL-RT</td>
</tr>
<tr>
<td>9:30 AM – 10:00 AM</td>
<td>Development of Hardware-in-the-Loop unit and Fast Prototyping tool using OPAL-RT at Karma Automotive</td>
<td>Geng Niu, Senior Manager, Powertrain Hardware, Karma Automotive</td>
</tr>
<tr>
<td>10:00 AM – 10:30 AM</td>
<td>Challenges, opportunities, and technology for electrification of LDV through HDV</td>
<td>David Christensen, Executive Director, Utah State University</td>
</tr>
<tr>
<td>10:30 AM – 10:45 AM</td>
<td>BREAK</td>
<td></td>
</tr>
<tr>
<td>10:45 AM – 11:15 AM</td>
<td>Tools, Methods and Quality Approaches to Deliver High Quality Control in Digital Power Electronics.</td>
<td>Dr. Hamish Laird, CTO, ELMG Digital Power, Inc</td>
</tr>
<tr>
<td>11:15 AM – 11:45 AM</td>
<td>eHS and Electrical motors: Features, Roadmap, return on experience and market trends</td>
<td>Vincent Lapointe, Product Manager, OPAL-RT TECHNOLOGIES</td>
</tr>
<tr>
<td>11:45 AM – 12:15 PM</td>
<td>Full Vehicle Simulation for Electrified Powertrain Selection</td>
<td>Brad Hieb, Principal Application Engineer, MathWorks</td>
</tr>
<tr>
<td>12:15 PM – 1:15 PM</td>
<td>LUNCH - SPONSORED BY NATIONAL INSTRUMENTS</td>
<td></td>
</tr>
<tr>
<td>1:15 PM – 1:45 PM</td>
<td>Applying a Platform-Based Approach to Optimize EV Testing</td>
<td>Nate Holmes, Principal Solutions Manager, Automotive, National Instruments</td>
</tr>
<tr>
<td>1:45 PM – 2:15 PM</td>
<td>SIL and HIL for ADAS and Autonomous testing architecture</td>
<td>Hervé Pollart, General Director, OPAL-RT STI</td>
</tr>
<tr>
<td>2:15 PM – 2:45 PM</td>
<td>Ensuring Reliable V2X Communications by Simulation</td>
<td>Lloyd Wi, Application Engineering, SCALABLE Network Technologies</td>
</tr>
<tr>
<td>2:45 PM – 3:00 PM</td>
<td>BREAK</td>
<td></td>
</tr>
<tr>
<td>3:00 PM – 3:30 PM</td>
<td>Advanced Power Emulators enable P-HIL Testing of Integrated Power Systems</td>
<td>David Eddy, General Manager, D&amp;V Electronics USA</td>
</tr>
<tr>
<td>3:30 PM – 4:00 PM</td>
<td>Battery Management System with OPAL-RT</td>
<td>Derek Boychuk, Customer Solutions Architect, OPAL-RT TECHNOLOGIES</td>
</tr>
<tr>
<td>4:00 PM – 4:30 PM</td>
<td>Assessing the Impacts of Electric Vehicles into the Distribution Grid</td>
<td>Gustavo Vianna Cezar, Staff Engineer, SLAC National Accelerator Laboratory</td>
</tr>
<tr>
<td>4:30 PM – 6:30 PM</td>
<td>Exhibition</td>
<td></td>
</tr>
<tr>
<td>6:30 PM – 9:30 PM</td>
<td>WELCOME RECEPTION - SPONSORED BY NATIONAL INSTRUMENTS</td>
<td></td>
</tr>
</tbody>
</table>

9:00 AM – 10:15 AM
Part 1 - Workshop on OPAL-RT’s HIL tools usage for Electrical Power train simulation including RT-LAB, eHS and Electrical Motor library

10:45 AM – 12:00 PM
Part 2 - Workshop on OPAL-RT’s HIL tools usage for Electrical Power train simulation including RT-LAB, eHS and Electrical Motor library

1:00 PM – 2:00 PM
Workshop on OPAL-RT’s Scripting using Python RT-LAB

Vincent Lapointe
Product Manager
Company: OPAL-RT TECHNOLOGIES

BIO: Vincent received his Master's in Mechanical Engineering from the University of Laval. Having occupied several positions at OPAL-RT, he is now responsible for defining the product strategy, in particular for electric products, and participates in defining the roadmap. He helps ensure that OPAL-RT is continuously innovating and remains ahead of trends.

THANK YOU FOR VISITING US AT RT SPOTLIGHT!
2:00 PM – 3:15 PM
Part 1 - Workshop on EV powertrain HIL on NI Veristand including eHS and Electrical Motor library

3:45 PM – 5:00 PM
Part 2 - Workshop on EV powertrain HIL on NI Veristand including eHS and Electrical Motor library

MYRIAM DESRANLEAU
Field Applications Engineer
COMPANY: OPAL-RT TECHNOLOGIES

BIO: Myriam Desranleau has been a Field Applications Engineer at OPAL-RT for two years. She works closely with customers developing hardware-in-the-loop test systems, and primarily focuses on OPAL-RT’s tools for the National Instruments platform. Previously, Myriam worked for NI as an Applications Engineering Specialist in the automated test industry. She received her bachelor’s degree in Mechanical Engineering from McGill University in 2013.

9:00 AM – 9:30 AM
Welcome to RT Spotlight, San Francisco Opening ceremony, Electrical power train HIL, where does OPAL-RT stand and where is OPAL-RT going?

PIERRE-FRANCOIS ALLAIRE
Vice-President, Sales & Marketing
COMPANY: OPAL-RT TECHNOLOGIES

— AND —

MAXIM BEAUDOIN
Team Leader, Western North America Sales
COMPANY: OPAL-RT TECHNOLOGIES

9:30 AM – 10:00 AM
Development of Hardware-in-the-Loop unit and Fast Prototyping tool using OPAL-RT at Karma Automotive

DR. GENG NIU
Senior Manager, Powertrain Hardware
COMPANY: Karma Automotive LLC

BIO: Dr Geng Niu, Senior Manager, Powertrain Hardware, Karma Automotive, is leading the electrified powertrain development for various Karma vehicle programs, including EREV and BEV architecture. He received his B.S. in Electrical Engineering from Beihang University, Beijing, China, followed by his M.S. and Ph.D. degrees in Electrical Engineering from Illinois Institute of Technology, Chicago. In his 3-year career in Karma Automotive, he was leading the in-house product development team to design the second generation power inverters for Karma Revero GT and Revero GTS. Also he was overseeing the e-drive system software development and control algorithms for traction derive and range extender.

ABSTRACT: Inverter team at Karma Automotive provides in-house development of power inverters (HW and SW) for world-class Karma EVs. As a main step in inverter SW and HW development, we developed a Hardware-in-the-loop unit and an inverter fast prototyping tool. The Hardware-in-the-Loop unit is a main tool for SW development task, and it is now being extended to include SW verification tests, too. On the other hand, the fast prototyping tool is an essential tool to facilitate the implementation of inverter HW for the future EV platforms. This unit also provides a powerful tool for development of SW application layer with the possibility of high frequency sampling and monitoring.

The presentation file will discuss the structure of Hardware-in-the-Loop unit (power stage and monitoring) using OP5700 platform and its interaction with control board via CAN bus. It also covers the CAN unit of OP5700 platform to be used for implementation of automatic verification tests. As another discussion, the development of the fast prototyping tool (including motor control algorithm, protection, diagnostics, and CAN communication) using OP4510 platform will be discussed. The testing of the fast prototyping unit with the hardware-in-the-loop unit will be also presented.
The nation is at a crossroads in time: our aging grid and electrification of LDV through HDV

ABSTRACT: The nation is at a crossroads in time: our aging grid and electrification of LDV through HDV. Challenges, opportunities, and technology for electrification of LDV through HDV.

David Christensen is Executive Director of the Sustainable Electrification Transportation (SELECT) Center. The Center is led by Utah State University and, since its founding in early 2016, the Center has grown from five university partners and a dozen faculty members to 13 core and affiliated university partners with more than 40 researchers with globally recognized expertise across sectors in electric transportation research. SELECT’s vision is to develop and strategically grow a network of diverse, inter-disciplinary faculty and students as well as key industry members and other stakeholders while fostering a culture of inclusion across ideas, diverse backgrounds, and research activities to spur pursuit of breakthrough research activities, enabling technologies, and engineered systems in electrified transportation. David coordinates SELECT’s strategic direction, member relations, and commercialization activities in addition to directing membership activities among the Center’s industry members and collaborators. David holds a PhD in Professional Communication/Rhetoric from Utah State University, and he also serves as the Board Chair for the DOE-funded Utah Clean Cities Consortium.

Dr. Hamish Laird is CTO at ELMG Digital Power, Inc. His work is helping people realize the benefit of digital power electronics control to speed time to market, minimize the converter cost, maximize efficiency and provide stable robust operation. His converter control experience includes HVDC transmission control, hybrid vehicles, electric vehicles and rail traction along with telecom power and battery energy storage. He has thirty years of experience in the design, research, development and commercialization of power converters with strong focus on manufacturability and production.

Hamish worked for Alstom Grid, Aucum and Eurotherm Drives before completing his Doctorate in Short Active Filtering and founding ELMG Digital Power. Current ELMG Digital Power customers include large electrical OEMs such as ABB, energy storage companies, traction companies and automotive companies.

Hamish recently worked with the PSMA (Power Supply Manufactures Association) to develop guidelines for software quality in the digital control of power electronics. He is a regular and well-respected presenter at APEC and other conferences.

Vincent received his Master’s in Mechanical Engineering from the University of Laval. Having occupied several positions at OPAL-RT, he is now responsible for defining the product strategy, in particular for electric products, and participates in defining the roadmap. He helps ensure that OPAL-RT is continuously innovating and remains ahead of trends.

ABSTRACT: eHs is OPAL-RT’s nanosecond power electronics solver for real-time simulation on FPGA. This presentation focuses on features, applications and enhanced workflows in the new version, featuring new components (transformers, line models, switching functions, and switches) as well as improved accuracy and precision. The improved usability of eHS workflows comes from the powerful and intuitive Schematic Editor, which enables construction, editing and integration of circuits, and is integrated within eHS. This new generation of solver has use cases within all types of power electronics systems, like industrial motor drive, battery management system and electrical transportation.

Brad is an application engineer at MathWorks, focusing on control design. Prior to joining MathWorks, Brad worked for Ford Motor Company for 14 years. His Ford experience included advanced powertrain controls design, vehicle and powertrain controls for Ford’s Formula 1 racing program, and vehicle dynamics simulation, tools and methods work. Prior to Ford, Brad worked for several years as a logic design engineer at Cray Research. Brad holds a M.S.E. from the University of Michigan, Ann Arbor and a B.S. from Iowa State University, both in electrical engineering.

ABSTRACT: Full vehicle simulation models are needed to assess attributes such as fuel economy and performance. In this session, you will learn how MathWorks automotive modeling tools can be used for powertrain selection studies. Specifically, we will examine the impact of adding an electric motor at different locations along the driveline (e.g., pre- or post-transmission). In order to make a fair comparison between alternatives, an optimal supervisory control strategy known as ECMS (Equivalent Consumption Minimization Strategy) is applied. With these closed-loop models, we can quantify the performance / fuel economy tradeoffs for the architectures under consideration and determine an optimal powertrain selection.

The challenges include:
- Limited Number of Bits
- Sampling and limited bandwidth
- Processing Delay
- Producing and maintaining high quality software code

The presentation explores the detail of these challenges and presents tools, methods and quality approaches to address them.
In the automotive industry, testing autonomous vehicles presents unique challenges due to the integration of new AD/ADAS sensors and the requirement for robust testing architecture. This presentation will highlight the best tools for migrating physical vehicle technology to the testing of autonomous vehicles.

**ABSTRACT:**

Our focus is on autonomous vehicle technology. As General Manager of Intelligents (Lyon), Hervé, with 15 years’ experience in the automotive field, will lead our team in addressing the challenges of testing automotive technology ranging from high-speed/high-fidelity control and emulation of power electronics to managing massive parallel deployments of testers and the data they generate. Learn how NI’s open and flexible platform combined with OPAL-RT real-time simulation models, tools, and expertise provide a foundation for standardizing test across the EV powertrain.

**SIL and HIL for ADAS and Autonomous testing architecture**

Hervé Pollart, General Director at OPAL-RT Intelligent Transportation Systems

**ABSTRACT:**

Learn how to integrate and validate each autonomous vehicle technology of new AD / ADAS sensors. In this presentation, you will discover the best tools for migrating physical testbeds onto simulation platforms, in order to overcome obstacles, the automotive industry faces when testing autonomous vehicles.

**Ensuring Reliable V2X Communications by Simulation**

Lloyd Wihl, Director, Application Engineering

**ABSTRACT:**

V2X promises to improve safety on the road by relaying information among vehicles to help reduce collisions and loss of life. The technology must operate with extreme reliability in a very dynamic environment, with high relative speeds, very low latency for dynamic connections and safety-critical message receipt, in crowded urban environments with interfering signals. V2X systems will use competing technologies including DSRC and C-V2X. However, there are many issues which will need to be resolved. Congestion on the roads will affect the ability to communicate, and mitigation strategies need to be developed. Security of the networks will be needed for trustworthiness. Significant testing will be needed to guarantee interoperability among devices.

**Ensuring Reliable V2X Communications by Simulation**

Lloyd Wihl is Director of Application Engineering at SCALABLE Network Technologies. His experience includes leading large-scale projects with OPAL-RT and using the hardware-in-the-loop (HIL) platform for V2X testing. His team is developing a platform that can handle the complexity of V2X systems, including DSRC and C-V2X, to ensure reliable communication.

**Battery Management System**

Derek Boychuk, Customer Solutions Architect

**ABSTRACT:**

Battery Management System enables the efficient and reliable operation of electric vehicles. This presentation will cover the design, implementation, and testing of Battery Management Systems (BMS) that are crucial for the safe and efficient operation of electric vehicles. The BMS monitors battery voltage, current, and temperature, ensuring optimal performance under various conditions. The BMS also manages charging and discharging rates to protect the battery lifespan and prevent overcharge or overdischarge. Testing and validation of these systems is critical to ensure the reliability and safety of electric vehicles.

**Advanced Power Emulators enable P-HIL Testing of Integrated Power Systems**

Dave Eddy, General Manager

**ABSTRACT:**

Advanced Power Emulators enable P-HIL Testing of Integrated Power Systems. This presentation will cover the development and implementation of advanced power emulators that can simulate real-world power systems in a controlled environment. The emulators are critical for testing power electronic systems and components, including DC power systems, power electronics, and power systems. The presentation will discuss the design and capabilities of the Direct Current Emulator (DCE) and how it can be used to test power electronic systems. The DCE is a bi-directional power source with a controllable bandwidth that can exceed the bandwidth of the fastest load. It can provide a means of determining system margin. The DCE can be controlled by a high-speed fiber optic interface with supermicrosecond latency for real-time simulation Power Hardware In the Loop (P-HIL) to verify small signal stability analysis. Full DC power systems and power system components can be tested using the DCE as a test component to connect the DC power system. When the DCE is emulating the DC power system, the test components can be configured as a controllable source impedance and can generate transients and controlled noise and ripple. In combination with DAV’s electric vehicle motor emulator, also capable of real time simulation P-HIL, full vehicle system integration and component compatibility testing can be achieved.

**Assessing the Impacts of Electric Vehicles into the Distribution Grid**

Gustavo Cezar, Staff Engineer

**ABSTRACT:**

Electric traction has been growing in a fast pace in the last few years worldwide. Many countries are creating policies and regulations to incentivize widespread adoption of electric vehicles (EV). In the US, California is leading the way with high goals. However, without an understanding of the real impacts of EV loads into planning and operations of the electrical grid, this wide adoption can create catastrophic consequences. In this talk, we will discuss two current projects SLAC is leading in order to address operations and planning challenges in workplace charging stations and fleet operations.
Critical technology trends in advanced driver assistance systems (ADAS) and electric vehicles (EVs) present new test challenges beyond the here and now. This quickly evolving technology landscape increases the pressure on any test schedule and requirements.

Using NI’s flexible platform-based approach means you can own the test system IP and make changes quickly rather than solely relying on a third-party vendor. Work with NI to overcome the pressure of these rapidly changing test requirements using an open and easily upgradable platform that offers the test system flexibility you need to test the vehicles of tomorrow today.


SCALABLE Network Technologies has developed a family of software products for engineers, analysts and operators of mission-critical, business-critical environments to help ensure the networks, the networked systems, and the distributed applications work effectively under all normal and emergency operating scenarios. Our solutions integrate software virtual networks with physical hardware and applications, allowing users to rapidly test a wide range of highly realistic scenarios for better operational planning, more effective training and enhanced communications effectiveness without the expense of building out physical infrastructure.

SCALABLE has created a “lab-based risk reduction” approach that provides a repeatable, verifiable, and highly cost-effective solution. SCALABLE’s simulation software is used by commercial, government, military, and educational organizations around the world.

The EXata communications simulation platform (EXata) is a network emulator that lets you evaluate on-the-move communication networks. It uses a software virtual network (SVN) to digitally represent the entire network, the various protocol layers, antennas, and devices. The system can interoperate, at one or more protocol layers, with real radios and devices to provide hardware-in-the-loop capabilities. EXata can also be connected to systems with real applications, which run on the SVN just as they would run on real networks. It provides a cost-effective and efficient way to ensure the reliability of V2X communications to reduce collisions and loss of life in the future. EXata is being used to support the research being done to develop V2X technology. In V2X, interoperability is crucial. The technology must also operate with extreme reliability in a very dynamic environment, with high relative speeds, very low latency for dynamic connections and safety-critical message receipt, in crowded urban environments with interfering signals. SCALABLE’s wireless simulation that includes urban environments, vehicle mobility, fading, shadowing, path loss and interference, and our models of 802.11p, LTE, Thread, Bluetooth and 5G provide the answer. Our tools reveal details about network performance at every layer of the stack, to locate problems in various environments and scenarios and improve safety on the road. EXata is already in use in the USA, Europe, and Asia to support this research.

www.scalable-networks.com
COMPANY DESCRIPTION:
Doble Engineering Company strives to ensure all people have reliable, safe and secure power. We do this by providing advanced diagnostics and engineering expertise to the energy industry worldwide. Our companies and product lines include Manta Test Systems, Morgan Schaffer, Vanguard Instruments and Xtensible Solutions. Whether the goal is condition monitoring or asset management, Doble has solutions for any need. Doble is part of the Utility Solutions Group of ESCO Technologies Inc. (NYSE: ESE).

PRODUCT DESCRIPTION:
F6350e / F6300e External Amplifiers
These amplifiers are useful in high power protection testing applications when you need additional current and/or voltage sources, for critical high burden relay testing, as well as system modeling.

When used in combination with Doble’s Protection Suite software, you will have the ultimate flexibility to test complex schemes. These amplifiers also offer the industry’s most current sources in one piece of equipment.

www.doble.com

COMPANY DESCRIPTION:
D&V Electronics designs and manufactures leading edge test solutions for all components of an electrified powertrain and for all stages of the product life cycle, from R&D through to end of line production and aftermarket. Its worldwide customer base includes OEMs, Tier 1 & 2 manufacturers, universities, government institutions, and test centers. D&V Electronics has supplied high quality testing expertise, technology, and support to customers in over 90 countries for over 20 years.

PRODUCT DESCRIPTION:
D&V Electronics combines leading edge technology and innovative design to produce superior vehicle electrification test solutions. We provide two advanced power emulators, e-Motor Emulator and DC Emulator that are P-HIL compatible with fiber optic interfaces. The DC Emulator product line is a 30kW to 1.2MW DC source/link that emulates dynamic, complex bidirectional loads with best in class frequency response, deterministic streaming with <1us latency, bidirectional full-power slew rate of <10us, and repeatable noise/ripple generation. Ideal for testing vehicle energy systems and components, including batteries, and for HIL with real-time simulation to emulate large switching and regenerative loads to study their effect on the whole power system. The e-Motor Emulator mimics the 4-quadrant electrical output of multi-phase synchronous or induction motor/generators under user-controlled speed, torque, and temperature conditions thereby simulating an electric drive train or electric propulsion motor. This electronic dynamometer, with facility requirements suitable for laboratory installations, offers significant advantages in test capabilities and flexibility as well as low acquisition and operating costs.

www.dvelectronics.com
THANK YOU!

<table>
<thead>
<tr>
<th>DIAMOND SPONSORS</th>
<th>GOLD SPONSORS</th>
<th>SILVER SPONSORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NATIONAL INSTRUMENTS™</td>
<td>SCALABLE NETWORK TECHNOLOGIES</td>
<td>doble® Electronics</td>
</tr>
</tbody>
</table>