

2024 IEEE 21st International Power Electronics and Motion Control Conference

Monday, 30 September 2024

08:00-09:00

Registration

Tutorials Registration

09:00-12:00

Alto B

Tutorial: Electrified Air Transportation - Babak Nahid-Mobarakeh

For two decades, the air transportation industry is undergoing a deep revolution, in which most actuators are being electrified. This started with the concept of “power by wire” leading to the well-known more electric aircraft (MEA). Then, electrified propellers have been considered for small air vehicles, like electric vertical take-off and landing (eVTOL) vehicles and very small aircraft. The trend is towards larger aircraft to be propelled by electric motors. The aim is to enhance reliability and propulsion efficiency and reduce maintenance costs and environmental impact. As an example, for vital functions like flight control system and landing system, the target mean time between failures (MTBF) for electric actuators is 109 hours. To get there, the aircraft industry must develop new electronic, electrical, and mechanical components, and look at new means to monitor them throughout their operating life. Hence, the reliability and fault-tolerant capability and control of power electronic converters, electric machines and microgrids become increasingly more important in modern aircraft.

In this tutorial, after a quick overview of the concepts and presentation of some existing motor drive topologies in electrified air transportation systems, the speaker focuses on some specific use cases. Different topologies will be studied and compared in terms of reliability, power density, and cost. Then, some topologies will be selected for which adequate control algorithms will be developed under different operating conditions including fault situations. This includes the state of the art of motor control techniques and their design, performance and robustness supported by simulation and experimental results. Also, some auxiliary functions like active stabilization will be considered. Finally, future challenges and trends in electric motor control for air transportation will be discussed. More

Basso B

Tutorial: A Generic Approach to Modern Electrical Drives - Christoph Michael Hackl

Electrical drives consume more than 50% of the globally generated electricity. Hence, advances in research on modelling, control and operation of electrical drives (machine+inverter) have been made.

This tutorial covers all aspects of modern electrical drives such as:

- ☒ nonlinear modelling and dynamic simulation of the electro-mechanical system considering e.g. (i) magnetic saturation & cross-coupling, (ii) back-emf harmonics, (iii) skin & proximity effects, and (iv) copper and iron losses;
- ☒ high-performance control compensating for (i) voltage-source inverter nonlinearities and dead-times, (ii) machine nonlinearities, (iii) current cross-coupling and (iv) voltage constraints; and
- ☒ optimal operation management by optimal feedforward torque control (OFTC) to guarantee an operation of the electrical drive at its physical current and voltage limits while efficiency is maximized for all operation strategies such as Maximum Torque per Losses (MTPL), Field Weakening (FW),

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Maximum Current (MC) and Maximum Torque per Voltage (MTPV)
All aspects are covered without imposing simplifying assumptions on the system. The generic approach allows to apply the presented methods for modelling, simulation, control and operation to all kind of electrical drives. Numerical, analytical and/or look-up tables (LUTs) approaches are discussed and compared. The proposed approach is suitable for any electrical machine (e.g. synchronous machines with/without electrical excitation or doubly fed induction machines). Simulation and measurement results illustrate effectiveness and applicability of the generic approach. More

Alto A

Tutorial: DC and AC Microgrids - Laura Ramirez Elizondo

The DC and AC microgrids tutorial will cover a wide range of topics, going from the description of basic definitions to the analysis of existing pilot projects. Special focus will be given to the modelling and control of DC microgrids and to the important role of power electronic components in these systems.

The tutorial will consist of 6 modules. During the first module, the student will learn to differentiate the concepts of microgrid, smart grid and virtual power plant, as well as to distinguish the difference between a passive and an active distribution network. During the second module the topics of centralized and decentralized control will be addressed. In module 3, the operation of different power electronic elements will be discussed.

During the fourth module, the topic of DC microgrids will be covered. DC microgrids are still at an early stage and there are still many challenges to be tackled. During this lecture the student will be able to describe the main motivations and challenges for the implementation of DC microgrids. In module 5, the student will be able to explain the concepts of microgrid protection, adaptive protection, and to describe the effect of using a fault current source and fault current limitation in a microgrid. We will discuss microgrid examples in Module 6. By the end of this lecture the student will have a broad picture of the state-of-the-art of DC and AC microgrids. More

Basso A

Tutorial: Modular Digital Twin Platform for Electrical Drivetrains - Omar Hegazy

Digital twins (DTs) are similar to simulation models but with more advanced capabilities. Both reproduce the behavior of a real physical system. While simulation models are more generic and can include systems that do not (yet) exist, DTs typically map the behavior of an existing system based on acquired data through data-driven models or hybrid models. In addition to the functionality of conventional simulation tools, DT tools can synchronize the behavior of the real assets and simulated twin. The modeling of DTs encompasses multi-physics, multi-scale cloud-based modeling to consider all phenomena and couplings, whether exploring (typically in the design phase) or monitoring (typically during the operational phase) the system's functioning under realistic mission profiles and aging conditions. This tutorial will cover several aspects and concepts regarding the Digital Twins modeling in a modular approach. The tutorial will cover two different parts:

Part I: Offline drivetrain component modeling and control design, offering

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	iterative design and validation of solutions via the use of a DT platform, and accelerate time-to-market. Part II: Online real-time condition monitoring and lifetime estimation techniques, ensuring the safe and reliable operation of drivetrain components by directly estimating their behavior and remaining Useful Lifetime (RUL) to support the vision on Reliability as a Service (RaaS). More
12:00-13:15	Registration Tutorial Lunch & Tutorial Registration
13:15-16:30	Alto B Tutorial: Medium Voltage Power Conversion with SiC Power Devices - Rafa Kopacz Nowadays, a rapid increase of interest in medium voltage (MV) power electronics can be observed, as there is a tendency for many formerly low-voltage applications to have their range extended into MV territory, e.g., photovoltaics, battery energy storage systems, or electric vehicle (EV) fast charging stations. This is caused by several factors. Firstly and especially important considering the recent actions aimed at decarbonization and lowered negative impact on the environment – because of the fundamental increase in energy efficiency, as the currents, and thus power losses, are reduced. Moreover, the process is further accelerated by constant advances in wide-bandgap power semiconductor device technology, especially in the form of Silicon Carbide, as devices with blocking voltages exceeding 10 kV are introduced and can be deemed highly competitive compared to conventional Si-based devices in terms of performance. Therefore, this tutorial will focus on the core part enabling efficient medium voltage applications of the future: SiC-based power converters. The seminar will start with low-level considerations on SiC power devices, including what is available on the market and what is forthcoming. This will comprise a discussion on the devices, their issues, modeling, and characterization and will contain considerations for both discrete components and power modules. Furthermore, the topic of gate drivers will also be elaborated on. The whole subject will be supported by proper examples. The mid part of the seminar will dive deep into the topic of available options for employing SiC power devices in the medium voltage range, taking into consideration the various methods of constructing power electronic switches and choosing appropriate power converter topologies. To be more precise, the discussed options will be: high-voltage power devices in two-level operation; series connection of low-voltage power devices, with both active and passive voltage balancing; multilevel topologies, including modular multilevel converters (MMC); and the quasi-two-level method. This part will be based on a technology evaluation, formed on the basis of theoretical considerations concerning fundamentals, design challenges, as well as experimental research on test circuits and full power converters, supported by data from the instructors' studies and literature. Finally, the last part of the tutorial will center around various medium voltage power electronics applications, from lower-voltage spectrum systems such as photovoltaic and battery energy storages up to high-power MV applications in the form of traction, ultrafast EV charging stations, data center systems, and many more. The outlook will be founded on the internal experience of the

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instructors and built power electronics systems, as well as an overview of findings from the literature and industrial applications. This tutorial is intended for researchers and development engineers alike, skilled in the field of power electronics. More

Basso B

Tutorial: Optimal Current Setpoints of Multiphase Drives - Vaclav Smidl

Optimal current setpoints are well studied in three-phase drives, but their extension to multiphase systems is more complex. The main complication is the satisfaction of limits on maximum current and voltage. The key challenge is to design current and voltage waveforms that respect the limits. This tutorial will show numerical solutions and compare them with previous strategies. The optimal current setpoints divide the operation profile of the drive into several regions, generalizing the maximum torque per ampere and field-weakening regions of the three-phase drive. We will discuss the impact of the new solution on the drive properties and its practical implications. We provide examples of optimal solutions for asynchronous and synchronous machines. More

Alto A

Tutorial: Current Source Inverters Using Wide Bandgap Devices and Comparison with VSI - Bulent Sarlioglu

Most recently, with the advance of state-of-the-art wide bandgap devices, the efficiency of the motor drives can be increased significantly compared to using Si devices such as IGBTs. The 2-level voltage source inverter (VSI) is the dominant choice for motor drive applications that are currently in production. However, there are some serious limitations experienced by VSIs when Si-based switches are directly replaced by WBG switches that are attributable to the extremely high dv/dt at the switch output terminals. These challenges include elevated electromagnetic interference (EMI) amplitudes, motor terminal overvoltages, and bearing damage risks due to discharge currents. The emergence of WBG power devices opens opportunities for current source inverters (CSIs) to provide a promising alternative drive configuration for motor drive applications.

In this tutorial, the CSI will be introduced as a promising alternative approach for applying WBG switches in future motor drives that overcomes several of the key obstacles that hinder their use in conventional VSIs as well as offering some intriguing application advantages made possible by the special features of the CSI topology. The advantages and challenges of CSIs using WBG devices will be discussed. Special attention will be focused on the game-changing potential of M-BD switches in future CSI-based integrated motor drives. Finally, a comprehensive comparison between VSI can CSI with DC-voltage power source and sine voltage output will be introduced including passive components, output performance, efficiency, and volume. Two projects that applied the combination of wide-bandgap power switches and a CSI into an integrated motor drive using a high-performance PM synchronous motor will be presented as examples. More

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	Tutorial: Reliable Power Electronics Systems - Aditya Shekhar Power electronic interfaces are essential for regulating power flow between different voltage levels and frequencies. Several AC/DC and DC/DC converters have been developed to perform this flexible control functionality between various sources and loads. A deeper understanding of the reliability of such converter topologies is important because converter applications such as smart EV charging, wireless power transfer, grid ancillary services, battery energy management systems, e-mobility, and intermittent renewable energy sources (wind, PV) can stress the internal power electronic components in very different ways. Thereby, lifetime estimation considering mission profiles with adequate redundancy, modularity, and reconfigurability is relevant so that the designed power electronic components comply with the operation life requirements of the larger fault-tolerant system. More
17:00-19:00	Registration PEMC24 Conference Registration

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07:30-18:00	Registration Registration
08:30-09:00	Big hall Opening Session Chairs: Pavol Bauer, Zdeněk Peroutka, Miroslav Lávička, Jan Michalík, Petr Novotný
09:00-09:45	Big hall Keynote: Modern trends in traction drives - application of SiC semiconductors and multiphase PMSM motors to achieve optimal vehicle efficiency and effectiveness in operation - Ladislav Sobotka ŠKODA ELECTRIC is a highly innovative company. For many years we have been working on the use of the latest developments in the field of power semiconductors and especially highly efficient traction motors IPMSM (Interior Permanent Magnet Synchronous Motor). In recent years, we have completed several unique projects that brought significant energy savings and a reduction in the weight of the car. An example is the direct drive system for the Suzhou subway with a passively cooled IPMSM traction motor and a SiC high voltage traction converter working with high frequency PWM. This system is already in standard operation for passengers in Suzhou. Another important project is a new traction drive for 12m and 18m electric buses, using a five-phase IPMSM traction motor and a SiC traction converter with high power density. To increase efficiency, these traction drives inject third harmonics into the traction motor. In addition, our rolling stock now includes battery traction systems that enable operation in sections without catenary. We are currently developing several traction drives for BEMU vehicles and freight electric locomotives. Especially for 3kV DC power systems, we have completed the development of a galvanically isolated SiC DC-DC traction

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	converter that charges the traction battery from the overhead line and increases the intermediate circuit voltage to 3kV when running on the traction battery. This application uses high-voltage SiC semiconductors with an insulation voltage of 10.2 kV. Key features include high efficiency, compact design, and low weight. More Chairs: Zdeněk Peroutka, Pavol Bauer
09:45-10:30	Big hall Keynote: Uncharted Territories in Power Electronics - Johann Kolar Power electronics is employed today in all kinds of modern society's electrical power processing and energy management systems. However, uncharted territories remain, namely deep sea exploration, which requires extreme pressure tolerance or space applications characterized by high radiation exposure. Moreover, reusing or recycling power electronic converters poses substantial future challenges. The talk highlights inspiring concepts currently being discussed in research in the abovementioned areas and finally sheds light on the potential primary importance of AI-based technologies in all engineering disciplines. More Chairs: Zdeněk Peroutka, Pavol Bauer
10:30-11:00	Big hall Coffe Break
11:00-13:00	Alto B TT09 - Motion Control, Adjustable Speed Drives and Robotics To access papers, please follow this link: Proceedings Chairs: Krzysztof Zawirski, Tomáš Glasberger Investigation of Weighted FOC of Dual Induction Motor Drives Operating under Heavy Load Imbalance <i>Eduardo Rodriguez Montero, Markus Vogelsberger, Thomas Wolbank</i> Model Predictive Control for Multiphase Electric Drives with Reduced-error Slope Term <i>Juan Carrillo Rios, Mario Duran, Ignacio González Prieto, Juan José Aciego, Angel Gonzalez-Prieto</i> Hybrid Velocity/Force Filtered Integral-Proportional Control for Damping of Torsional Vibration <i>Kosuke Shikata, Krzysztof Szabat, Seiichiro Katsura</i> Speed and Torque Model Predictive Control for Permanent Magnet Synchronous Motor <i>Hubert Lisi G6, Robert Surus, Tomasz Tarczewski</i> Navigating Attention-Centric: A Machine Learning Approach to EMG-Based Hand Gesture Recognition for Interactive RC Car <i>Husam Almusawi, Magd Saeed Dhaiban, Mohammed A. Khudhair</i> Technical limitations of Organic Human-Robot Interaction (O-HRI) for mobile robots moving amongst humans <i>Kornel Katona, Laszlo Keczan, Balazs Orsi, Robert Mikuska, Husam A. Neamah, Csilla Csukonyi, Peter Korondi</i> Alto A TT01 - Power Electronics and Drives in Transportation To access papers, please follow this link:

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Proceedings

Chairs: Babak Nahid, Pavel Drábek

Voltage Distortion Effects in GaN-Based Dual Inverters Caused by Deadtime and Delayed Switching *Ondrej Lipcak, Pavel Skarolek, Filip Baum*

Optimal reference voltage saturation for nonlinear current control of synchronous machine drives *Niklas Monzen, Christoph Hackl*

Comparison of Voltage Balancing Methods for Supercapacitor-Based Elevator Energy Storage *Martin Makar, Martina Kutija, Marinko Kovač, Tomislav Ivaniš*

Enhanced DC-link Capacitors Failure Diagnosis for a Three-Phase Interleaved Converter, Using Hilbert Transform *Acacio Amaral, Khaled Laadjal, Antonio J. Marques Cardoso*

Simulation-Based Comparative Analysis of Extractable Energy from Various Commercial Electric Vehicles During Regenerative Braking *William Wood, David Zamora, REZA SABZEHGAR, Mohammad Rasouli*

A New Three-Level Switched Reluctance Motor Drive for Electric Vehicles *Nasir Ali, Mehdi Narimani*

Basso A

TT12 - Education and other related topics

To access papers, please follow this link:

Proceedings

Chairs: Péter Korondi, Jan Michalík

Creating an Energy-Efficient Óbuda University Blockchain in Education for Secure Data Storage *Krisztián Bálint*

Open-Source Internal Signal Analysis Unit for FPGA Paired With Rust Real-Time Monitor GUI *Petr Zakopal, Jakub Kucera, Filip Baum, Jan Bauer*

Bond Graph Benefits the Education in Mechatronics

Engineering Zenan Guo, Husam Almusawi, Peter Szemes

Simulating Operation and Trading of Aggregated Energy Portfolios in Multi-Market Environments *István Balázs, Gábor Oláh, Imre Pácsónyi, Attila Fodor, Attila Magyar*

Online Education of Microcontroller Control of Electric Drives with FPGA Based HIL *Tomas Kosan, Jakub Talla, Stepan Janous*

Project Based Learning Activities as a Tool for Efficient Education in Power Electronics *Mariusz Stepień, Paweł Lasek*

Big hall

TT07 - Power Electronic Converter Design and Control

To access papers, please follow this link:

Proceedings

Chairs: Dan Lascu, Dmitri Vinnikov

Energy Management based on Supertwisting Sliding Mode in the Stand-Alone Photovoltaic Power System with Battery Backup *Resul Cotel, Ruhi Zafer Caglayan, Korhan Kayisli, İlhami COLAK*

Control Based on FGS-PID for Modular Multiport DC/DC Converter in Multi-Energy Storage Barge System *Shahriar Farajdadian, Amin Hajizadeh, Mohsen Soltani*

Optimized Bus-Clamping Modulation Strategies for Dual-Inverter Topology *Jakub Kucera, Filip Baum, Petr Zakopal, Ondrej Lipcak, Jan Bauer*

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	A New Control Strategy of the Solar Buck Battery Charger using the Interleaved Ampere-Sec Balance Control <i>Byeong Su Ko, Jang hanjoon, Hyoung Ku Kang, Il Song Kim</i> Data-driven NARX-based digital twin thread modelling of Boost converter inductance current under closed-loop output voltage control <i>Rados & Walepa</i>
13:00-14:15	Emporio Lunch
13:15-14:15	Basso A Sponsor presentations 13:15-13:45 TechSoft Engineering, s r.o. 13:45-14:15 Innoscience Europe NV.
14:15-14:45	Big hall Invited paper: 48V application switching – a new EI Dorado for GaN - Jan Šonský This presentation will discuss the vast opportunities and benefits that GaN power devices can offer in the 48V space, including for example data server applications, hybrid cars with 42V batteries, USB PD charging with extended power range or E-bike applications (motor driver, battery charger or traction inverter). We will illustrate how Innoscience solutions from discrete GaN switches to our integrated SolidGaNTM devices to our Bi-Directional VGANTM switches drive performance and what benefits are offered to the end-users. More Chairs: Pavel Drábek, Bulent Sarlioglu
14:45-16:30	Alto B SS05 - Reliable Power Electronic Systems To access papers, please follow this link: Proceedings Chairs: Aditya Shekhar, Omar Heghazi Adequacy of Hybrid AC-DC Grids with Reliability Oriented Modular Multilevel Converter Design - A Case Study Using Modified RTS-24 Network <i>Miad Ahmadi, Robin van der Sande, Aditya Shekhar, Pavol Bauer</i> Investigating the Effect of Power Curtailment on the Switch of a Solar Boost Converter Under Residential Loads <i>Joel Alpízar-Castillo, Carina Engström, Laura Ramírez-Elizondo, Pavol Bauer</i> End of life influencing factors for Dual Active Bridge components in Flow Battery Application <i>Sourabh Singh, Jelle Zeilstra, Aditya Shekhar, Pavol Bauer</i> Simplified Thermal Analysis and CFD Simulation in Design Process of Power PCB Fitted with SMD <i>Martin Zavrel, Vladimír Kindl, Tristan Schönfelder, Bohumil skala, Jaroslav Plesinger</i> A Novel Approach to Ensure Reliable EMI Performance: Identifying and Mitigating EMI Challenges in Fast Switching Power Converters <i>Tabish Ahmad, Jurgen Willaert, Przemyslaw Misiewicz, Jean-Paul Linnartz</i>
	Alto A TT01 - Power Electronics and Drives in Transportation

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To access papers, please follow this link:

Proceedings

Chairs: Babak Nahid, Martin Janda

Electric Resonance Effects in Electric Machines – How to Measure Them? *Martin Janda, Hans Baernklau, Jaroslav Dragoun*

Model-Free Predictive Control for PMSM Incorporating Flux-weakening *Masoumeh Ahrabi, Subarni Pradhan, Babak Nahid-Mobarakeh*

Development of Meta-Heuristic Optimization Based Control of Redesigned VW Crafter Hybrid Vehicle *Aminu Babangida, Peter Korondi, Szabolcs Dios, Peter Szemes*

Bidirectional Single-Phase Integrated On-Board Charger for Ultracapacitor-Battery Based EVs with V2G and Regenerative Braking Capability *Homayoun Soltani Gohari, Lynn Verkroost, Peter Sergeant, Hendrik Vansompel*

A Comprehensive and Comparative Study of Different Motor Drive Topologies Based on 1.2 kV- and 1.7 kV-SiC MOSFETs for Off-highway EV Applications *Feida Chen, Sangwhae Lee, Wenda Feng, Thomas Jahns, Bulent Sarlioglu*

Basso A

SS02 - Sensorless Control of E-Drives

To access papers, please follow this link:

Proceedings

Chairs: Dénes Fodor, Štěpán Janouš

Study on Rotor Position Detection Implementation for On-the-fly Start-up Technique of a PMSM Drive without a Position Sensor *Matej Pacha, Lukas Gorel*

A Zero and Low Speed Sensorless PMSM Drive Utilizing Existing Inverter PWM harmonics *Reiko Raute*

Parameter Robustness Comparison of Pseudo-Sliding Mode Observer and Extended EMF Observer for Synchronous Reluctance

Motors *Branislav Taká, Ľuboslav Makys*

Impact of Coordinate System Selection and Model Observability on Position Sensorless State Estimation of Nonsalient-Pole

PMSM *Krisztián Horváth, Miklós Kuczmann*

Simscape Implementation of a Nonlinear Permanent Magnet

Synchronous Machine Model for Sensorless Polarity Detection *István Szalay, Denes Fodor*

Big hall

TT07 - Power Electronic Converter Design and Control

To access papers, please follow this link:

Proceedings

Chairs: Dan Lascu, Andrii Chub

Analysis of Output Power with Temperature Using Bi-Directional DC Converter in Boost Mode *Kusuma Priya Krovi, Jan Bauer*

An improved Bidirectional Hybrid Switched-Inductor Switched-Capacitor Converter Topology with Wide Voltage Ratio *Mihaita Gireada, Dan Hulea, Florian Babos, Octavian Cornea, Nicolae Muntean*

Sensorless Magnetic Flux Balancing Strategies for Novel Dual Active Bridge Converter ZVS Modulation Patterns *Kubilay Sahin, Sebastien Mariethoz, Jean-Luc Schanen, Yann Cuenin*

Design and Implementation of a Multi-Output Flyback Auxiliary Power

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	Supply for Bipolar DC Grids <i>Sachin Yadav, Zian Qin, Pavol Bauer</i>
16:30-17:00	Big hall Coffe Break
17:00-18:15	Big hall Student & Young Professionals (S&YP) Forum During the conference, the Student & Young Professionals (S&YP) Activity Committee of the Industrial Electronics Society (IES) will organize the S&YP Forum - an event designed to help students and young professionals stay connected within the IES community. The S&YP Forum offers a unique opportunity to ask questions and gain professional advice directly from IEEE Fellows, the IES President, AdCom members, and experienced colleagues. The program includes keynote speeches from leaders in academia and industry, a 3-Minute Video session, and an open discussion among participants. We encourage all conference participants to join! More Chairs: Andrii Chub, Jakub Ševčík
17:00-18:30	Emporio Technical Visit: R&D Centre RICE
19:30-21:45	Big hall Welcome Reception

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07:30-18:00	Registration Registration
08:30-09:15	Big hall Keynote: On the small-signal stability and impedance passivation in power electronics dominated future electrical grids - Paolo Mattavelli The presentation will describe some recent control-oriented research issues concerning small-signal stability and dynamic interaction in future electrical grids dominated by power electronics converters. The presentation will focus on small-signal stability based on impedances, self-tuning and stability monitoring, impedance specifications, unterminated modeling, and the impact of high-performance oversampled current/voltage control. Different approaches to enable impedance passivation, including unterminated converter modeling, will be outlined. Examples will cover a range of different scenarios, including small lab-scale microgrids, multi-port converters, soft-open point applications, and offshore wind power plants. More Chairs: Drazen Dujic, Václav Šmíd
09:15-10:00	Big hall Keynote: Soft-Switching Inverters for Electric Traction - Matthias Preindl This talk explores the use of soft-switching inverters in electric traction. The concept combines variable frequency critical soft-switching (VFCSS) with wide-bandgap semiconductors, optimized AC filters, and real-time control to

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	render common-mode stabilized sine output voltages and currents. Existing soft-switching inverter prototypes operate SiC FETs up to 1.2MHz switching frequency. The 10kW to 80kW designs achieve over 99.5% efficiency and a power density of 10kW/L to 40kW/L (air-cooled). The soft switching inverters are stackable resulting in reconfigurable and partially redundant software-defined power converters for traction motor drives as well as onboard charging. In motor drives, VFCSS mitigates PWM losses and bearing currents from the electric motor increasing the overall drive efficiency and lifetime. For charging applications, VF-CSS mitigates leakage currents and enables transformerless charger topologies that are cost-effective in providing V2x services. More Chairs: Drazen Dujic, Václav Šmídl
10:00-10:30	Big hall Coffe Break
10:30-12:15	Alto B SS08 - Future-proof power electronic systems and control for residential microgrids To access papers, please follow this link: Proceedings Chairs: Dmitri Vinnikov, Andrii Chub Conversion Efficiency of Active Magnetic Energy Harvesters Operating Under High Primary Currents <i>Alexander Abramovitz, Moshe Shvartsas, MOSHE SITBON, Alon Kuperman</i> Efficiency of Passive Magnetic Energy Harvesters Operating Under High Primary Currents <i>Yarden Siton, Alexander Abramovitz, Moshe Shvartsas, MOSHE SITBON, Georgios Orfanoudakis, Alon Kuperman</i> Comparative Evaluation of a DAB Converter and SRC for DC Buildings Application <i>Edivan Laercio Carvalho, Andrii Chub, Andrei Blinov, SATISH NAIK BANAVATH, Dmitri Vinnikov</i> Bidirectional Wide Voltage Range Series-Parallel Resonant Buck-Boost DC-DC Converter <i>Andrei Blinov, Dmitri Vinnikov, Andrii Chub</i> Reliability Evaluation of the Universal Power Electronic Interface Converter for PV Applications <i>Salman Khan, Andrii Chub, Dmitri Vinnikov, Matthias Kasper, Gerald Deboy</i> Alto A TT02 - Power Electronics in Power Grids To access papers, please follow this link: Proceedings Chairs: İlhami Çolak, Jakub Talla Compensation strategies of electric arc furnace with ability to detect cyber-attacks <i>Martin Bejvl, Petr Šimek, Viktor Valouch</i> LCL-Filtered Grid-Tied Inverter with FCS-MPC Based on FAS Model <i>Cesar Limones, Nimrod Vazquez, Claudia Hernandez, Hector Lopez, Ricardo Femat, Jaime Arau, Angel de Castro, Joaquin Vaquero</i> The Three-Level Zero Harmonic Distortion Grid-Forming Converter: A Practical Filterless Solution for Sinusoidal Voltages <i>Gabriel Vilkn Ramos, Thiago Parreiras, Braz J. Cardoso Filho</i> Simultaneous, Coordinated and Centralized Control of Fast Charging Stations and Advanced Microgrids <i>Dener Brandao, Gabriel Vilkn Ramos,</i>

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	<i>Danilo Iglesias Brandao, Igor Amariz Pires</i> Case Study of BESS Capability for Low-Frequency Power Oscillations <i>Active Compensation Martin Vins, Jaroslav Dragoun</i> Basso A SS03 - Fault Diagnosis and Fault-Tolerant Control in AC Machine Drives To access papers, please follow this link: Proceedings Chairs: Teresa Orłowska-Kowalska, Moussa Boukhniher Optimal multi-fault tolerant control for PMSMs – Part I: Feedforward control <i>Martin Ackermann, José-Luis Marqués, Claus Hillermeier</i> Optimal multi-fault tolerant control for PMSMs – Part II: Feedback control <i>Martin Ackermann, José-Luis Marqués, Claus Hillermeier</i> Dual-Mode Hidden Markov Models For Smart Detection Of Clogging In Variable Frequency Drives <i>Artur Surówka, Teemu Mikkela, Asko Kavala, Marcin Firla</i> Application of the extended Kalman filter in current sensors fault-tolerant control of the induction motor drive <i>Magdalena Miniach, Teresa Orłowska-Kowalska, Michal Adamczyk</i> Accurate Estimation of Rotor Position and Speed for BLDC Motor Drives During Faulty Hall Sensors <i>Mohsen Ebadpour, David Uzel</i> Big hall TT07 - Power Electronic Converter Design and Control To access papers, please follow this link: Proceedings Chairs: Dan Lascu, Tomáš Košan Cycle-by-Cycle Optimized Active Gate Drive for SiC MOSFETs <i>Tomislav Ivaniš, Marinko Kovač, Martin Makar, Željko Jakopović</i> Comparative loss evaluation of SiC semiconductors and capacitors in 800-V DC-Link for NPC family structures <i>Saeid Deliri, Pasi Peltoniemi, Lassi Aarniovuori</i> An optimal dual active bridge converter modulation strategy for optimal loss distribution and reduction <i>Sebastien Mariethoz</i> Battery Charging Resonant Converter with a Secondary Side PFC <i>Pavel Vorel, Jan Martiš</i>
12:15-13:45	Emporio Lunch
12:45-13:45	Basso B Sponsor presentations 13:15-13:45 ŠKODA ELECTRIC a.s. 13:45-14:15 Plexim GmbH
13:45-14:15	Big hall Invited paper: MVDC Power Distribution Networks - Drazen Dujic Despite benefiting from alternating current (AC) systems for over a century there are numerous applications where direct current (DC) technology offers substantial benefits. With advancements in power semiconductors and power

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electronics systems, it has become possible to implement systems not imaginable a hundred years ago. While DC is a reality for high-voltage (HV) bulk power transmission and many low-voltage (LV) applications, potentials, and benefits are largely unexplored in the medium-voltage (MV) domain due to the lack of available and standardized high-power conversion and protection technologies for DC. The talk will provide an overview of the MVDC applications and their specific requirements that involve various technologies. These include advanced power electronics converters (DC-DC, DC-AC, AC-DC), protection coordination, protection equipment as well as overall system analysis and modeling, often needed to access system operation and stability limits. Various onshore and off-shore electrical grids offer certain benefits if implemented with MVDC, and requirements, as well as challenges will be discussed. More

Chairs: Teresa Orlowska-Kowalska, Tomáš Komrská

14:15-16:00

Alto B

TT08 - Electrical Machines and Actuators

To access papers, please follow this link:

Proceedings

Chairs: Goga Cvetkovski, Roman Pechánek

Modification of the Clarke Transformation Matrices for Controlling Electric Machines with Non-Equally Spaced Windings *Yixuan Wu, Gustaf Falk Olson, Luca Peretti*

Open Phase Condition and its Impact on the Induction

Machine *Bohumil skala, Vladimir Kindl, Lukas Sobotka, Martin Zavrel, Jan Sobra, Karel Nohac*

Design and Measurement of an Axial Five Phase Permanent Magnet Synchronous Machine *Zdenek Frank, Jan Laksar, Karel Hruska*

Multi-Verse Optimizer as a Tool for Efficiency Improvement of Permanent Magnet Motor *Goga Cvetkovski*

Systematic Design Method of a PMSM for EVs Using Analytical Characteristic Equations *Jeonghan Lee, Byungtaek Kim, Yunahui Kim*

Alto A

TT02 - Power Electronics in Power Grids + SS01 - DC and AC Microgrids and Energy Hubs + SS02 - Sensorless Control of E-Drives + TT01 - Power Electronics and Drives in Transportation

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Proceedings

Chairs: İlhami Çolak, Jakub Talla

Crowbar Overvoltage Protection with Passive Power Supply of Control Circuit *Jan Strossa, Vladislav Damec, Martin Sobek, Pavel Cyprich, Petr Cyprich, Marek Kubatko*

Power Grid Current Harmonics Reduction and Voltage Balancing with 5-Level CHB Active Filter *Zdenek Kehl, Tomáš Glasberger, Zdenek Peroutka*

Impact of Uncertainties and Price of Robustness in receding-horizon EV Smart-Charging *NIKOLAOS DAMIANAKIS, Yunhe Yu, Gautham Ram Chandra Mouli, Pavol Bauer*

Performance Comparison of the General the Dual and the Joint Extended Kalman Filter on State Estimation of Li-ion Battery Cells for

Wednesday, 2 October 2024

	BMS <i>Tamás Horváth, Denes Fodor</i> Comparative Performance Analysis of 21700-Type Cylindrical and Pouch Nickel Manganese Cobalt Battery Cells for Electric Vehicle Applications <i>Mohammed Kabir Billa Boumegouas, Katia Kouzi, Mohamed Trabelsi, Mohamed Bougrine, Bachir Bendjedja, ATIF IQBAL</i>
	Basso A TT07 - Power Electronic Converter Design and Control + TT13 - Multiphase Machines and Drives To access papers, please follow this link: Proceedings Chairs: Dan Lascu, Tomáš Glasberger Part 3: Design and thermal performance evaluation of 3-phase shared core power inductor for Vienna rectifier <i>Michal Frivaldsky, Vladimír Kindl, Lukas Sobotka, Pavol Gonscak</i> Optimal Current Setpoints for Five-Phase Induction Motor Drive <i>Jan Laksar, Vaclav Šmídl, Tomáš Komrská, Lukáš Adam</i> An Approach for Rapid Online Robustness Enhancement of Distributed Power Systems using Load Classifier Forecasting <i>Xin Wei, Denis Sidorov, Aliona Dreglea, Alexey Isakov, Zongjie Wang, Ligu Wang</i>
	Big hall SS03 - Fault Diagnosis and Fault-Tolerant Control in AC Machine Drives + SS08 - Future-proof power electronic systems and control for residential microgrids To access papers, please follow this link: Proceedings Chairs: Teresa Orłowska-Kowalska, Emrah Zerdali Current Sensor Fault Detection and Compensation Based on Single Modified Extended Luenberger Observer for Induction Motor Drive <i>Michal Adamczyk, Teresa Orłowska-Kowalska, Magdalena Miniach</i> Early fault detection of current sensors operating in a closed-loop control structure using transfer learning <i>Maciej Skowron, Krystian Teler, Teresa Orłowska-Kowalska</i> Fault Classification of Stator Current Sensors using LSTM Neural Network in an Induction Motor Drive <i>Krystian Teler, Maciej Skowron, Teresa Orłowska-Kowalska</i> Droop Control with Incorporated Dead Zone for Indirect Energy Management in DC Nanogrids <i>Indrek Roasto, Dmitri Vinnikov, Andrei Blinov</i> Addressing Cross-Coupling Issues in Magnetically Integrated Three-Port DC-DC Converters <i>Edivan Laercio Carvalho, Andrei Blinov, Umer Sohail, Andrii Chub</i>
16:00-16:30	Big hall Coffe Break
16:30-18:00	Big hall Industrial forum: Future Power Semiconductor Technology Chairs: Zdeněk Peroutka, Pavel Drábek, Stanislav Černý

Wednesday, 2 October 2024	
	Emporio Technical visit: Škoda Group
19:30-22:00	Big hall Gala Dinner - Pilsner Urquell Brewery
Thursday, 3 October 2024	
07:30-13:00	Registration Registration
08:30-09:00	Big hall Closing Session Chairs: Zdenek Peroutka, Pavol Bauer, Peter Korondi, Babak Nahid, Dmitri Vinnikov
09:00-09:45	Big hall Keynote: Electric Propulsion System: A Technology Outlook - Babak Fahimi This talk provides an overview of the state of the art and future trends in design and development of modern electric propulsion systems for electrified land and air vehicles. A comparative study of various motor drives in terms of torque density, cost, efficiency, reliability, and NVH will be provided. Recent advances in power electronic devices, passive elements, and integration will be introduced and an assessment of the existing challenges and future needs of the transportation industry will be discussed. Recent breakthroughs and new frontiers in aerospace applications will be addressed as well. More Chairs: Christopher Hackl, Miroslav Chomát
09:45-10:30	Big hall Keynote: Regulation of Multiphase Electric Drives: Introduction, Challenges and Trends - Mario J. Duran Multiphase electric drives (MED) have reemerged in the last two decades with an increasing interest from both academia and industry. As an introduction, the presentation will initially show some key aspects of multiphase electric machines, highlighting their main distinctive features compared to their three-phase counterparts and reviewing recent industrial applications for the propulsion in electric transportation. Focusing on the regulation of MED, some generalities of high-performance control techniques will be presented, with a special emphasis on the description of Model Predictive Control (MPC) and its evolution in the last decade. The talk will then continue with the description of fault-tolerant strategies in the event of open-phase faults, including control approaches with fault detection/reconfiguration and universal strategies (i.e., natural/passive fault tolerance). Finally, the last part of the presentation will be focused on the challenges and trends for MED, including some hints on how to revisit the control strategies when they are operated at high switching frequencies with converters based on Silicon Carbide (SiC) power switches. More Chairs: Christopher Hackl, Miroslav Chomát

Thursday, 3 October 2024

10:30-11:00	Big hall Coffe Break
11:00-11:30	Big hall Invited paper: Motion-Copying System for Reproduction of Human Motions - Seiichiro Katsura Reproduction and skill transfer of various human tasks to robots are required not only in automation but also human support. We succeeded in development of a novel method for preserving and reproducing human motion based on motion control technology. This method is called a "motion-copying system (MCS)" as it is a spatio-temporal coupler of real-world haptic information. As with sound and visual information, the MCS is capable of preserving and reproducing the raw force and position information of human operators. Once human motions are preserved as digital data, it is possible not only to analyze the experts' skills but also to transfer them to a robot. In addition, quantitative training including rehabilitation becomes possible. In the lecture, recent challenges for medical applications will be also presented. More Chairs: Mariusz Stępień, Peter Korondi
11:30-13:15	Alto B TT08 - Electrical Machines and Actuators + SS04 - Future Trends in Electrical Machines + TT03 - Power Electronics in Electrical Energy and Heat Generation To access papers, please follow this link: Proceedings Chairs: Goga Cvetkovski, Karel Hruška Robust Model-Free Control Framework with Safety Constraints for a Fully Electric Linear Actuator System MEHDI HEYDARISHAHNA, Pauli Mustalahti, Jouni Mattila Electromagnetic rotor design of a hybrid-excited PMSM for automotive applications Michal Stař, Pavol Rafajdus The Summary of Induction Motor Torque Ripple Theories for Motor Torque Analysis Jan Otýpka, Jan Sobra, Roman Pechanek Study of electrical energy coupling between turbine and compressor in gas-cooled small modular reactor Martin Bejvl, Petr Šimek, Viktor Valouch, Miroslav Chomat Thermal Analysis of DC-link using Reduced Order Modeling Method Jakub Kazda, Libor Sova, Milada Krejř, Filip Lekeš, Jiřka Ždražan Alto A TT05 - Power Supplies and Special Converters + SS06 - Advanced Multilevel Converters with DC Capacitors: Topology, Modulation, Voltage Balancing, and Control Strategies To access papers, please follow this link: Proceedings Chairs: Dénes Fodor, Luboš Streit Analysis of a WPT system in terms of coupling factor and compliance with magnetic flux density limits Tristan Schönfelder, Vladimír Kindl Python-LTSpice Framework for Impact Study of PCB Parasitics on

Thursday, 3 October 2024

Conducted Emission Jose Romero Lopera, Herbert Hackl, patrick Gsoels, Martin Stoiber, Bernhard Auinger

Geometrical Optimization of Charging Pads for Electric Vehicles

Wireless Power Supply Vladimír Kindl, Martin Zavrel, Bohumil skala, Ondrej Soupal, Petr Pichlik, Tristan Schönfelder

The Design and Control of Universal TNPC Single-Phase Voltage Inverter Ales Havel, Jan Strossa, Jan Mojzisek, Martin Sobek, Stepan Kirschner, David Bielez

Multivariable control of aclac modular multilevel converters under square wave operation using Fourier expansion Victor Daniel Reyes Dreke, Ygor Pereira Marca, Kaveh Pouresmaeil, Maurice Roes, Mircea Lazar

Basso A

TT04 - Power Electronics and Drives in Industry

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Chairs: Martin Brůha, Paolo Mattavelli

Assessment of Aluminum Electrolytic Capacitors Health Status

Through Signal-Based Techniques Acacio Amaral, Khaled Laadjal, Antonio J. Marques Cardoso

Torque Ripple Suppression Control Considering Magnetic Saturation in Position Sensorless Control with Extended Induced Voltage for IPMSM Taiki Mikami, Keitaro Kawarazaki, Nobukazu Hoshi

Active motor terminal overvoltage mitigation method for parallel voltage source inverters Juhamatti Korhonen, Lauri Tuimala, Tommi Kärkkäinen, Pertti Silventoinen

Reconfigurable Partial Power Converter for beer brewing applications Nicolas Muller, Lorenzo Reyes-Chamorro, Francisco Navarrete

Dead Time Adaptive Control for Efficiency Improvement of GaN Transistor Based SPWM Modulated Inverter Kaspars Kroics, Kristi  2 Gaspersions

Big hall

TT10 - Machine Learning in Power Electronics and Drives + TT11 - Sensors, Measurement and Observation Techniques + TT06 - Semiconductor Devices

To access papers, please follow this link:

Proceedings

Chairs: Péter Korondi, Václav Šmíd

Online Multi-Layer Perceptron-Based Power Quality Monitoring for

Electric Vehicles Luis Fernando Gaona, Nimrod Vazquez, Héctor Juan Carlos López Tapia, Claudia Veronica Hernández Gutiérrez, Sergio Enrique Pinto Castillo

Classification of Rigid Objects from High-Bandwidth Data

Acquisition Sora Yamaguchi, Shunichi Sakurai, Seiichiro Katsura

The Inductive External Low-frequency Sensor of Electromagnetic Field using AME 3D PCB Nanotechnology for Biophysics Applications Aleš Richter, Želmíra Ferková, Zdenek Pliva, Leos Pertzilka

Suppression Strategy for Oscillation between Two Paralleled GaN-HEMTs Based on Harmonics of Switching Surge Kotaro Kobashi, Kazuhiro Umetani, Masataka Ishihara, Eiji Hiraki

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	Deep-Learning based Power Switch Fault Diagnosis in DC-DC Converters for Photovoltaic Applications <i>AMINE BEN RHOUMA, HOUDA MEDDEB, BADII GMATI, Sejr KHOJET EL KHIL, Chiara Boccaletti</i>
13:15-13:30	<i>Big hall</i> Best Paper Awards Chairs: Pavol Bauer, Peter Korondi, Babak Nahid, Zdenek Peroutka
13:30-14:45	<i>Emporio</i> Lunch

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