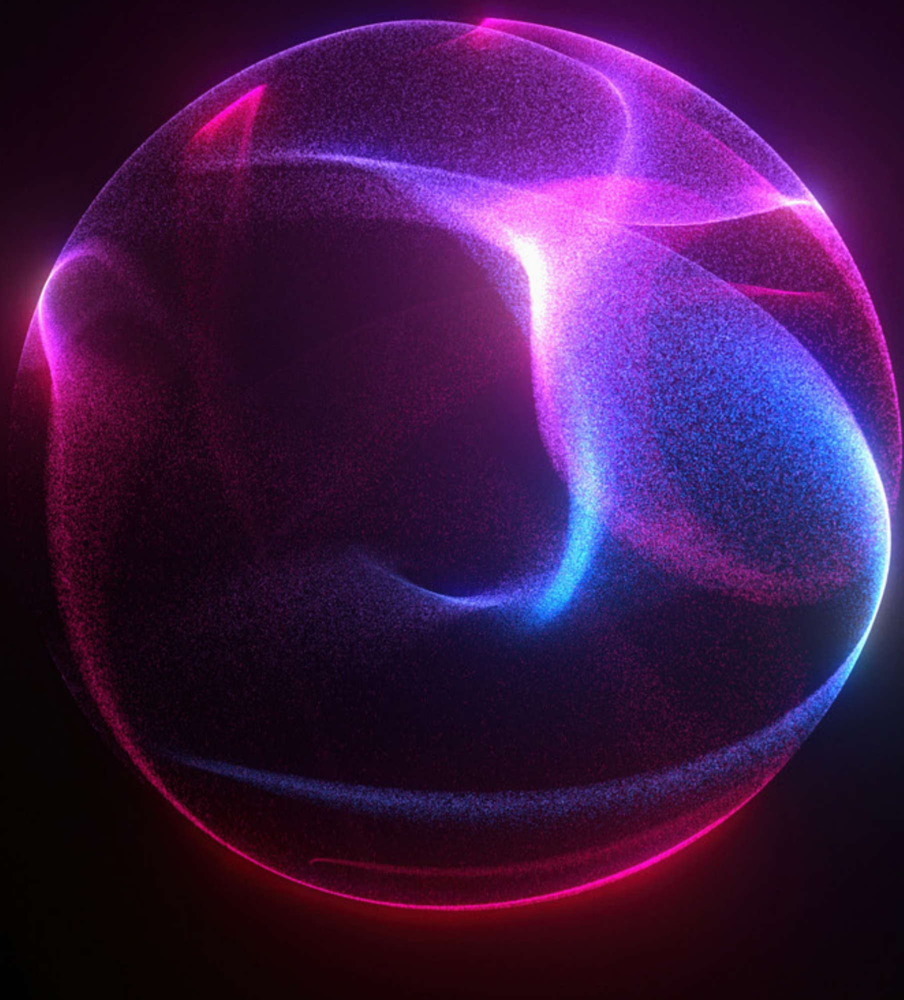
POWER IN MIND

Convergence of Energy & Electrification



OPAL-RT TECHNOLOGIES

VOLUME 9 - WINTER 2025

A Word from the Editor

Welcome, dear readers, to a new and electrifying edition of OPAL-RT's Power in Mind Magazine. As we continue to explore the evolving landscape of energy, this edition delves into the transformative power of the convergence between energy systems and electrification—an intersection redefining the future of both industries.

At OPAL-RT, our journey has always been fueled by the most demanding challenges from across a spectrum of industries. From pioneering advancements in power electronics for the automotive sector long before the energy transition gained momentum, to meeting the rigorous standards of aerospace and industrial applications, our history is one of relentless innovation. This diversity is our strength—each industry's unique demands have sharpened our capabilities and positioned us at the forefront of real-time simulation technology.

The electrification of transportation, aviation, and industrial processes is no longer a distant vision but an unfolding reality. Our tools empower engineers and researchers to push the boundaries of what's possible, accelerating the development of electric propulsion systems, battery management systems and renewable energy integration. The challenges we tackle today—from optimizing energy efficiency to ensuring grid stability—are the culmination of decades of cross-industry collaboration and technological refinement.

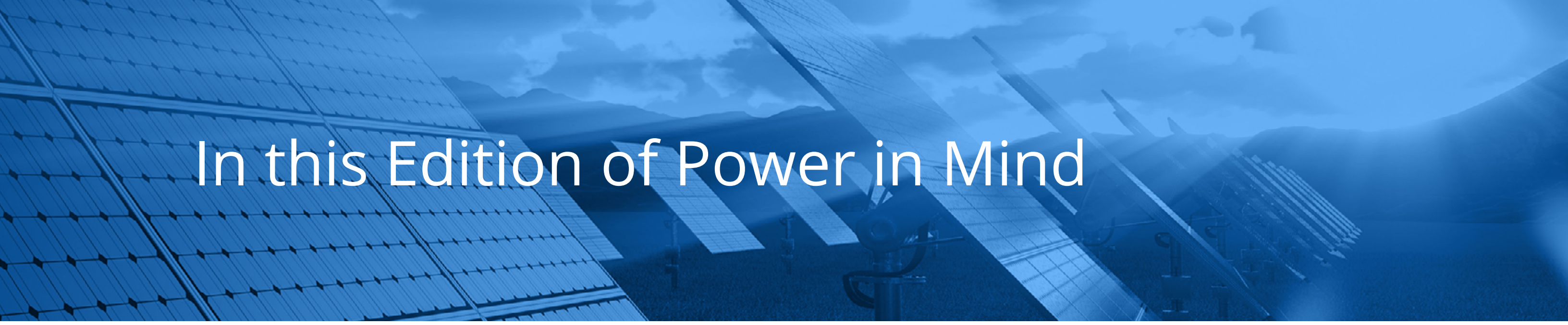
As the energy landscape continues to evolve, OPAL-RT remains committed to delivering cutting-edge solutions that drive innovation and sustainability. Our legacy of working with the most forward-thinking industries ensures that we are not just adapting to change—we are actively contributing to it. The convergence of energy and electrification promises transformative shifts, and OPAL-RT is uniquely positioned to support this transition with the most advanced, reliable, and flexible simulation tools available.

Join us in this edition as we explore the dynamic intersections of technology and energy, celebrate the pioneers pushing boundaries, and envision a future powered by innovation, collaboration, and sustainability.

Together, let's power the future.

Etienne Leduc,
Director of Product Strategy

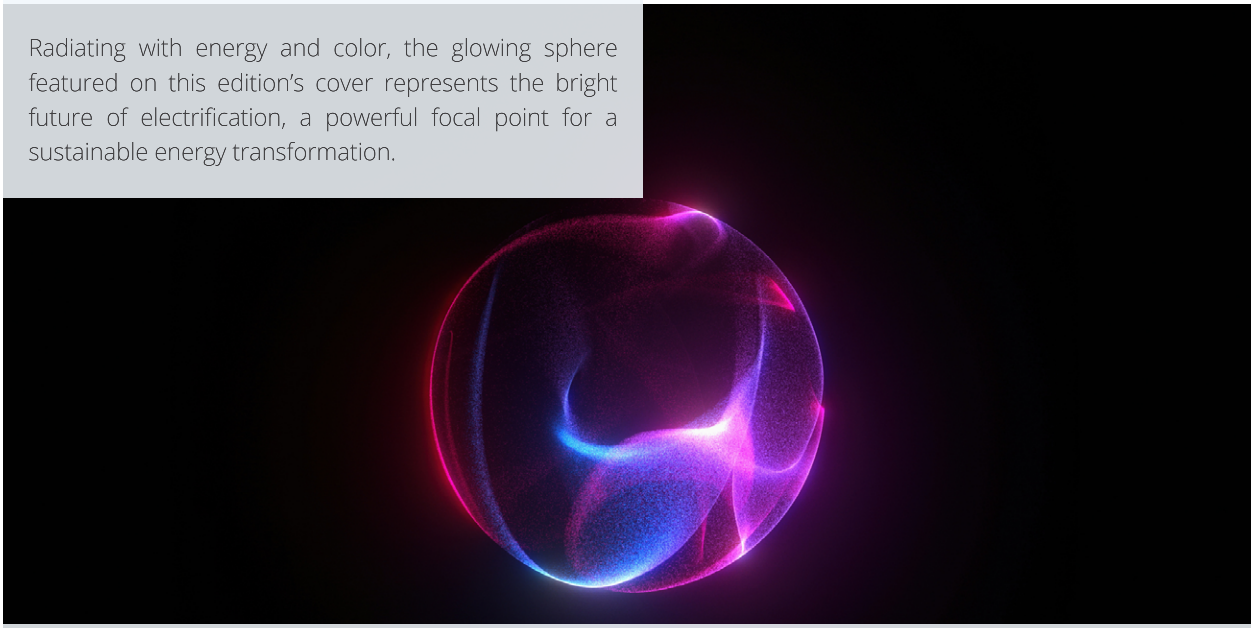
Etienne Leduc is a highly accomplished professional in electrical engineering and power systems at OPAL-RT TECHNOLOGIES. With expertise in real-time simulation and hardware-in-the-loop testing, Etienne has made significant contributions to power system simulation and control technologies. He is dedicated to promoting green energy solutions, particularly in renewable energy integration and grid modernization.



In this Edition of Power in Mind

Behind the Cover

Radiating with energy and color, the glowing sphere featured on this edition's cover represents the bright future of electrification, a powerful focal point for a sustainable energy transformation.



Editors: Etienne Leduc, Nadine Hariri, Sofía Escalera Eguíluz, and Maija Baroni
Design and layout: Sofía Escalera Eguíluz, Maija Baroni and Tania Gray

Electrification and Testing Evolution: A Talk with Alan Soltis

As the automotive industry undergoes a major transformation toward electrification, simulation and real-time testing have become critical to ensuring the reliability and efficiency of new technologies. Alan Soltis, Customer Success Manager at OPAL-RT TECHNOLOGIES, has spent over two decades at the forefront of this evolution, working closely with companies to integrate advanced Hardware-in-the-Loop (HIL) simulation tools into their development and validation processes.

With deep expertise in automotive testing and real-time simulation, Alan has seen firsthand how industry expectations have shifted—from the early days of HIL as an experimental tool to its current role as an essential component in modern powertrain and battery testing. In this interview, he shares his insights on how testing methodologies have evolved, the impact of electrification on simulation demands, and the challenges facing the industry as it prepares for the next decade of innovation.

Can you tell us about your background and what you do today at OPAL-RT?

Before joining OPAL-RT in 2003, I worked as a HIL test engineer in the automotive sector after earning a master's degree in electrical engineering. I began using HIL simulation in 2000, back when it was still an exploratory research topic, with industrial applications limited to early adopters.

I started at OPAL-RT as a Field Applications Engineer. After a few years, I transitioned into sales, eventually leading the Automotive Business Unit, where I helped automotive clients integrate their deliverables and supported them from our Michigan office.

Today, I'm a Customer Success Manager. I work directly with clients to ensure they succeed using our tools and provide customer insights to our internal teams in R&D, quality, and sales. This helps us align our efforts with our customers' current and future needs.

What did the HIL and testing landscape look like when you started, and how has it changed?

In the automotive sector, there was a heavy reliance on custom analog test systems and prototype "mule" vehicles to test individual components and controls in their environment. The concept of model-based, digitally controlled simulation was groundbreaking. Because of its novelty, test teams and HIL vendors like OPAL-RT had to navigate a learning curve together to establish best practices.

At the time, HIL testing focused primarily on the embedded controllers of the most consequential—and expensive—powertrain components. Engines were often modeled using simplified plant models, while some components, like throttle bodies, were integrated physically rather than simulated.

Today, HIL testing has become mainstream, extending beyond R&D niches to play a critical role in early defect detection and ensuring production readiness. This evolution has brought tighter timelines and higher standards. Systems are now expected to work immediately with minimal setup, reflecting the industry's maturity and elevated expectations compared to 25 years ago.

With electrification on the rise, when did the shift from combustion to electrification happen, and how has testing evolved?

I'd say the significant shift began around 2008. I recall attending an SAE conference panel featuring senior engineers from leading OEMs alongside EV-focused startups. Unsurprisingly, they held starkly different

> *"HIL testing has become mainstream, extending beyond R&D niches to play a critical role in early defect detection and ensuring production readiness."*
>
> **Alan Soltis Customer Success Manager at OPAL-RT TECHNOLOGIES**

views on electrification's future. Neither the most bullish nor pessimistic predictions about where we'd be today have entirely played out.

Early successes in battery and motor design demonstrated the potential benefits of EVs and dispelled some of the most fervent doubts. By the early 2010s, automakers began reallocating resources from internal combustion engines (ICE) to electrification. Today, the focus is on motor simulation and battery technology, which remains the bottleneck for mainstream adoption.

Electrified powertrains have also introduced new testing demands. Simulation loops, for instance, need to accelerate by several orders of magnitude—from milliseconds to nanoseconds. For example, while combustion engines could be simulated in the millisecond range for controls validation, the fast-switching technologies of electric powertrains and peripherals like fast chargers require sub-microsecond simulations.

Despite challenges such as supply chain constraints, inconsistent government incentives, and environmental concerns, EV market share has steadily expanded. This growth continues to drive our investment in advancing solutions.

Batteries seem to be the centerpiece of electrification. Is that still the prevailing view in the market?

Absolutely. Building better batteries and the control systems to manage their efficiency remains central to any electrification strategy. However, significant bottlenecks—such as resource availability and scaling production capacity—present challenges beyond automakers' control. Questions like "Where do we source material X at scale?" and "How do we retool facility Y for high-volume EV manufacturing?" are becoming increasingly important.

While investment in electrification remains heavy, comparing a century of incremental ICE development to about 15 years of serious electrification efforts highlights the scale of the challenge. The coming decade will be pivotal as the industry continues to mature.

It seems like the challenges of electrification are often tackled incrementally, only when unavoidable. Initially, the focus was on convincing people to adopt EVs. Now, the conversation seems to be shifting to issues like grid readiness. Are EV manufacturers even coordinating with the grid?

Grid readiness and EV adoption are deeply interconnected. Without smart grid solutions or clever strategies to stagger charging, rapid EV adoption could overwhelm the system.

Progress will likely remain incremental, similar to the annual improvements in fuel efficiency we saw with ICE vehicles. EV adoption and grid capacity must advance in tandem.

Globally, grid solutions require an "all of the above" approach, encompassing coal, natural gas, nuclear energy, and renewables.

> *"Building better batteries and the control systems to manage their efficiency remains central to any electrification strategy."*
>
> Alan Soltis Customer Success Manager at OPAL-RT TECHNOLOGIES

Localization plays a significant role—solar and wind, for instance, are more viable in some regions than others.

Localization is key. Grid upgrades differ by region. Aligning EV makers, grid operators, and energy producers on standards seems like a major challenge.

It is. Any lack of coordination essentially puts a speed limit on progress. This underscores the need for long-term planning and deeper collaboration across industries.

Looking ahead 10 years, do you see incremental progress continuing, or do you anticipate a step function—a significant leap—in this space?

A revolutionary leap in battery technology, for example, would undoubtedly change the landscape. However, to date, battery improvements have been constrained by chemistry. Most progress has been driven by impressive engineering and better utilization of existing technologies rather than abrupt breakthroughs.

From a test and validation perspective, we can't rely on revolutions. Instead, we focus on maximizing the potential of current technologies while making incremental efficiency gains. Software advancements will remain crucial, and our simulation tools need to stay ahead of the curve.

Much of the progress so far has been government-driven. Do you think that will continue, or is the industry ready to sustain itself?

Governments have played a critical role in funding and incentivizing the industry's growth. Moving forward, private investment will likely take the lead as the industry matures. However, systemic challenges—like infrastructure and standards—will still require public-private collaboration.

Despite these challenges, EV adoption continues to grow. The focus now is not just on promoting EVs but on making them profitable and sustainable. As the industry builds a stronger track record, this will drive further improvements in this still relatively young sector. ■

Alan Soltis Customer Success Manager at OPAL-RT TECHNOLOGIES

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User Manual

Fidelity Assessment of Real-Time Simulation for High-Frequency Resonant Converter Applications

Real-Time Simulation: Enhancing High-Frequency Resonant Converter Applications

High-frequency resonant converters are essential in modern power electronics, particularly in the electrification of transportation. These converters provide bidirectional power flow with high efficiency, making them a preferred choice for applications that require high power density. However, designing and validating controllers for these converters is a complex and time-consuming process. This is where Hardware-in-the-Loop (HIL) testing plays a crucial role in accelerating and simplifying the development cycle.

The Challenge of High-Fidelity Real-Time Simulation

One of the major challenges in real-time simulation of high-frequency resonant converters is maintaining a high level of simulation accuracy. The precise modeling of switching events and resonant behaviors is critical for achieving realistic results. Traditional numerical integration methods, such as the Backward Euler (BE) method, often fall short in accurately representing resonant circuits, necessitating the use of more advanced methods.

The OPAL-RT Solution

To address these challenges, OPAL-RT has developed an advanced FPGA-based electrical hardware solver (eHS) designed specifically for high-fidelity real-time simulation of high-frequency resonant converters. This cutting-edge solver:

- ✓ Captures switching signals with a sampling frequency exceeding 1GHz.
- ✓ Utilizes a high-order numerical integration method to accurately simulate resonant circuits.
- ✓ Implements an efficient FPGA-based design that minimizes simulation time steps, achieving 135ns for an entire DC-DC converter system that consists of multiple conversion stages without component decoupling.

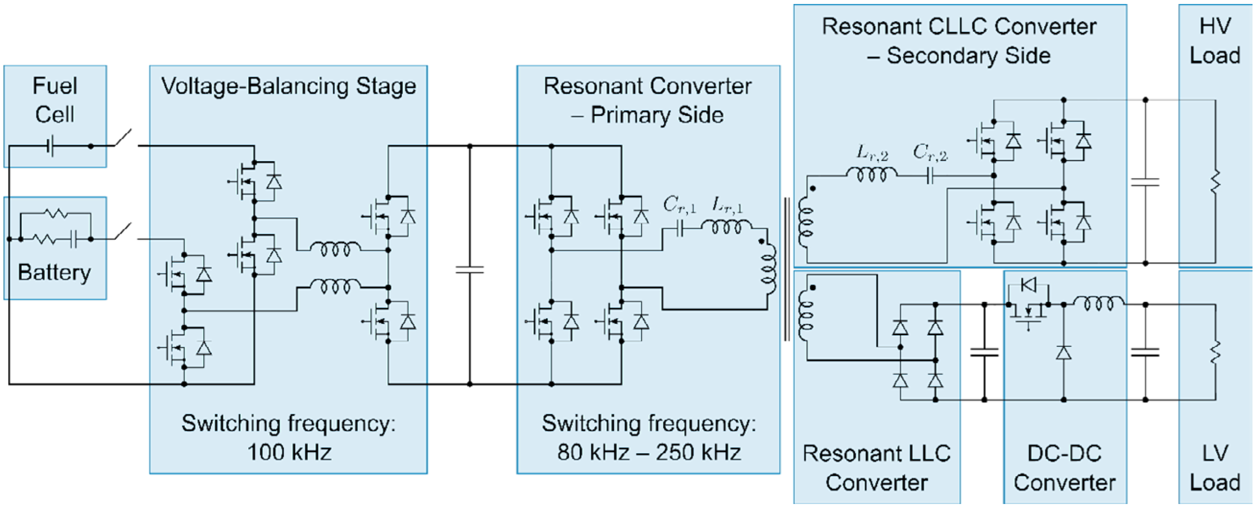


Figure 1 - Topology of the DC-DC converter system for hybrid electric aircraft

Real-World Application: Hybrid Electric Aircraft

A practical use case demonstrating the effectiveness of this technology involves a DC-DC converter system designed for a Hybrid Electric Aircraft. This system features a multi-port converter with two main stages:

- ✓ **A voltage-balancing stage** operating at 100kHz.
- ✓ **A resonant converter stage,** operating at up to 250kHz, which includes:
    - - A bidirectional CLLC converter interfacing the High-Voltage (HV) load.
    - - A unidirectional LLC converter interfacing Low-Voltage (LV) loads.

Using OPAL-RT's eHS solver, real-time simulations were compared to offline reference simulations that employ a variable-step solver. The results demonstrated a significant improvement in simulation fidelity when using the PADE-5 numerical integration method over the BE method, particularly in modeling the resonant inductor current at the primary side of the converter.

The Future of HIL Testing in Power Electronics

As power electronics continue to evolve, particularly in applications such as electric vehicles and hybrid aircraft, the demand for high-fidelity HIL testing will only increase. Ensuring precise and reliable real-time simulation models will be necessary to advance these technologies. OPAL-RT's latest eHS solver and hardware solutions set a new standard in simulation accuracy, empowering engineers to develop and test innovative power electronic systems with confidence.

With continuous advancements in real-time simulation, engineers can accelerate the design and validation process, ultimately driving the future of high-efficiency, high-power-density electronics forward. ■

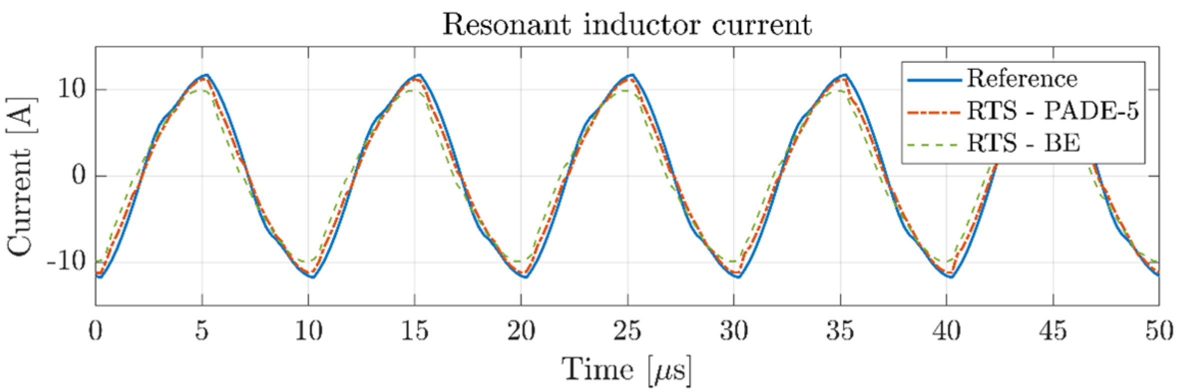


Figure 2 - Simulation results for the resonant circuit and comparison of numerical

To read the technical paper, click HERE

Electrifying Flight: Pioneering Real-Time Simulation in Aviation

Commercial aviation, a sector known for stringent safety standards and cautious innovation, is experiencing a transformative shift with electric propulsion. A significant milestone was reached on December 10, 2019, when magniX, in collaboration with Harbour Air Seaplanes, conducted the world's first commercial electric airplane flight. Powered by magniX's 560kW electric propulsion system, this event marked a new era in aviation where sustainability and technological advancements converge.

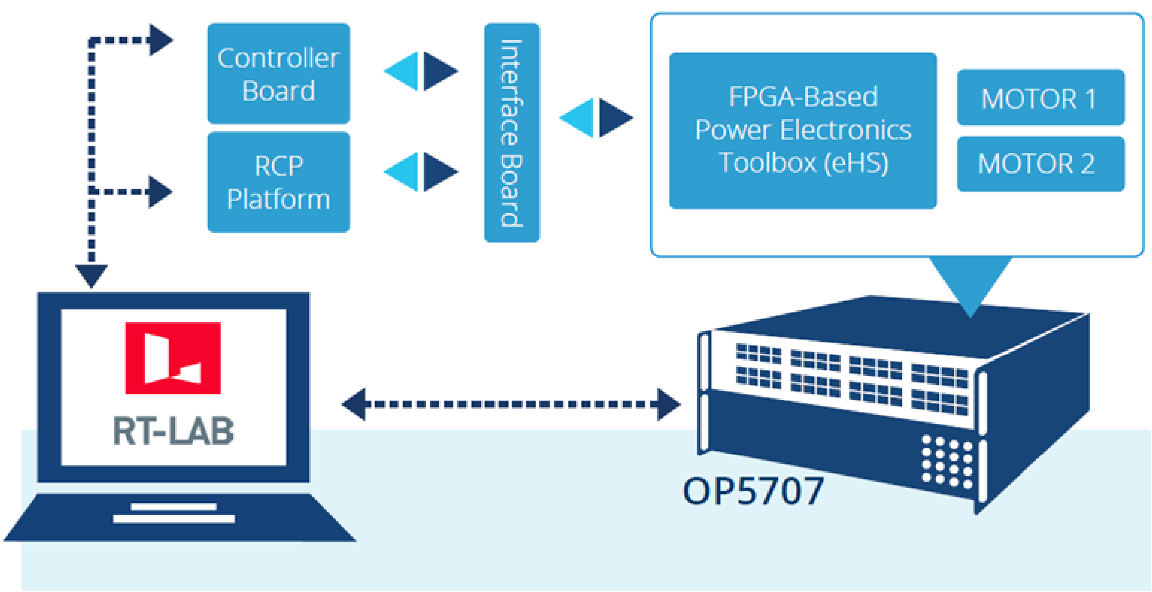
Overcoming the Challenges of Electrification

Despite its promise, electrifying flight presents significant challenges. Jet fuel's energy density is over 40 times greater than that of lithium-ion batteries, creating hurdles for electric aviation. However, magniX has tackled these issues through high-efficiency power electronics, power-dense electric motors, and thermal management solutions. Short regional routes, such as those operated by Harbour Air, serve as the perfect testbed for electric aircraft. These flights allow electric propulsion systems like the magni500 motor to be validated under real-world conditions, proving the viability of battery-powered aviation in practical applications.

Real-Time Simulation: A Game-Changer

Key to magniX's rapid advancements is its use of OPAL-RT's real-time simulation systems, which streamline the development and validation of electric propulsion control software. As Akshat Yadav, a Power Electronics Engineer at magniX, explains:

"The objective was to test the control software for flight in a very short period. OPAL-RT systems enabled rapid modeling and emulation of hardware for verification and validation."



magniX used an OP5707 with OPAL-RT's FPGA-Based Power Electronics Toolbox (eHS) to simulate their magniDrive inverters and magniSeries motors for controller development and testing.

> *"The objective was to test the control software for flight in a very short period. OPAL-RT systems enabled rapid modeling and emulation of hardware for verification and validation."*
>
> **Akshat Yadav, Power Electronics Engineer at magniX,**

This simulation capability allows engineers to analyze hardware virtually before integration, accelerating development while minimizing risks and costs.

Innovative Engineering for Efficiency

MagniX employed OPAL-RT's OP5707 simulator with FPGA-based Power Electronics Toolbox (eHS) to integrate and test their magniDrive inverters and magni-Series motors. Using an iterative approach, the team first emulated a simple R-L load model before progressing to a full motor model. Real-time measurements and Python-based API automation improved efficiency, reduced errors, and enhanced software validation.

"During setup, the OPAL-RT team was very supportive. The connectors and peripherals integrated seamlessly with our control module and measurement units," Yadav noted.

These advanced simulation tools were instrumental in developing the magniDrive inverter, which powers the eBeaver and eCaravan—the world's largest all-electric commercial aircraft.

The Path to Sustainable Aviation

Electric aviation presents a compelling economic case. The eBeaver's 30-minute test flight cost just $8.20 in electricity, compared to $135 for a fuel-powered equivalent. With zero emissions during operation and significantly lower costs, electric aircraft are poised to revolutionize regional air travel.

MagniX's breakthroughs demonstrate that electric flight is not a distant dream but an

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>
> **Akshat Yadav, Power Electronics Engineer at magniX,**

The magniX team in the hangar after its first successful flight. The eBeaver in the back.

imminent reality. By integrating real-time simulation tools, the company has propelled the electrification of aviation forward, proving that sustainability and efficiency can coexist in the skies.

Looking Ahead

As battery technology and power electronics continue to advance, electric aviation will expand beyond regional flights. The successes of magniX's eBeaver and eCaravan flights signal a new trajectory for the industry. Real-time simulation will remain a cornerstone, enabling engineers to push the boundaries of innovation and redefine global transportation. With pioneers like magniX leading the charge, the convergence of energy and electrification is set to reshape not just aviation but the future of mobility worldwide. ■

> ***"We decided to use OPAL-RT amongst other choices of HIL systems because of their widespread research and industry use, fast and accurate emulation of the complex power electronics hardware and great customer support."***
>
> **Akshat Yadav, Power Electronics Engineer at magniX**

To learn more about this application, click HERE

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We invite articles on emerging trends, challenges, and innovations in the energy and electrification sectors. Each issue explores a new theme

Length

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OPAL-RT TECHNOLOGIES

Holiday party recap

Looking back on a wonderful holiday season at OPAL-RT TECHNOLOGIES! A heartfelt thank you to everyone who participated in our Christmas celebrations – from the festive outfits to the stunning decorations, the holiday cheer was truly unforgettable. Here's to carrying that spirit of joy and collaboration into the year ahead!

OUR UPCOMING EVENTS & WEBINARS

EVENT **March 4** — Workshop | Securing the future : Advancing Grid Digitalization and Cybersecurity

EVENT **March 5** — Training | Grid Modeling and Its Integration With EXata CPS, Communication Network Modeling Environment

WEBINAR **March 5** — OP1400 New Version

EVENT **March 16-20** — APEC

EVENT **March 18** — Testforce NI Tech Day @ OPAL

EVENT **March 25-27** — AeroMart

EVENT **March 25-27** — Distributech

WEBINAR **March 27** — Advanced Applications for Autonomous Off-Road Vehicles Using 4DV-Sim

EVENT **April 2** — Workshop Australia

EVENT **April 14-16** — CPES Annual Conference

EVENT **April 15-17** — Microgrid Knowledge

EVENT **April 16-17** — Battery Show

InnovÉÉ, a catalyst for innovation in the energy transition

The energy transition is a complex challenge requiring the collaboration of multiple players. Tackling challenges such as decarbonisation, the integration of renewable energies and the electrification of key sectors require strategic partnerships. InnovÉÉ plays a central role in stimulating, supporting and financing these collaborations, enabling the development of concrete technological innovations.

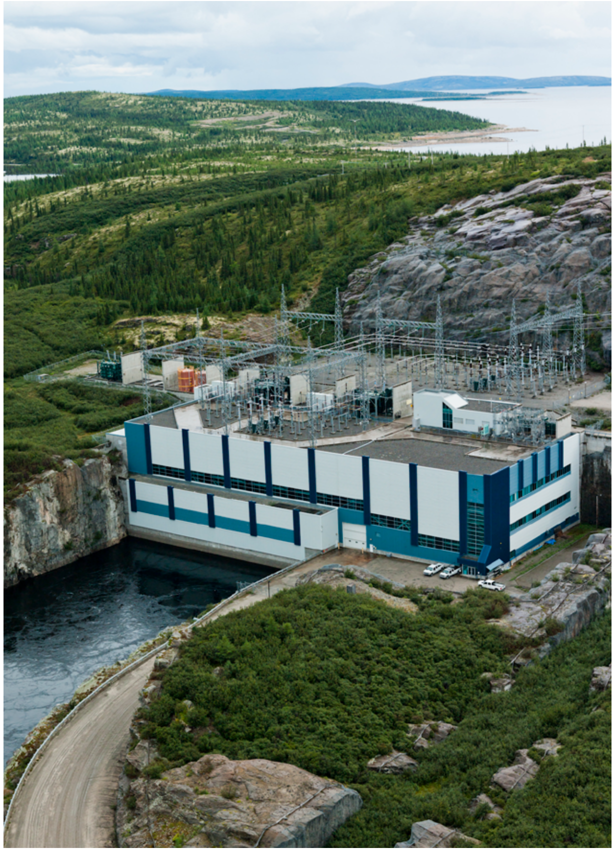
As such, the organisation has funded more than 130 collaborative projects addressing a wide range of issues and illustrating the power of cooperation to accelerate the energy transition.

The projects supported have contributed to a wide range of spin-offs, from business start-ups such as Calogy Solutions, which develops thermal management systems, to the development of a 100% electric urban Midibus by Letenda and its partners. Other projects, such as those by E-SMART and Deeplite, have used artificial intelligence to improve road safety by actively recognising speed signs.

At the heart of convergence lies an important element: the need to connect players and stimulate their encounters. This is precisely the kind of collision that InnovÉÉ through events like ēnergiQ enables: bringing together leaders in energy innovation to share ideas, build partnerships and accelerate the energy transition together.

The impact of advanced simulation on energy systems

One of the flagship projects supported by InnovÉÉ through funding from the ministère de l'Économie, de l'innovation et de l'Énergie (MEIE) and carried out in collaboration with OPAL-RT, École de Technologie Supérieure (ÉTS) and Hydro-Québec illustrates how collaborative research can de-risk innovation and accelerate its integration into industry.



Context of this ADRIQ-RSRI 2024 prize-winning project: Optimization of an ageing alternator fleet

Hydro-Québec is facing a critical challenge: a large proportion of its alternators, essential to electricity generation, are nearing the end of their useful life. This equipment needs to be maintained at full potential, while minimizing downtime. The aim of the project was to develop non-intrusive diagnostic tools and advanced simulation models to assess and optimize alternator performance, even in the event of internal faults.

Solution: Cutting-edge technology and collaboration

Thanks to research partnerships, the team has developed:

- ✓ Advanced simulation models, fundamental for creating digital twins of alternators.
- ✓ Non-intrusive diagnostic tools, based on artificial intelligence and analysis of vibro-acoustic and leakage flow data.

These innovations make it possible not only to predict and prevent failures, but also to extend the service life of critical equipment without interrupting operation.

The results of this project go far beyond alternators:

- ✓ Reduced maintenance costs and risks.
- ✓ Accelerated deployment of reliable, optimized innovations.
- ✓ Transferability of the solutions developed to other sectors such as transport electrification, renewable energies and smart grids.

De-risking innovation; facilitating development and accelerating integration

Market conditions, workforce, funding: the risks associated with innovation can take many forms. Collaboration, whether business-to-business or business-to-academia, can help mitigate these risks and accelerate the commercialization of innovative solutions. How can it help?

- ✓ By creating research and development partnerships
- ✓ By providing access to advanced equipment and qualified specialists with cutting-edge expertise (researchers, students, research professionals, etc.).
- ✓ By offering non-refundable grants.

The importance of convergence in an interconnected world

The award-winning project with OPAL-RT, ETS and Hydro-Québec, winner of the ADRIQ-RSRI 2024 prize, illustrates the benefits of convergence and collaboration. Thanks to these partnerships, supported by structuring funding, innovations do not remain at the theoretical stage, but become concrete solutions adapted to industry needs. ■

ADRIQ 2024 Innovation Awards Gala

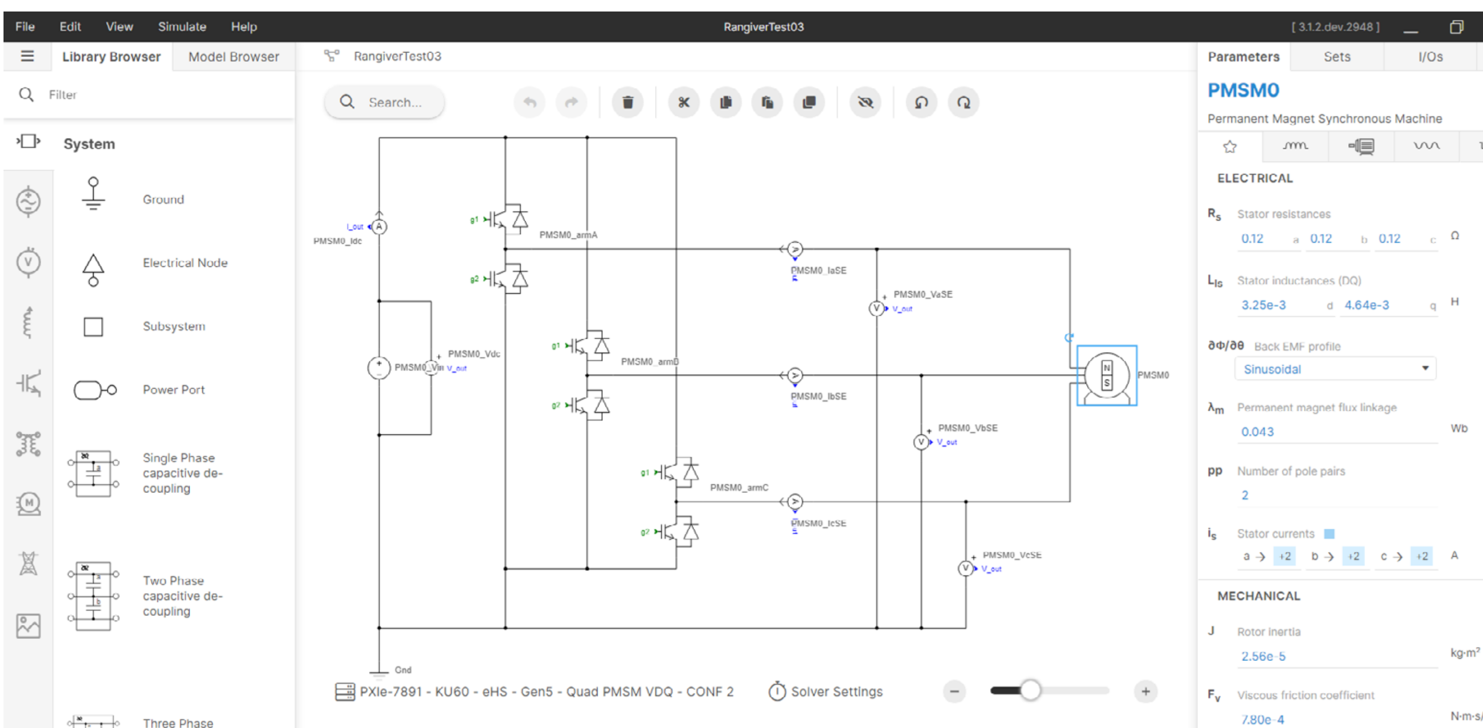
Using VeriStand for Configuration and User Interface Design

Electrification: A Market-Wide Transformation

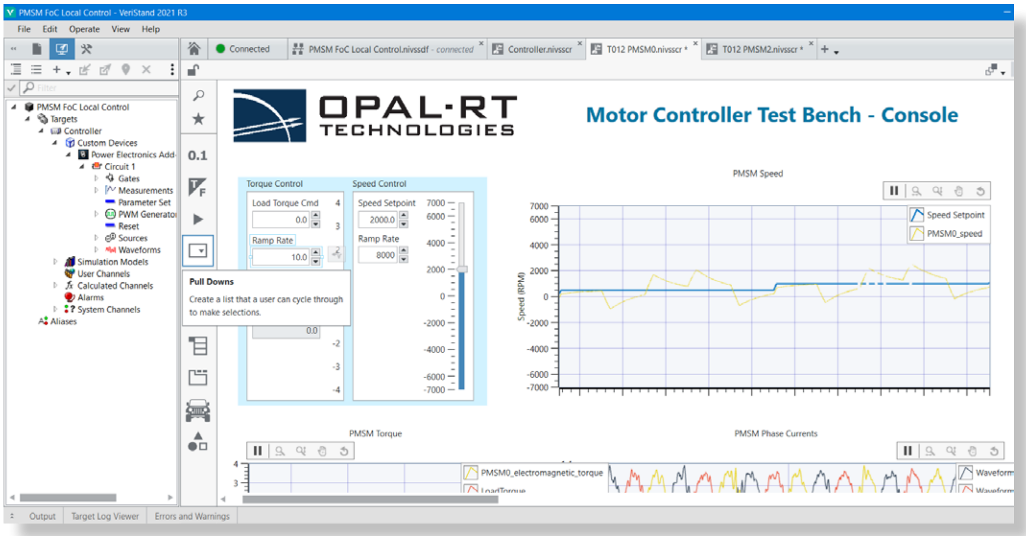
Design and validation of electromechanical systems has become a prominent topic across industries that were once considered unrelated and insular. A growing shift is occurring in the market as electrification becomes a reality across various application spaces. OPAL-RT's expertise in Power Systems and Power Electronics, combined with its work across Aerospace, Automotive, and Rail markets, uniquely positions the company to discuss how electrification and energy are converging. From the adoption of EVs to trends in market electrification, charging infrastructure, and overall readiness, OPAL-RT is at the forefront of this transformation.

Consider how electric vehicles manufacturers are deciding to add onboard chargers (OBCs) as a default feature. OBCs shift part of the grid infrastructure away from base station chargers to the vehicle creating more options for EV consumers where they charge their vehicles. The challenge is that OBCs need to be lightweight and compact compared to charging station which requires higher switching frequencies. OPAL-RT's electric simulation solver (eHS) can meet the OBC requirements by having the smallest time-step available (80 ns and an innovative digital interpolation feature. The latest generation allows the accurate simulation of frequency and/or phase-controlled power electronics systems, such as resonant converter and Dual Active Bridge with switching frequency above 200 kHz.

Other examples of converging electrification applications are locomotive drivetrains or aircraft LRUs which now closely resemble microgrids with many electric subsystems.



Workflow using the OPAL-RT Schematic Editor



Using VeriStand at Configuration and User Interface Design

These may also have small time-step requirements but have additional complexity by being very large systems with multiple parts interacting. In the past engineers had to break the simulations into many independent systems due to the size of models, but now with eHS they can simulate large designs using decoupling technology within the same simulation core. Engineers can configure functional units of their simulation in the Schematic Editor and select electrical components as decoupling elements. Behind the scenes OPAL-RT optimizes equations to distribute the computation and improve the time step, as well as diminishing the impact of decoupling on the simulation fidelity.

Pushing the Boundaries of Real-Time Simulation for an Electrified Future

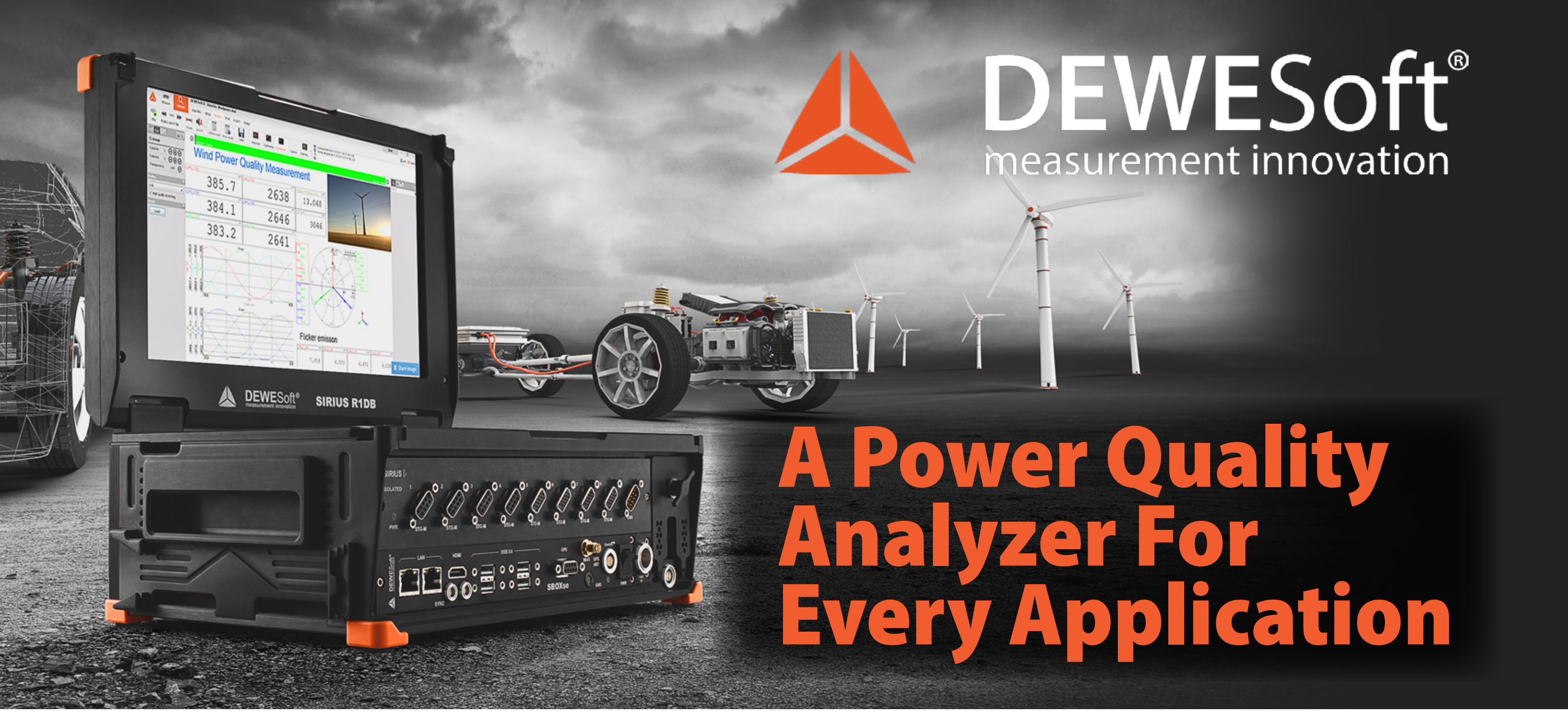
To start the new year off right, OPAL-RT has just released the latest version of the Power Electronics Add-on for VeriStand which brings the best-in-class eHS Solver and the ease-of-use of the Schematic Editor to the NI/Emerson Test & Measurement platform. Features like 80ns time-steps, large circuit decoupling, the elimination of Simulink as a dependency, and soon the latest in electric machines are available in the latest PXI form factor.

So, **if you're a VeriStand user or need a specific transportation communication protocol now you have another option for your OBC, uninterruptable power supply, or photovoltaic array application.**

As electrification and energy converge, the need for adaptable test solutions with robust features becomes more critical than ever. OPAL-RT is leading the way by delivering innovative tools that meet the demands of this rapidly evolving landscape. By continuing to push the boundaries of real-time simulation, OPAL-RT ensures that engineers across industries are equipped to tackle the challenges and opportunities of a more electrified future. ■

To learn more, click HERE

A Power Quality Analyzer For Every Application



Dewesoft combined a rugged hardware platform with high-end signal conditioning and robust software features to create the world's most capable Power Quality Analyzer (PQA). This instrument opens up entirely new possibilities for engineers performing power quality analysis. The Dewesoft PQA calculates over 100 power parameters, such as P, Q, S, PF, and cosine phi, according to the IEC 61000-4-30 Class A standard. All calculations can be done online or in post-processing. It also offers an easy-to-use oscilloscope, FFT analyzer, and harmonics display.

Power quality parameters describe the voltage deviation from its ideal sinusoidal waveform at specific frequencies. These deviations can lead to disturbances, outages, lower power factors, or damage to electrical equipment. Tracking these parameters from the development phase through on-line operation is essential. Continuous monitoring of critical points in the electrical grid prevents quality disturbances and allows them to be corrected before they cause problems.

Because Dewesoft PQA stores raw and processed data, it can analyze data in more detail than conventional power quality analyzers. The software includes all standard power calculations, but users can also create custom calculations and save

Dewesoft SIRIUS R8DB Portable Power Quality Analyzer

them for later use. A powerful yet easy-to-use mathematical engine makes this possible. Data is fully synchronized across all channels, making comparisons fast and reliable.

The Dewesoft PQA is a flexible DAQ solution that combines power and energy loggers and several other measurement instruments into a single device.

Key PQA Applications

Grid Analysis includes the monitoring, analysis, and reporting of:

- Voltage and current
- Line frequency
- Harmonic components
- Power and power-line flicker
- Symmetrical components

Battery Testing includes:

- Storing energy for electric vehicles and other applications
- Researching new ways of storing energy
- Supercapacitor energy storage enables rapid growth of renewable energy, mitigates power peaks, and enhances power grid stability.
- High current and high voltage capabilities
- Temperature measurements
- Very short transients
- Charge-discharge capabilities
- Energy calculations, battery abuse testing

Electric Vehicle Testing includes:

- Electric and hybrid vehicle testing
- Testbed and in-vehicle testing
- EMC emissions
- Short-duration high current peaks
- Rapid voltage changes

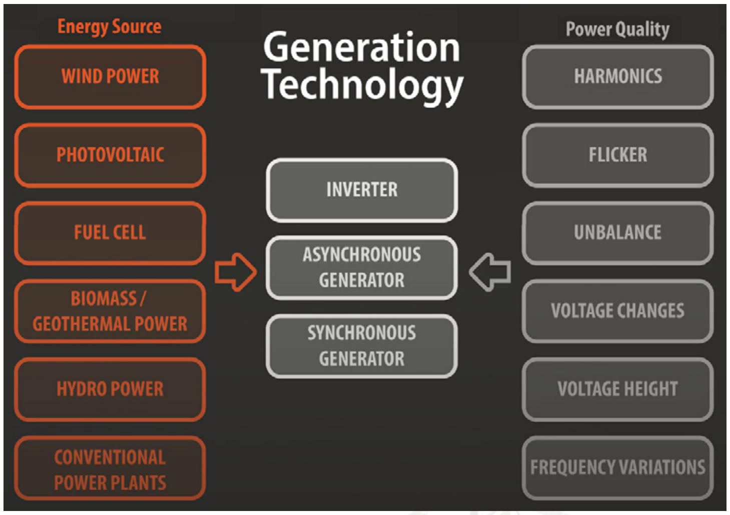
Renewable Energy Testing includes:

- Solar panels and farms
- Wind turbines (monitoring, power quality)
- Active vs. Reactive power
- Fault detection and alerting
- Typical PQA Configurations and Applications

Today's power signals are complex. Accurate power quality data is essential for developing and maintaining today's high-speed inverters, high-efficiency transformers, high-frequency filters, and variable power supplies. Regardless of their update rates, all parameters are fully synchronized.

User-designable DewesoftX PQA display

Dewesoft PQA instruments measure data across multiple domains, including vibration, temperature, strain, loads, GPS/GNSS location data, CAN bus, XCP/CCP, video, and more. No other PQA can measure such a broad range of data types with fully synchronized power quality measurements.



PQA tests by energy source and generation technology

Despite its processing power, the Dewesoft PQA is capable of measuring:

- Harmonics and THD up to 150 kHz
- Interharmonics & higher frequencies
- Flicker, Flicker Emissions, RVCs
- FFT, Harmonic FFT, Waterfall FFT
- Symmetrical components
- Handles multiple base frequencies
- Measures multiple 3-phase systems.

The DewesoftX software and power module included with the PQA include a perpetual license without any maintenance or subscription fees. All updates are provided free of charge for the life of the product. An industry-best 7-year warranty protects the whole system.

Dewesoft's PQA is small and lightweight yet rugged enough for industrial use. Its rich visualization, analytical capabilities, portability, and affordability make it an indispensable test instrument for power test engineers across multiple industries.

Learn more about the Dewesoft PQA:
https://dewesoft.com/applications/power-quality-analysis

Powering Innovation: Highlights from OPAL-RT's Technical Event RT24 in Brazil

In 2024, OPAL-RT hosted landmark technical events in multiple cities around the world, bringing together industry leaders and experts to discuss innovations in real-time simulation and hardware-in-the-loop (HIL) testing. Among the amazing cases presented by our customers at the RT24 realized in Brazil we can highlight presentations from ONS (Brazil's National System Operator), WEG (a global leader in wind turbine technologies), and XM (Colombia's Power System Operator and Market Administrator). These studies showcased cutting-edge applications of OPAL-RT's solutions in advancing power systems worldwide.

ONS: Enhancing Brazil's Power System Through Real-Time Co-Simulation

ONS presented its groundbreaking work on co-simulating Brazil's National Interconnected System (SIN) using OPAL-RT's HYPERSIM with RTDS. The study highlighted:

- ✓ Integration of Renewable Energy: ONS emphasized the challenges and innovations in modeling dynamic equivalents for the heavily renewable SIN system, with 82.86% of its energy from renewables.
- ✓ Advanced Co-Simulation Techniques: By connecting geographically distributed facilities, ONS demonstrated the feasibility of large-scale system testing while optimizing hardware resources.
- ✓ **Real-World Impact: The use of real-time simulation helped ONS improve HVDC link performance, ensure operational reliability, and train system operators effectively.**

This work underscores the importance of real-time co-simulation in managing Brazil's rapidly evolving energy grid and integrating renewable energy sources seamlessly.

WEG: Pioneering HIL Testing for Wind Power Converters

WEG's presentation focused on verifying the performance of wind turbine converter controllers through HIL testing. Key takeaways included:

- ✓ State-of-the-Art Turbine Models: WEG shared insights into its 4.2 MW and 7.0 MW wind turbine topologies, featuring advanced permanent magnet generators and full-power converters.
- ✓ Grid Code Compliance: By simulating low-voltage and high-voltage ride-through scenarios, WEG ensured its converters met stringent grid code requirements set by ONS.

- ✓ **Safety and Cost Efficiency: HIL testing enabled WEG to conduct rigorous and safe testing of firmware updates and controller behavior, significantly reducing project costs and risks.**

WEG's work demonstrated the transformative potential of HIL testing in ensuring grid stability and accelerating the adoption of renewable energy technologies.

XM: Advancing Energy Transition in Colombia

XM shared its innovative approach to real-time simulation and the development of digital twins for Colombia's power grid. Their presentation showcased:

- ✓ Digital Transformation: XM highlighted how real-time simulation platforms are being used to optimize system performance, improve fault diagnostics, and integrate renewable energy resources.
- ✓ Collaboration and Impact: XM's work with local universities and industry partners has created a thriving ecosystem for innovation, resulting in safer, scalable, and efficient power systems.
- ✓ Operational Benefits: By employing real-time analysis, XM reduced testing times and enhanced operational security, saving approximately $250,000 per project.

XM's efforts exemplify the role of advanced simulation tools in addressing the complexities of energy transition and building resilient power systems.

Conclusion

The presentations from ONS, WEG, and XM at OPAL-RT's technical event demonstrated the critical role of real-time simulation and HIL testing in driving innovation and operational excellence in the power sector. As the energy landscape evolves, these studies serve as a testament to the power of collaboration, innovation, and technology in shaping a sustainable energy future.

POWER IN MIND MAGAZINE

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