

ISSUE: [October 2026](#)

Conference Addresses Emerging Concepts In Design Methodologies For Power Electronics

On November 18-20, in Aalborg, Denmark, the IEEE Power Electronics Society (PELS) will host the [Design Methodologies Conference](#), bringing together design automation, artificial intelligence, machine learning, and cyber-physical security methodologies for power electronics applications.

PELS has witnessed a significant and growing interest in advanced Design Methodologies for Power Electronics (the conference also goes by this name) in recent years, and it has hosted several independent initiatives in the areas of design automation, cybersecurity, artificial intelligence/machine learning and verification & testing. Consequently, the time has come to make a crucial, decisive step forward and organize a single specialized conference dedicated to these emerging concepts.

The conference will feature a keynote by Matthias Kasper of Infineon Technologies Austria on “Powering AI—Future Trends and Innovation in Power Electronics for Data Centers” and an industry-oriented panel session titled, “What will it take to industrialize AI in Power Electronics?”

For those interested in tutorials, there will be sessions on “Thermal Modeling and Model Order Reduction of Power Electronics,” “Holistic Optimization of Power Electronic Systems,” “Explainable AI for Proactive Resilience in Critical Infrastructure Systems” and “Model-Based Engineering Across the Product Lifecycle: From Offline Design and Controller HIL Testing to Industrial HIL Digital Twins”. Descriptions of these various sessions are provided below.

For more information on the conference including details on registration and the the conference venue, see the DMC [website](#).

Keynote: Powering AI—Future Trends And Innovation In Power Electronics For Data Centers

Abstract: The rapid increase in AI compute density is pushing conventional power-delivery architectures toward their limits. Supporting future rack power levels will require more than higher-efficiency versions of today’s converters. This calls for innovation across the entire power chain, from the grid interface and distribution architecture to the final voltage regulator supplying the processor core.

This talk follows the power flow from the ac grid to the processor core, highlighting innovations at each conversion stage. Starting with the state of the art in single-phase server power supplies, it explores the transition toward three-phase front ends and single-stage conversion concepts that challenge conventional boundaries between power factor correction, isolation, and voltage regulation. Moving further downstream, the presentation examines advances in intermediate-bus and point-of-load conversion, where semiconductor technology, magnetics, packaging, control, and thermal management increasingly need to be developed as an integrated system.

A major focus is the emerging 800-V dc ecosystem and its potential to reshape power delivery for future AI infrastructure. High-voltage intermediate-bus converters and solid-state transformers open new possibilities for simplifying conversion chains, redefining power-distribution boundaries, and enabling the next generation of high-power AI systems. Hardware demonstrators and practical design examples illustrate how innovations at the component, converter, and system levels can work together to transform power delivery from the grid to the core.



Industry Session: What Will It Take To Industrialize AI In Power Electronics?

Moderated by Mohammed Ali Khan, University of Southern Denmark, and Shuai Zhao, Aalborg University, this panel discussion will feature the following panelists: Kevin Hermanns, PE-Systems; Nima Tashakor, Volkswagen; Norbert Hanigovszki, Danfoss Drives; Oliver Wallscheid, Universität Siegen; Pascal Schirmer, BMW Group; and Satya Kurukuru, Silicon Austria Labs (SAL).

Panel Session

What Will It Take to Industrialize AI in Power Electronics?



Kevin Hermanns
PE-Systems GmbH



Nima Tashakor
Volkswagen



Norbert Hanigovszki
Danfoss Drives



Oliver Wallscheid
University of Siegen



Pascal Schirmer
BMW Group



**Varaha Satya
Bharath Kurukuru**
Silicon Labs Austria



IEEE pels
Advancing Technology
for Humanity

Tutorial Sessions

Tutorial 1: Thermal Modeling And Model Order Reduction Of Power Electronics

Instructors: Pascal Schirmer, BMW Group Research and Innovation Center; Kaichen Zhang, Eindhoven University of Technology; and Yubo Song, Aalborg University



Pascal Schirmer
BMW Group Research and
Innovation Center Munich, Germany



Kaichen Zhang
Eindhoven University of Technology
Netherlands



Yubo Song
Aalborg University
Denmark

Abstract: Thermal modeling of power electronic components is essential for predicting temperature distribution and ensuring reliable operation under varying electrical loads and environmental conditions. Accurate thermal models help in designing effective cooling strategies and preventing overheating-related failures. However, detailed thermal simulations often involve complex, high-dimensional systems that are computationally intensive.

Model order reduction techniques address this challenge by simplifying these complex thermal models into lower-order representations while preserving essential dynamic characteristics. This reduction significantly accelerates simulation times and facilitates real-time thermal management and control in power electronics systems without compromising accuracy.

Learning outcomes include:

- Power electronics reliability: failure mechanisms and basic evaluation approaches
- How to model power electronic ECUs and components using 3D Finite
- Element simulation (example full bridge).

- How to perform 1D, 2D, and 3D model order reduction
- Introduction to the TherMOS toolkit (freely available on GitHub)
- Advanced thermal testing and measurement techniques

Tutorial 2: Holistic Optimization Of Power Electronic Systems

Instructor: Andreas Roszkopf, IISB Fraunhofer, Germany



Abstract: Modern power electronic systems are increasingly pushed to their physical limits by wide-bandgap semiconductors, high power density requirements, and strict efficiency targets. Their design has become a highly coupled, multi-domain challenge involving electrical, magnetic, thermal, and EMI interactions, where siloed workflows often lead to suboptimal solutions and costly hardware iterations.

This tutorial introduces a holistic optimization framework for power electronic systems, combining high-fidelity yet computationally efficient models with advanced design automation and AI/ML techniques. It covers multi-objective optimization considering efficiency, volume, cost, and reliability, and explores methods such as GPU-based solvers, genetic algorithms, tree search, and reinforcement learning to identify promising converter designs.

The session also addresses model-based validation and large-scale simulation approaches to verify optimized systems before prototyping, providing engineers and researchers with practical strategies to accelerate the development of next-

generation power converters.

Tutorial 3: Explainable AI For Proactive Resilience In Critical Infrastructure Systems

Instructor: Mike Mekkanen, University of Vaasa, Finland

Abstract: Modern critical infrastructures (CI) are increasingly operated as interdependent, tightly coupled cyber-physical systems among diverse stakeholders. These cyber-physical systems acquired complex, algorithm-based protection and control capabilities that exceeded the cognitive limits of human operators, especially under cyber or hybrid attacks.

Moreover, Dynamic Proactive Resilience (DPR) is proposed as a novel approach to strengthening the resilience of interdependent critical infrastructures (CIs), with particular emphasis on energy systems that underpin essential urban services.

Because modern CIs are highly interconnected, disturbances in one sector can quickly propagate across others, triggering cascading failures. My presentation investigates how human-centered explainable artificial intelligence (XAI) is designed to be embedded into automated workflows to enhance the proactive resilience of CIs while preserving decision-makers' confidence and confidentiality.

The presentation focuses on data-driven CIs proactive resilience through normal operation and CIs disturbances as representative use cases. The work demonstrates how a Local Interpretable Model-Agnostic Explanations (LIME) could generate instance-specific human-understandable rationales that highlight which signals, assets, and attack patterns drove each alert.

These local explanations can transform automated protection, control, and security analytics from opaque alarm generators into transparent decision aids. This allows for both operational robustness and the decision-makers' responsibility for investing in and safeguarding CIs and service continuity.

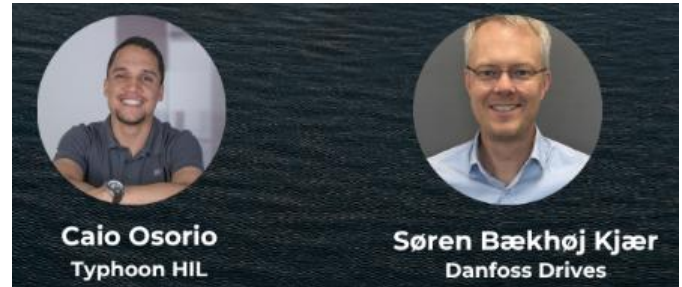


Tutorial 4: Model-Based Engineering Across The Product Lifecycle: From Offline Design And Controller HIL Testing To Industrial HIL Digital Twins

Instructors: Caio Osorio, Typhoon HIL and Søren Bækhoj Kjær, Danfoss Drives

Abstract: Modern electric drives and power electronic systems demand increasingly sophisticated development methodologies that reduce engineering risk while accelerating time-to-market. Model-Based Engineering (MBE) has emerged as a key enabler by allowing engineers to use high-fidelity system models throughout the entire product lifecycle, from early concept development to deployment and operational support.

This tutorial presents an end-to-end MBE workflow for electric drive applications, demonstrating how Typhoon HIL integrated toolchain can support offline design exploration, controller software development, Controller Hardware-in-the-Loop (C-HIL) verification, virtual commissioning, and ultimately industrial HIL digital twins. Participants will gain an understanding of how real-time simulation enables continuous validation of embedded control software while reducing dependence on costly physical prototypes and laboratory testing.



The tutorial first introduces the principles of model-based engineering, real-time simulation, and C-HIL testing, highlighting how high-fidelity plant models can be integrated into modern development workflows to support rapid design iterations, automated testing, and continuous integration. It then presents the transition from development-oriented HIL testing toward operational HIL digital twins that extend the value of simulation into commissioning, software maintenance, and lifecycle optimization.

The second part of the tutorial showcases Danfoss MyDrive HIL for the iC7 platform as an industrial implementation of this workflow and toolchain. The session demonstrates how high-fidelity real-time simulation, combined with actual drive control hardware, enables virtual testing, commissioning, software validation, and lifecycle support using application-specific HIL digital twins. The integrated workflow illustrates how model-based engineering can seamlessly connect research, product development, and industrial operation within a unified simulation environment.

This industrial approach replaces much of the traditional physical testing with virtual testing while enabling continuous integration, faster commissioning, and long-term system support through HIL digital twins.