CPE-POWERENG 2023

TAL TECH

IEEE Industrial Electronics Society

IEEE ESTONIA SECTION

17TH IEEE INTERNATIONAL CONFERENCE ON COMPATIBILITY, POWER ELECTRONICS AND POWER ENGINEERING

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Power Electronics and Motion Control Council

PEMC

14-16 June 2023

Tallinn, Estonia

PROGRAM

OF THE 17TH IEEE INTERNATIONAL CONFERENCE ON COMPATIBILITY, POWER ELECTRONICS AND POWER ENGINEERING

Editor: Andrii Chub

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MESSAGE FROM THE CONFERENCE CHAIRS

On behalf of the organizing committee and technical board, it is our pleasure to welcome all the delegates, representatives of various universities, research institutes, industries, and participants from all around the world to the 2023 IEEE 17th International Conference on Compatibility, Power Electronics and Power Engineering (CPE-POWERENG), 14-16 June 2023, in Tallinn, Estonia.

CPE-POWERENG is a flagship conference of the IEEE Industrial Electronics Society devoted to the dissemination of new ideas, research, and work in progress within the fields of power electronics, renewable energy integration, power generation, transmission and distribution, power systems, electro-mechanical energy conversion, automation, and EMC/EMI issues. The conference aims to provide high-quality research and professional interactions between industry and academia to advance science, technology, and fellowship. The main features of the conference include Invited Talks, Regular Sessions, and Special Sessions.

Estonia holds a myriad of treasures, offering an abundance of world-class museums, unspoiled natural wonders, and extraordinary medieval architecture. Each corner you turn in this remarkable country reveals a delightful surprise. Among its numerous marvels, Tallinn, the capital of Estonia, stands proudly as the finest-preserved medieval city in all of Northern Europe. Tracing its roots back to the 13th century, Tallinn was graced with the construction of a castle by the valiant knights of the Teutonic Order. The Tallinn Old Town, boasting a remarkably well-preserved 13-century layout, was recognized as a UNESCO World Heritage Site in 1997, proudly joining the league of the world's most renowned landmarks.

Finally, we would like to thank all the authors and participants for their input, the Technical Board members, the Technical Track Chairs, the Keynote Speakers, the Special Session Organizers, the reviewers, and all the local and international volunteers who have contributed to the event, making it a reality.

We wish all participants a happy and pleasant stay in Tallinn.

Dmitri Vinnikov
General Chair

Andrii Chub
Co-Chair

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TECHNICAL TRACK CHAIRS

TT1 – POWER GENERATION, TRANSMISSION AND DISTRIBUTION

G. De Carne, Karlsruhe Institute of Technology, Germany
Hamed Mashinchi Maheri, University of Tabriz, Iran

TT2 – POWER ELECTRONICS AND APPLICATIONS

A. Kuperman, Ben-Gurion University of the Negev, Israel
O. Husev, Tallinn University of Technology, Estonia

TT3 – SMART GRIDS TECHNOLOGIES AND APPLICATIONS

G. Buticchi, University of Nottingham Ningbo China, China
R. Ahmadiahangar, Tallinn University of Technology, Estonia

TT4 – RENEWABLE ENERGIES

G. Spagnuolo, University of Salerno, Italy
J. Kilter, Tallinn University of Technology, Estonia

TT5 – STORAGE TECHNOLOGIES

A. Barrado, Universidad Carlos III de Madrid, Spain
A. Shekhar, TU Delft, The Netherlands

TT6 – DISTRIBUTED POWER GENERATION SYSTEMS, COMMUNICATIONS, SECURITY AND SMART METERING

V. Pires, Polytechnic Institute of Setúbal, Portugal
A. Rosin, Tallinn University of Technology, Estonia

TT7 – ELECTRICAL MACHINES AND ADJUSTABLE SPEED DRIVES

V. Ambrozic, University of Ljubljana, Slovenia
A. Kallaste, Tallinn University of Technology, Estonia

TT8 – TRANSPORTATION ELECTRIFICATION

P. Tricoli, University of Birmingham, UK
I. Galkin, Riga Technical University, Latvia

TT9 – ELECTRIC MOBILITY

Y. Siwakoti, University of Technology Sydney, Australia
A. Rassõlkin, Tallinn University of Technology, Estonia

TT10 – ENERGY MARKET

C. Roncero Clemente, University of Extremadura, Spain
M. Langwasser, Kiel University, Germany

TT11 – EMI AND EMC ISSUES

R. Smolenski, University of Zielona Gora, Poland
S. Naik, Indian Institute of Technology Dharwad, India

SUCCESSFUL SPECIAL SESSIONS

SS1 – ADVANCED CONTROL TECHNIQUES FOR POWER ELECTRONICS CONVERTERS

Hasan Komurcugil, Eastern Mediterranean University, Turkey

Sertac Bayhan, Hamad Bin Khalifa University, Qatar

Ramon Guzman, Technical University of Catalonia, Spain

SS5 – FUTURE-PROOF POWER ELECTRONIC SYSTEMS AND CONTROL FOR RESIDENTIAL MICROGRIDS

Edivan Laercio Carvalho, Tallinn University of Technology, Estonia

Carlos Roncero-Clemente, University of Extremadura, Spain

Vitor Fernão Pires, Instituto Politécnico de Setúbal, Portugal

Sebastian Rivera, Delft University of Technology, The Netherlands

SS7 – ADVANCED CONTROL OF GRID-CONNECTED CONVERTERS FOR DISTRIBUTED GENERATION AND POWER QUALITY

Hadi Kanaan, Saint Joseph University of Beirut, Lebanon

Fadia Sebaaly, Hydro-Quebec, Montreal, Canada

Kamal Al-Haddad, Ecole de Technologie Supérieure, Montreal, Canada

Hasan Komurcugil, Eastern Mediterranean University, Turkey

SS11 – DEMAND SIDE FLEXIBILITY AND ENERGY MANAGEMENT

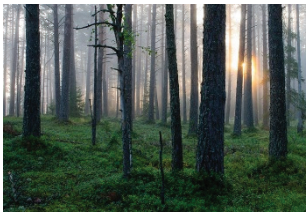
Roya Ahmadiahangar, Tallinn University of Technology, Estonia

Argo Rosin, Tallinn University of Technology, Estonia

Poria Divshali, Aalto University, Finland

João Martins, Universidade Nova de Lisboa (UNINOVA-CTS), Portugal

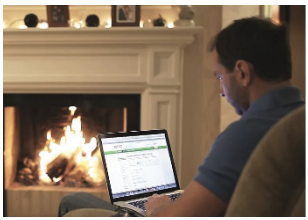
FUN FACTS ABOUT ESTONIA



Untouched, Accessible, and Wild Nature
One would probably think that a country so modernized and digitally advanced wouldn't be very green, or nature-rich but believe it or not, Estonia is actually ranked as one of the greenest countries in the world. With about half of the country covered in forests, nature lovers can explore and enjoy Estonia's untouched natural beauty.

Historical Country
Estonia's occupation by the Swedes, Russians, and Germans, and their previous place in the Soviet Union has left the country with a distinct history, rich culture, and beautiful architecture. No matter where you go, you will find remnants of historical sights, and old traditions and customs, especially in Tallinn.

Internet Everywhere
Estonia ensures all their visitors can tweet and snapchat about how awesome Estonia is by having free wifi hotspots everywhere. It is a digital nomads' and travel bloggers' heaven! Estonia is also the birthplace of ten unicorns companies, like Skype, BOLT, Wise, Playtech, and others.



Digital Society
From voting to signing documents or doing taxes online, Estonia implements a hassle-free and modern approach. Residents can do nearly everything they need online, like getting a medical prescription or registering a business. Additionally, Estonia is the first e-government in the world and offers e-residency to people from all over the world.

For more information, visit:
https://www.visitestonia.com/en/why-estonia/estonia-facts
https://www.workinestonia.com/living-in-estonia/fun-facts/
https://www.roadaffair.com/visit-estonia/

THINGS TO SEE AND DO IN TALLINN

St Olaf's Church is Tallinn's biggest medieval structure. It was first mentioned in 1267. According to some sources, it may have been the tallest building in the world from 1549 to 1625. Its observation platform is open for visits.

Passages were built along with the **bastions** in the 17th and 18th centuries to conceal the movement of soldiers and ammunition. After removing fortifications in 1857, parks were established on the Ingrian and Swedish bastions.

Kadriorg Park is a palatial urban park covering around 70 hectares. Its construction began in 1718 on the orders of Russian tsar Peter I. Elements of park design from the 18th, 19th, and 20th centuries can be seen here.

Kumu Art Museum has a permanent exhibition that introduces Estonian art from the beginning of the 18th century to 1991, and temporary exhibitions of international and contemporary art.

Telliskivi Creative City houses galleries, small shops, various creative companies, start-ups, and restaurants in the former industrial complex of Tallinn. More than twenty different works of street art can be found in the creative city.

Tallinn TV Tower, built in 1980, offers a picturesque view of Tallinn. Today, it has three functions: to provide nationwide communication, to offer traditional Estonian flavors in a modern café-restaurant, and to provide experiences.

Estonian Open Air Museum showcases the Estonian rural architecture and way of life. The 14 farms in the museum provide an overview of how families from different strata of society lived in the 18–20th centuries.

Rotermann Quarter was founded in the 19th century. This industrial site has become an oasis of modern architecture, skillfully blending old and new. It offers many shops, cafes, restaurants, and the Estonian Museum of Architecture.

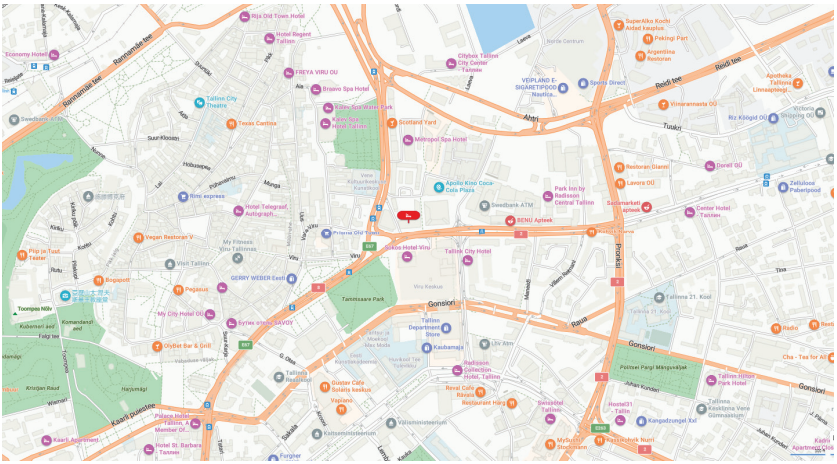
Seaplane Harbour display about 200 genuine items: a real submarine called Lembit, a century-old icebreaker called Suur Tõll, a Short 184 seaplane, the remains of the oldest ship found in Estonia, etc. in the historical seaplane hangars

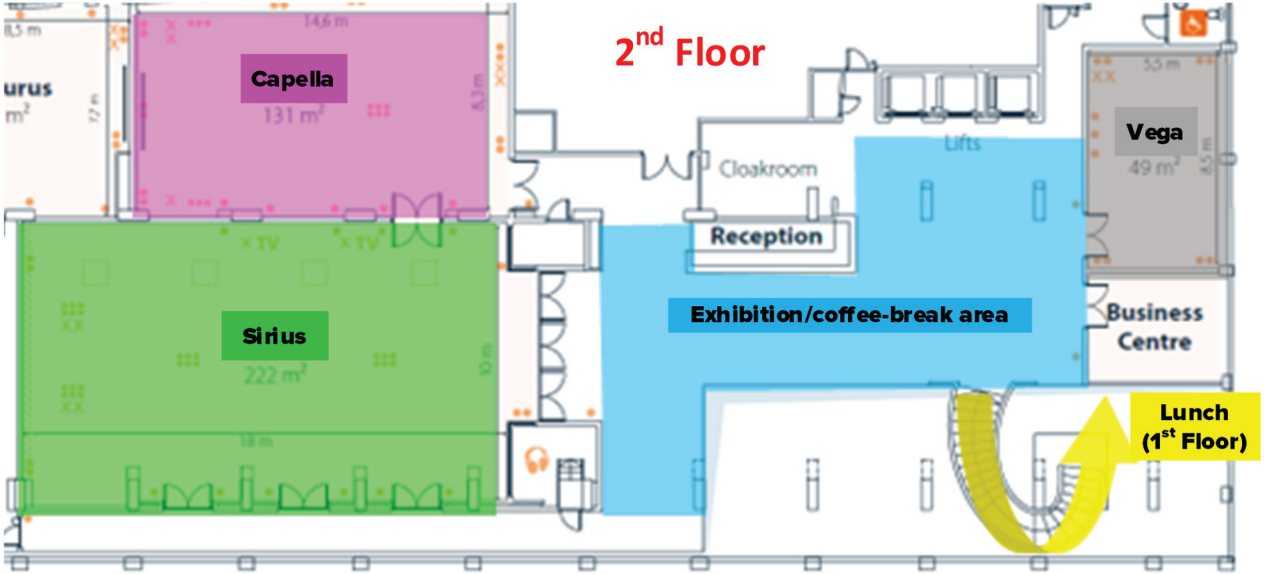
For more information, visit:
https://www.visitestonia.com/en/why-estonia/estonia-facts
https://www.workinestonia.com/living-in-estonia/fun-facts/
https://www.roadaffair.com/visit-estonia/

VENUE: NORDIC HOTEL FORUM

CPE-POWERENG 2023 will be held at Nordic Hotel Forum, Viru väljak 3, 10111 Tallinn.

Nordic Hotel Forum is a modern four-star superior business and conference hotel in the heart of Tallinn, located on the edge of the picturesque Tallinn Old Town, a UNESCO World Heritage site. Thinking of everything, taking care of the smallest detail, being an invisible presence ready to fulfill your every wish, even those you have not yet had a chance to express – this is the Nordic Hotel Forum.





CONFERENCE CENTER LAYOUT

The conference rooms are located on the 2nd floor of the hotel.
Lunches will be served on the 1st floor, in the restaurant Nomel, on the right from the reception desk.

PROGRAM AT A GLANCE

During the conference, 16 regular sessions and 6 special sessions are scheduled. They will be organized in three parallel sessions for the first two days and two parallel sessions on the third day. All regular sessions start with the letter "T" followed by a number, while the special sessions are designated with the letters "SS". In total, 128 papers will be presented at the conference.

All papers will be presented in oral form. Each paper must be presented within a 15-minute time slot, meaning the presentation must take no more than 12 minutes.

Session chairs have the right to interrupt presenters disregarding the schedule.

The conference provides coffee breaks (Expo area) and buffet lunches (restaurant Nomel, 1st floor) on-site to keep all attendees together and foster networking.

The program at a glance is given below with color-coded conference rooms. It is worth noting that the registration will be open every day from 8:30 a.m.

JUNE 14, 2023 (WEDNESDAY)			
8:30–17:00	Registration		
9:00–9:30	Opening		
9:30–10:00	**Johann W. Kolar (ETH Zurich)**		
10:00–10:30	**Frede Blaabjerg (Aalborg University)**		
10:30–11:00	Vendor Presentations		
11:00–11:30	Coffee break		
11:30–13:00	T1. Electromobility – Converters	T2. Electrical Machines and Adjustable Speed Drives	T3. Power Generation, Transmission, Distribution, and Energy Markets
13:00–14:00	Lunch & Networking		
14:00–15:30	T4. Power Electronics – Topologies, Converters, and Systems	T5. Power Electronics – Analysis, Modeling, and Design	T6. Energy Storage Systems
15:30–17:00	T7. Power Electronics – Applications	T8. Power Electronics – Components and Devices	SS1. Advanced Control Techniques for Power Electronics Converters
19:30–22:30	**Welcome Reception**		

June 15, 2023 (Thursday)			
8:30–17:00	Registration		
8:00–11:30	**IES SYP Morning**		
8:00–9:00	Ice-Breaking Coffee with Power Snacks		
9:00–9:30	**C.-C. Liu (Virginia Tech) and F. Z. Peng (Florida State University)**		
9:30–10:00	**Remus Teodorescu (Aalborg University)**		
10:00–10:30	**Pavol Bauer (TU Delft)**		
10:30–11:00	IES SYPA 3-min Speeches		
11:00–12:00	SYP Mentoring Session with Coffee		
12:00–13:00	T9. Transportation Electrification	T10. Grid-Connected Converters	T11. Power Quality and Electromagnetic Compatibility
13:00–14:00	Lunch & Networking		
14:00–16:00	T12. Renewable Energy and Smart Grids	T13. Power Electronics – Control, Modulations, and Communication	SS11. Demand Side Flexibility and Energy Management
16:00–17:30	T14. Multilevel Converters	SS5-1. Future-Proof Power Electronic Systems and Control for Residential Microgrids – Energy Management and Supply Reliability	SS7. Advanced Control of Grid-Connected Converters for Distributed Generation and Power Quality
20:00–23:00	**Gala Dinner**		

June 16, 2023 (Friday)		
8:30–13:00	Registration	
9:00–9:30	**Alon Kuperman (Ben Gurion University)**	
9:30–10:00	**Jose Cobos (TU Madrid)**	
10:00–11:30	SS5-2. Future-Proof Power Electronic Systems and Control for Residential Microgrids – Converters	T15. Mechatronics
11:30–13:00	SS5-3. Future-Proof Power Electronic Systems and Control for Residential Microgrids – Topologies	T16. Electromobility – Components and Control
13:00–13:30	Closing Session and Farewell Coffee with Snacks	

Color-coding of locations					
Nordic Hotel Forum					Outside hotel
Sirius Room	Capella Room	Vega Room	1st floor lunch area	2nd floor open area	

SOCIAL EVENTS

Welcome Reception

The welcome reception will be organized in Energy Discovery Centre at **19:30 on June 14, 2023.** Eesti Energia and the Department of Electrical Power Engineering and Mechatronics of TalTech support this event.
The Energy Discovery Centre is located in a 100-year-old power plant in the center of Tallinn on the border of the Old Town and the Kalamaja district. Here, you can see lightning even on a sunny day! More than 100 hands-on exhibits explain how different electrical equipment work.

Address: Põhja pst 29, 10415 Tallinn
If the weather allows, a walking tour from the conference hotel to the welcome reception venue will be organized at 6 p.m.

Gala Dinner & Awards Ceremony

Gala Dinner will be organized in "Seaplane Harbour" – Estonian Maritime Museum – at **20:00 on June 15, 2023.**
Located in the unique and historic seaplane hangar, its interactive exhibition includes about 200 authentic items on display: a submarine from the mid-1930s called Lembit, a century-old icebreaker Suur Tõll, a seaplane called Short 184, remains of the oldest ship found in Estonia, and much more.
Gala Dinner attendees can visit inside the 89-year-old mine-laying diesel submarine Lembit from 20:00 to 21:00.

Address:
Vesilennuki 6,
10145 Tallinn

You MUST present the corresponding ticket from your conference package to gain entry to a social event.

IES SYP MORNING

IES SYP Morning will be a new format of mentoring events for the student and young professional (SYP) members of the IEEE Industrial Electronics Society. It will give IEEE IES SYP members a unique opportunity to ask questions and get professional advice directly from IEEE Fellows, IES President, AdCom members, and experienced colleagues. **We encourage all conference participants to join!**

The IES SYP Morning will be organized by the IEEE IES Students and Young Professionals Activity Committee (SYP-AC). It will take place on Thursday, June 15, from 8:00 to 12:00 a.m. and include the following activities:

- Ice-breaking coffee and power snacks with Mentors.
- **Three keynotes from world-renowned experts:**
  - **F.Z. Peng** (Florida State University, USA) and **C.C. Liu** (Virginia Tech, USA)
    Envisioning the Future Renewable and Resilient Energy Grids — a Power Grid Revolution Enabled by Renewables, Energy Storage, and Power Electronics
  - **R. Teodorescu** (Aalborg University, Denmark)
    Smart Battery — The Next Generation of Battery Management Technology!
  - **P. Bauer** (TU Delft, The Netherlands)
    Digital Energy
- Presentation of 3-min videos from the winners of IES-SYPA.
- Informal mentoring session with coffee.

Please direct your questions about the IES SYP Morning to the local coordinator – Dr. Edivan Carvalho.

Winners of the IES Student and Young Professionals Paper Assistance (IES-SYPA):

- **Miad Ahmadi**, Delft University of Technology, The Netherlands
- **Alvaro Carreno**, UTFSM, Chile / WUT, Poland
- **Moria Sassonker**, Ben-Gurion University of the Negev, Israel
- **Isavella Koukoula**, Tampere University, Finland
- **Rafael Souza Baquero**, Politecnico di Milano, Italy
- **Przemysław Trochimiuk**, Warsaw University of Technology, Poland
- **Satish Naik Banavath**, Indian Institute of Technology Dharwad, India
- **Riccardo Mandrioli**, University of Bologna, Italy
- **Shan He**, Aalborg University, Denmark
- **Uğur Fesli**, Gazi University, Turkey

DAY I – JUNE 14

DAY I 9:00–9:30 **SIRIUS**	**OPENING** **Moderator:** *Andrii Chub* **Welcome Words from the IEEE Industrial Electronics Society** *Mariusz Malinowski, President of the IEEE IES* **Welcome Words from Honorary Chairs** *Ryszard Strzelecki and João Martins* **Welcome Words from TalTech** *Tiit Lukk, TalTech Vice-Rector for Research* **Welcome Remarks** *Dmitri Vinnikov*
DAY I 9:30–10:00 **SIRIUS**	**KEYNOTE I** **Materializing The Vision of "Flying Carpets" — Ultra-Lightweight/Efficient Power Electronics Enabling Future Urban Transport** ***Johann W. Kolar, ETH Zurich, Switzerland*** **Moderator:** *Dmitri Vinnikov*
DAY I 10:00–10:30 **SIRIUS**	**KEYNOTE II** **Power Electronics as the Enabling Technology for a Modern Carbon Neutral Society** ***Frede Blaabjerg, Aalborg University, Denmark*** **Moderator:** *Andrii Chub*

Day I 10:30–11:00 **Sirius**	**Vendor Presentations** • **OPAL-RT TECHNOLOGIES** • **Typhoon HIL**
Day I 11:00–11:30 **Expo**	**Coffee Break**
Day I 11:30–13:00 **Sirius**	**T1. Electromobility – Converters** **Chairs:** *Oscar Lucia, Oleksandr Husev* **Concepts and Matching Power Semiconductor Devices for Compact On-Board Chargers** Matthias J. Kasper, Alex Pacini, Alessandro Pevere, Jon Azurza Anderson, and Gerald Deboy **High-Performance Bidirectional Fast EV Charger Featuring Full Power/Voltage Range and Cost-Effective Implementation** Héctor Sarnago, Ignacio Álvarez, and Óscar Lucía **Single-/Three-Phase Bidirectional EV On-Board Charger Featuring Full Power/Voltage Range and a Cost-Effective Implementation** Héctor Sarnago, Óscar Lucía, David Menzi, and Johann W. Kolar **Experimental Evaluation of SiC-Based Medium Voltage Series Resonant Dual-Active-Bridge Three-Level DC/DC Converters for EV Charging** Przemysław Trochimiuk, Rafał Miśkiewicz, Jacek Rąbkowski, Kaushik Naresh Kumar, and Dimosthenis Peftitsis **Buck-Boost Flying Capacitor DC-DC Converter for Electric Vehicle Charging Stations** D. Pesantez, F. Rodriguez, H.Renaudineau, S. Rivera, and S. Kouro

Day I 11:30–13:00 **Sirius**	**A Fast Charging Station for Electric Vehicles with 400-V/800-V Charging Ports and Second-Life Batteries** Marzio Barresi, Edoardo Ferri, and Luigi Piegari
Day I 11:30–13:00 **Capella**	**T2. Electrical Machines and Adjustable Speed Drives** **Chairs:** *Valery Vodovozov, Payam Shams Ghahfarokhi* **Modeling and Characteristic Analysis of Line-Start Synchronous Reluctance Motor** Yu-Chen Luo and Yee-Pien Yang **Estimation of Remaining Useful Life and Failure Probability of an Electrical Machine – Case Study** Jan Leffler and Pavel Trnka **Comprehensive Analysis of Pole/Slot Combination on Performance for Wheel-hub Propulsion** Chenglong Chu, Yunkai Huang, Zichong Zhu, and Andrea Cavagnino **Design of an Additively Manufactured Polymer Composite Electrical Machine** Martin Sarap, Ants Kallaste, Muhammed Usman Naseer, Hans Tiismus, Viktor Rjabtšikov, Payam Shams Ghahfarokhi, Toomas Vaimann, Alexander Aman, and Mykhailo Kutia **AC Loss Analysis Approaches for Hairpin Winding Configuration: Analytical, Hybrid Model, and FEA** Payam Shams Ghahfarokhi, Ants Kallaste, Andrejs Podgornovs, Antonio J. Marques Cardoso, Anouar Belahcen, and Toomas Vaimann **Optimal Flux Reference to Operate a Five-Phase Induction Machine Under Two Open-Phase Fault Condition** Gioele Gregis, Maria Stefania Carmeli, Marco Mauri, Mauricio B. C. Salles, and Luigi Piegari

Day I 11:30–13:00 **Vega**	**T3. Power Generation, Transmission, Distribution, and Energy Markets** **Chairs:** *Gevork. B. Gharehpetian, Tarmo Korõtko* **Non-Intrusive Defects Identification for the High Voltage Instrument Transformers** Sajjad Asefi, Jako Kilter, and Mart Landsberg **The Effect of Non-Coordinated Heating Electrification Alternatives on a Low-Voltage Distribution Network with High PV Penetration** Joel Alpízar-Castillo,Laura Ramírez-Elizondo, and Pavol Bauer **Flux Compensation in a Hybrid Transformer with the Series Converter Connected on the Primary-Side** Alvaro Carreno, Marcelo Perez, and Mariusz Malinowski **Propagation Characteristics of Partial Discharges in an Oil-Filled Power Transformer** Sayed Mohammad Kameli, Shady S. Refaat, Ali Ghrayeb, Haitham Abu-Rub, and Jarosław Guziński **Comparative Analysis of Travelling Wave-Based Fault Location Method for Different Sampling Frequencies** J. F. Martins, Adriano Martins, Rui Lopes, Pedro Pereira, A. J. Pires, and V. Fernão Pires **Potential Assessment of Closed Distribution System Uptake in Estonia** Hannes Agabus, Tarmo Korõtko, Karl Kull, Argo Rosin, and Ivo Palu
Day I 13:00–14:00 **Nomel**	**Lunch & Networking**

Day I 14:00–15:30 **Sirius**	**T4. Power Electronics – Topologies, Converters, and Systems** **Chairs:** *Enrique Romero-Cadaval, Oleksandr Matiushkin* **A DC/DC Converter with Buck and Quadratic Buck Characteristic for Loads Connected to Bipolar DC Microgrids With Voltage Balancer Support** V. Fernão Pires, Daniel Foito, Armando Cordeiro, J. Fernando Silva, Carlos Roncero-Clemente, and Enrique Romero-Cadaval **Triple-Loop Control Configuration for Grid-Connected LCL-Filtered Inverters Based on Time-Domain Design** Moria Sassonker Elkayam and Dmitri Vinnikov **A Novel Bridgeless Interleaved-Based Dual-Output Boost-Type PFC Rectifier** Vitor Monteiro, Joao Martins, and Joao L. Afonso **AC/DC Four-Switches Boost Buck Converter for EV Battery Charging** Mamoud Nassary, Enric Vidal-Idiarte, and Javier Calvente **Maximum Power Point Tracking Algorithm for Step-Up/Down Partial Power Converters with Improved Performance Around Zero Partiality** Neelesh Yadav, Andrii Chub, Naser Hassanpour, Andrei Blinov, and Dmitri Vinnikov **DC Fast Charging of Electric Vehicles: A Review on Architecture and Power Conversion Technology** Gabriele Arena, Pietro Emiliani, Andrii Chub, Dmitri Vinnikov, and Giovanni De Carne

DAY I
14:00–15:30
CAPELLA

T5. POWER ELECTRONICS – ANALYSIS, MODELING, AND DESIGN

Chairs: *Mattia Ricco, Alon Kuperman*

Probabilistic Approach for the Study of Neutral Current Ripple in Split-Capacitor Inverters
Riccardo Mandrioli, Lohith Kumar Pittala, Vincenzo Cirimele, Mattia Ricco, and Gabriele Grandi

Comparison of Military Handbook and the FIDES Methodology for Failure Rate Estimation of Modular Multilevel Converters
Miad Ahmadi, Aditya Shekhar, and Pavol Bauer

A Visual Method to Compare Balancing Algorithms for Modular Multilevel Converters Integrating Batteries
Marzio Barresi, Davide De Simone, Luigi Piegari, and Rafael Souza Baquero

Input Current of H-bridge Inverters with Asymmetric Switch Parameters for Wireless Power Transfer Applications
Mattia Simonazzi, Leonardo Sandrolini, and Alessandro Campanini

Converter Averaging Approach for Modeling a Residential Supply Subsystem
Luis Martinez-Caballero, Radek Kot, Adam Milczarek, and Mariusz Malinowski

Real-Time Thermal Evaluation of Power Converters in Microgrids by Device Current Reconstruction
Yubo Song, Subham Sahoo, Yongheng Yang, Frede Blaabjerg, and Yun Wei (Ryan) Li

Day I 14:00–15:30 **Vega**	**T6. Energy Storage Systems** **Chairs:** *Andres Barrado, Aditya Shekhar* **Impact Assessment of Combined Compressed Air and Latent Heat Storage Systems on Gas Turbines** Tony Karam, Chantal Maatouk, and Elias Al Sarraf **Insight into the Characterization of Sea-Salt Batteries** Sang Jae Kouwenberg, Joel Alpízar-Castillo, Laura Ramírez-Elizondo, and Pavol Bauer **Impact of Load Simultaneity and Battery Layout on Sizing of Batteries for Preventing Grid Overloading** Christian van Someren, Martien Visser, and Han Slootweg **The Effect of Multi-Stage Constant Current Charging on Lithium-ion Battery's Performance** Muhammad Usman Tahir, Ariya Sangwongwanich, Daniel-Ioan Stroe, and Frede Blaabjerg **Energy Storage for Export Limitation Mitigation and Capacity Factor Enhancement in GB: A Case Study** Andrew. J. Hutchinson, and Daniel. T. Gladwin **Li-ion Battery Digital Twin Based on Online Impedance Estimation** Abhijit Kulkarni, Hoda Sorour, Yusheng Zheng, Xin Sui, Arman Oshnoei, Nicolai André Weinreich, and Remus Teodorescu
Day I 15:30–17:00 **Sirius**	**T7. Power Electronics – Applications** **Chairs:** *Ilya Galkin, Oleksandr Husev* **Application of a Multiphase Interleaved DC-DC Converter for Power-to-Hydrogen Systems** Filippo Pellitteri, Nicola Campagna, Rosalinda Inguanta, and Rosario Miceli

Day I 15:30–17:00 **Sirius**	**Output Voltage Regulation of Isolated PV-Connected Boost Converters with Variable Loads Using Converted Hysteresis Sliding Mode Controller** Mahdi Zolfaghari, Afshin Zolfaghari, Gevork. B. Gharehpetian, Roya Ahmadiahangar, and Argo Rosin **Design of Frequency Bounded IWPT Systems under Sub-Resonant Control for Improved Misalignment Tolerance** Andrey Vulfovich, Moshe Sitbon, and Alon Kuperman **A Review of Wireless Charging Systems for Cardiac Pacemakers** Víctor Hueros, Andrés Barrado, Antonio Lázaro, and Cristina Fernández **Initial Evaluation of Multiport Power Supply System for Medical Lighting Equipment** Alexander Bubovich, Pavels Suskis, and Ilya A. Galkin **Inverters for Power Systems with Renewable Sources: Basic Topologies and Purposes** Iuliia Yamnenko, Tetiana Tereshchenko, Ihor Fedin, Edivan Laercio Carvalho, Yuliia Kozhushko, and Oleksandr Bondarenko
Day I 15:30–17:00 **Capella**	**T8. Power Electronics – Components and Devices** **Chairs:** *Kasper M. Paasch, Oleksandr Matiushkin* **Comparison of Methods for Measuring the Turn-Off Energy of SiC FETs** Paweł Górecki, Krzysztof Górecki, and Jacek Rąbkowski **A Three-Level Voltage-Source Gate Driver for SiC MOSFETs in Synchronous Rectification Mode** Andreas Giannakis, Daniel A. Philipps, Andrei Blinov, and Dimosthenis Peftitsis

Day I 15:30–17:00 **Capella**	**Performance Analysis of Protection Methods in Residential DC Microgrid** Tanel Jalakas, Satish Naik Banavath, Andrii Chub, Indrek Roasto, and Dmitri Vinnikov **Single-Stage Single-Switch Curved Air Gap PFC Integrated Flyback Transformer Design** Wai Keung Mo, Kasper M. Paasch, and Thomas Ebel **Influence of Selected Factors on the Parameters of a Compact Thermal Model of an Air Transformer** Krzysztof Górecki and Kalina Detka
Day I 15:30–17:00 **Vega**	**SS1. Advanced Control Techniques for Power Electronics Converters** **Chairs:** *Sertac Bayhan, Naki Guler* **Comparison of Decoupling Control Strategies for Multiple Active Bridge DC-DC Converter** Yicong Cai, Giampaolo Buticchi, Chunyang Gu, Jing Li, Edivan Laercio Carvalho, and He Zhang **Optimized Pulse Patterns for Anisotropic Synchronous Machines** Eleftherios Kontodinas, Petros Karamanakos, Andreas Kraemer, and Sebastian Wendel **Single Loop Controller for T-Type Rectifier and Dual Active Bridge Converter** Ali Sharida, Sertac Bayhan, and Haitham Abu-Rub **Improving Dynamic Response of Grid-Connected Converters with Electronic DC Links** Pavel Strajnikov, Alexander Abramovitz, Alon Kuperman

Day I 15:30–17:00 **Vega**	**Lyapunov-Function Based Control Technique for a Single-Phase Grid-Connected Five-Level Active Neutral Point Clamped Flying Capacitor Inverter with LCL Filter** Ugur Fesli, Sertac Bayhan, Naki Guler, and Hasan Komurcugil **Sliding Mode Control Based on Super Twisting Algorithm for Single-Stage On-Board Charger** Naki Guler, Hasan Komurcugil, Sertac Bayhan, Dmitri Vinnikov, and Andrei Blinov
Day I 19:30–22:30	**Welcome Reception** **Energy Discovery Center** **Põhja pst 29, 10415 Tallinn**

DAY II – JUNE 15

IES SYP Morning **Moderator:** *Edivan Carvalho*	
Day II 8:00–9:00 **Expo**	**Ice-Breaking Coffee with Power Snacks**
Day II 9:00–9:30 **Sirius**	**Keynote III** **Envisioning the Future Renewable and Resilient Energy Grids — a Power Grid Revolution Enabled by Renewables, Energy Storage, and Power Electronics** *Chen-Ching Liu, Virginia Tech, USA* *Fang Z. Peng, Florida State University, USA*
Day II 9:30–10:00 **Sirius**	**Keynote IV** **Smart Battery — The Next Generation of Battery Management Technology!** *Remus Teodorescu, Aalborg University, Denmark*
Day II 10:00–10:30 **Sirius**	**Keynote V** **Digital Energy** *P. Bauer, TU Delft, The Netherlands*
Day II 10:30–11:00 **Sirius**	**IES SYPA 3-min Speeches**
Day II 11:00–12:00 **Expo**	**SYP Mentoring Session with Coffee**

Day II 12:00–13:00 **Sirius**	**T9. Transportation Electrification** **Chairs:** *Pietro Tricoli, Riccardo Mandrioli* **Stationary Fuel Cell Power Supply for Railway Electrification Systems** Steffen Roth and Pietro Tricoli **High-Precision Model for Accurate Simulation of Trolleybus Grids: Case Study of Bologna** Riccardo Barbone, Riccardo Mandrioli, Rudolf F. P. Paternost, Mattia Ricco, and Gabriele Grandi **Analytical Study of Open-Ended Winding Induction Machines Supplied by Fuel Cells and Batteries for Hydrogen Trains** Hakime Hanife Goren and Pietro Tricoli **Concept of Energy Management System for the Fast EV Charger with Battery Storage** Krzysztof Kalinowski, Jacek Rąbkowski, Rafał Miśkiewicz, Radosław Sobieski, and Dimosthenis Peftitsis
Day II 12:00–13:00 **Capella**	**T10. Grid-Connected Converters** **Chairs:** *Shan He, Meng Chen* **Predictive Control for Isolated Matrix Rectifier Without Current Distortion at Sector Boundary** Pietro Emiliani, Andrei Blinov, Giovanni De Carne, Gabriele Arena, and Dmitri Vinnikov **Improved Damping Control of Grid-forming Inverter Using DC Dynamics** Meng Chen, Dao Zhou, and Frede Blaabjerg

Day II 12:00–13:00 **Capella**	**Design-Oriented Dissipativity Enhancement for Single-Loop Voltage Control of Grid-Forming VSCs** Shan He and Frede Blaabjerg **Analysis of X/R Ratio Effect on Stability of Grid-Following and Grid-Forming Converters** Xian Gao, Dao Zhou, Amjad Anvari-Moghaddam, and Frede Blaabjerg
Day II 12:00–13:00 **Vega**	**T11. Power Quality and Electromagnetic Compatibility** **Chairs:** *Satish Naik Banavath, Kaspars Kroics* **An Improved Three-Phase Transformerless Neutral Point Clamped Inverter Topology for Common Mode Voltage Reduction** Jamil Hassan, Victor Minambres-Marcos, Fermin Barrero-Gonzalez, and Anas Abdullah Alvi **Analysis of Performances of Single-Phase PV Transformer-Less Inverters for Compliance with the New Standards CEI 0-21and IEEE 1547-2018** Rosa Anna Mastromauro **Load Current Harmonic Model Complexity Reduction through Empirical Pattern Analysis** Kamran Daniel, Lauri Kütt, Muhammad Naveed Iqbal, Noman Shabbir, Marek Jarkovoi, and Martin Parker **Design Considerations of Common Mode and Differential Mode EMI Input Filter Based on Planar Ferrite Core** Kaspars Kroics
Day II 13:00–14:00 **Nomel**	**Lunch & Networking**

Day II 14:00–16:00 **Sirius**	**T12. Renewable Energy and Smart Grids** **Chairs:** *Juri Belikov, Michel Piliougine Rocha* **Multi-Factor Modelling of Electric Grids for Social and Technical Impact Studies** Rafael Marentes-Ortiz, Franck Sellier, Fei Gao, Joao Martins, and Ylenia Curci **An Enhanced NN-based Load Frequency Control Design of MGs: A Fractional Order Modeling Method** Vjatseslav Skiparev, Komeil Nosrati, Juri Belikov, Aleksei Tepljakov, and Eduard Petlenkov **Power Quality Management in Microgrids for Mission Critical NZEBs: A Case Study** Joaquin Garrido-Zafra, Aurora Gil-de-Castro,Antonio Moreno-Munoz, Emilio J. Molina-Martínez, Fco. Javier López-Alcolea, and Alfonso Parreño Torres **Resilience Metrics Applied to Renewable Energy Communities** Adriana Mar, Pedro Pereira, and João F. Martins **Risk-Averse Estimation of Electric Heat Pump Power Consumption** Nikolaos Damianakis, Gautham Chandra Ram Mouli, and Pavol Bauer **Estimation of the Power of a Thermoelectric Harvester for Low and Ultra-Low Temperature Gradients Using a Dimensional Analysis Method** Simon Lineykin, Alon Kuperman, and Moshe Sitbon **Identification of Static and Dynamic Parameters of PV Models through Multi-Objective Optimization** Luis Enrique Garcia Marrero, Rudy Alexis Guejia-Burbano, Giovanni Petrone, Michel Piliougine, and Eric Monmasson

Day II 14:00–16:00 **Sirius**	**Performance Evaluation of a Three-Phase PV Power Plant under Unbalanced Conditions with Islanding Detection Reliability Test** Anas Abdullah Alvi, Enrique Romero-Cadaval, Eva González-Romera, Dmitri Vinnikov, and Jamil Hassan
Day II 14:00–16:00 **Capella**	**T13. Power Electronics – Control, Modulations, and Communication** **Chairs:** *Cristian Garcia, Freddy Flores-Bahamonde* **Predictive Control Using Virtual Voltage Vectors for Three-Level Neutral-Point Clamped Inverters with Constant Common-Mode Voltage** Majid Akbari, S. Alireza Davari, Reza Ghandehari, Freddy Flores-Bahamonde, Cristian Garsia, and Jose Rodriguez **FCS-Model Predictive Control of a Quadratic Buck Converter for More Efficient Data Centers** Shirin Azadi, F. Flores-Bahamonde, S. Alireza Davari, C. A. Torres-Pinzon, Andrii Chub, and J. Rodríguez **Circulating Current Elimination in Parallel Operation of Non-Isolated AC-DC 4-Leg Converters** Cezary Soból and Adam Milczarek **A Dual-Output NPC-Type Converter with a Model Predictive Controller with Compensation of DC Capacitor Voltage Imbalance** Joaquim Monteiro, V. Fernão Pires, J. Fernando Silva, and Sónia Pinto **Comparison of Several Modulation Strategies for the Four Switch Buck-Boost converter** Víctor Díaz, Andrés Barrado, Antonio Lázaro, and Pablo Zumel

Day II 14:00–16:00 **Capella**	**Three-Level Optimized Pulse Patterns with Zero Common-Mode Voltage** Isavella Koukoula, Petros Karamanakos, and Tobias Geyer **Control Strategy of Hybrid Energy Storage System for High-Dynamic Load Changes** Adam Milczarek and Luis Martinez-Caballero **A Review of Communication Protocols and Control Strategies in DC Microgrids: An Experimental Validation Focus** Antonio Veliz, Sebastian Riffo, Carlos Restrepo, Marco Rivera, Alejandro Garces-Ruiz, Andrii Chub. Catalina Gonzalez-Castano, and Freddy Flores-Bahamonde
Day II 14:00–16:00 **Vega**	**SS11. Demand Side Flexibility and Energy Management** **Chairs:** *João Martins, Younes Zahraoui* **Q-Learning Routing Protocol Applied to Energy Internet for Power Distribution** Amani Fawaz, Imad Mougharbel, and Hadi Y. Kanaan **Sensitivity Analysis of Day-Ahead Energy Management Strategies under Variant Resolution Mission Profiles** Xiangqiang Wu, Zhongting Tang, and Tamas Kerekes **Stochastic Energy Management for Battery Storage System-Based Microgrid Considering Different Forecasting Models** Younes Zahraoui, Tarmo Korõtko, Argo Rosin, and Roya Ahmadiahangar **Virtual Energy Storage Model of Ventilation System for Flexibility Service** Vahur Maask, Argo Rosin, and Tarmo Korõtko

Day II 14:00–16:00 **Vega**	**Exploratory Data Analysis for Demand-side Flexibility Quantification** Arqum Shahid, Roya Ahmadiahangar, Argo Rosin, Vahur Maask, and João Martins **Review and Indication of Key Activities for Energy Management Improvement in DC Microgrids** Kawsar Nassereddine, Marek Turzynski, and Ryszard Strzelecki **Cooperative Control of Flywheel Energy Storage System and Diesel Generator for Frequency Regulation of Microgrids Using Digital FIR Filters** Mahdi Faraji, Mohammad Saeed Mahdavi, G. B. Gharehpetian, Roya Ahmadiahangar, and Argo Rosin **Digital Twins for Designing Energy Management Systems for Microgrids: Implementation Example Based on TalTech Campulse Project** Tarmo Korõtko, Younes Zahraoui, Argo Rosin, and Hannes Agabus
Day II 16:00–17:30 **Sirius**	**T14. Multilevel Converters** **Chairs:** *Jacek Rabkowski, Satish Naik Banavath* **Five-Level Standalone Neutral Point Clamped Rectifier with Time Division Multiplexing-based Voltage Balancing Control and Active PFC** Eli Barbie, Dmitry Baimel, and Alon Kuperman **Hardware Design and Development of Modular Multilevel Converter** Kumar Mayank, Atul Verma, Somnath Meikap, Hrishikesan V. M., and Chandan Kumar

Day II 16:00–17:30 **Sirius**	**Minimum DC Link Capacitance for a Family of Three-Phase Three-Level Grid-Connected Converters Operating with Unity Power Factor** Yarden Siton, Alexander Abramovitz, Martin Mellincovsky, Moshe Sitbon, Simon Lineykin, and Alon Kuperman **Experimental Evaluation of Inductor Configurations and Modulation Techniques in an Interleaved Three-Level DC/DC SiC-Based Converter** Rafał Kopacz, Michał Harasimczuk, Jacek Rąbkowski, and Radosław Sobieski **Modular Multilevel Converters Enabling Multibus DC Distribution** Mahyar Hassanifar, Hrishikesan V. M., Jun-Hyung Jung, Sattar Bazyar, Hamzeh Beiranvand, Thiago Pereira, Marius Langwasser, and Marco Liserre
Day II 16:00–17:30 **Capella**	**SS5-1. Future-Proof Power Electronic Systems and Control for Residential Microgrids - Energy Management and Supply Reliability** **Chairs:** *Edivan Carvalho, Armando Cordeiro* **Reliability Assessment of Photovoltaic Buck-Boost Microconverter for Estonian Climate Conditions** Abualkasim Bakeer, Andrii Chub, and Dmitri Vinnikov **Optimized Energy Scheduling of Residential DC Building: Case of Nordic Climate** Aleksandra Sidorova, Andrei Blinov, Roya Ahmadiahangar, Dmitri Vinnikov, Karl-Villem Võsa, and Jarek Kurnitski **Generative Adversarial Network and CNN-LSTM Based Short-Term Power Load Forecasting** Yushan Liu, Zhouchi Liang, Xiao Li, and Abualkasim Bakeer

Day II 16:00–17:30 **Capella**	**Effects of Voltage Transients on the DC Droop Control in Residential Nanogrids** Indrek Roasto, Andrei Blinov, Dmitri Vinnikov, and Tanel Jalakas **Energy Storage and Forecasting Error Impact Analysis in Photovoltaic Equipped Residential Nano-Grids** Hossein Nourollahi Hokmabad, Oleksandr Husev, Juri Belikov, Dmitri Vinnikov, and Eduard Petlenkov **Bidirectional SSCB for Residential DC Microgrids with Reduced Voltage and Current Stress during Fault Interruption** Aditya P, Satish Naik Banavath, Alessandro Lidozzi, Andrii Chub, and Dmitri Vinnikov
Day II 16:00–17:30 **Vega**	**SS7. Advanced Control of Grid-Connected Converters for Distributed Generation and Power Quality** **Chairs:** *Hadi Kanaan, Szymon Piasecki* **Detection of Harmonics and Interharmonics by Using Cascaded Limit Cycle Oscillators** Erick Vazquez, Javier Roldan-Perez, and Milan Prodanovic **LV Distribution Grid Stabilisation Using Energy Storage System** Szymon Piasecki, Krzysztof Szaniawski, Jaroslaw Zaleski, Rozmyslaw Mienski, Pawel Kelm, Marek Jasinski, and Yu-Chen Chang **Aggregate Model of Parallel Distributed Energy Resources Controlled using Virtual Admittance** Dionysios Moutevelis, Javier Roldan-Perez, and Milan Prodanovic **Impedance Modeling and Stability Analysis for the PLL-Less and Voltage Sensor-Less Grid-Tied Converters** Yuchen He, Bokang Zhou, Yuan Li, and Fang Z. Peng

Day II 16:00–17:30 **Vega**	**Switching-Cycle-Based Startup for Grid-Tied Inverters** Yuchen He, Yuan Li, Bokang Zhou, and Fang Z. Peng **Efficient SEPIC Differential Mode Inverter with New Feedforward Control Technique for Selective Harmonic Compensation** Ahmed Shawky, Mokhtar Aly, Abualkasim Bakeer, and Jose Rodriguez
Day II 20:00–23:00	**Gala Dinner** **Seaplane Harbour – Estonian Maritime Museum** **Vesilennuki 6, 10145 Tallinn**

DAY III – JUNE 16

DAY III 9:00–9:30 **SIRIUS**	**KEYNOTE VI** **Surface Power Delivery – The Future of High-Performance Computing** *José A. Cobos, Universidad Politécnica de Madrid, Spain* **Moderator:** *Oleksandr Husev*
DAY III 9:30–10:00 **SIRIUS**	**KEYNOTE VII** **Principles of Wireless Power Transfer in Applications with "Almost Known" Coupling** *Alon Kuperman, Ben-Gurion University of the Negev, Israel* **Moderator:** *Andrei Blinov*
DAY III 10:00–11:30 **SIRIUS**	**SS5-2. FUTURE-PROOF POWER ELECTRONIC SYSTEMS AND CONTROL FOR RESIDENTIAL MICROGRIDS – CONVERTERS** **Chairs:** *Edivan Carvalho, Armando Cordeiro* **Multi-Mode PWM Modulator for a 4-Switch DC-DC Converter Operating with Tri-State** Qiong Wang and Luiz A. C. Lopes **Back-to-Back Energy Router Based on Common-Ground Inverters** Mohammadreza Azizi, Saeed Rahimpour, Oleksandr Husev, and Oleksandr Veligorskyi **Bidirectional EV Charger Integration into LV DC Traction Grid** Mykola Lukianov, Ievgen Verbytskyi, Enrique Romero Cadaval, and Ryszard Strzelecki

Day III 10:00–11:30 **Sirius**	**Operation of the Step-Up/Down Bidirectional Partial Power Converter Near Zero Series Voltage** Naser Hassanpour, Andrii Chub, Andrei Blinov, and Dmitri Vinnikov **Feasibility Study of Universal Power Electronics Interface Operation in 350 V and 700 V Residential DC Microgrids** Vadim Sidorov, Andrii Chub, and Dmitri Vinnikov **Evaluation of Dual-Active Bridge Converter for DC Energy Buildings** Edivan Laercio Carvalho, Andrei Blinov, Aleksandra Sidorova, Andrii Chub, and Dmitri Vinnikov
Day III 10:00–11:30 **Capella**	**T15. Mechatronics** **Chairs:** *Anton Rassõlkin, Toomas Vaimann* **Persistent Continuous Surveillance of Remote Local Objects by Multirotor UAVs** Oleksandr Veligorskyi, Andrii Los, and Roustiam Chakirov **Analysis of Motion Cueing Performance of Large Range Robotic Motion Simulator: A Luge Sports Simulator Case Study** Andrejs Stupans, Pavels Maksimkins, Armands Senfelds, and Leonids Ribickis **ISEAUTO Self-Driving Vehicle Dynamic Model Verification** Viktor Rjabtšikov, Mahmoud Ibrahim, and Vladimir Kuts **Hyperspectral Imaging for Vehicle Traction Effort Prediction: ISEAUTO case study** Daniil Valme, Anton Rassõlkin, and Dhanushka C. Liyanage **Vehicle Energy Management System: A Survey** Jessica G. Maradey Lázaro, Arly D. Rincón Quintero, Gianina G. Silva, and Rolando A. Gilbert Zequera

	SS5-3. Future-Proof Power Electronic Systems and Control for Residential Microgrids - Topologies **Chairs:** *Edivan Carvalho, Armando Cordeiro*
	A Fault Tolerant Converter for a SRM Drive Based on a Nine-Switch Inverter with a Dual Output V. Fernão Pires, Daniel Foito, A. J. Pires, Armando Cordeiro, and J. F. Martins
	Electric Vehicle Integrated Charger Based on a Multilevel Dual-Output Nine-Switch Converter Armando Cordeiro, Miguel Chaves, Pedro Fonte, Paulo Gâmboa, Ricardo Luís, J. Fernando Silva, V. Fernão Pires, Daniel Foito, and João F. Martins
Day III 11:30–13:00 **Sirius**	**A Comparison between Three-Phase Conventional Two-Stage AC-DC and Single-Stage Matrix Converter Approaches** Parham Mohseni, Pietro Emiliani, Oleksandr Husev, Dmitri Vinnikov, and Laurens Mackay
	Wide Output Voltage Range Isolated Buck-Boost PFC Converter with Reconfigurable Rectifier Ievgen Verbytskyi, Mohammad Mahad Nadeem, Andrei Blinov, Andrii Chub, and Dmitri Vinnikov
	Three-Phase Four Wire High-Frequency Link Converter for Residential DC Grids Pietro Emiliani, Andrei Blinov, Giovanni De Carne, Gabriele Arena, and Dmitri Vinnikov
	A Novel Isolated Buck-Boost DC-DC Converter with Wide Range of Voltage Regulations Hossein Afshari, Oleksandr Husev, and Dmitri Vinnikov

Day III 11:30–13:00 **Capella**	**T16. Electromobility - Components and Control** **Chairs:** *Toomas Vaimann, Anton Rassõlkin* **Light-Weight Communication Fault Tolerant OCPP-Based EV Supply Equipment** Naheel Faisal Kamal, Ali Sharida, Sertac Bayhan, and Haitham Abu-Rub **Multiple Receiver Dynamic Wireless Power Transfer: Economic Advantages and Technical Considerations** Nicola Campagna, Rosario Miceli, Patrizia Livreri, Francesco Piran, and Stanimir Valtchev **Simulation Study of Processes in Electric Vehicles under Braking Control Based on Reinforcement Learning** Valery Vodovozov, Zoja Raud, and Eduard Petlenkov **EV-Permanent Magnet Synchronous Motor Control Strategy Evaluation Based on Digital Twin Concept** Mahmoud Ibrahim and Viktor Rjabtšikov **Clustering and Outlier Analysis for Key Performance Indicators in Battery Energy Storage Systems Applications** Rolando Antonio Gilbert Zequera, Anton Rassõlkin, Toomas Vaimann, and Ants Kallaste	
Day III 13:00–13:30 **Sirius/Expo**	**Closing Session and**	**Farewell Coffee with Snacks**

KEYNOTE I

Power Electronics as the Enabling Technology for a Modern Carbon Neutral Society

Frede Blaabjerg
Aalborg University
Denmark

Frede Blaabjerg (S'86–M'88–SM'97–F'03) was with ABB-Scandia, Randers, Denmark, from 1987 to 1988. From 1988 to 1992, he got the PhD degree in Electrical Engineering at Aalborg University in 1995. He became an Assistant Professor in 1992, an Associate Professor in 1996, and a Full Professor of power electronics and drives in 1998 at AAU Energy. From 2017 he became a Villum Investigator. He is honoris causa at University Politehnica Timisoara (UPT), Romania in 2017 and Tallinn Technical University (TTU), Estonia in 2018.

His current research interests include power electronics and its applications such as in wind turbines, PV systems, reliability, harmonics and adjustable speed drives. He has published more than 600 journal papers in the fields of power electronics and its applications. He is the co-author of four monographs and editor of ten books in power electronics and its applications.

He has received 38 IEEE Prize Paper Awards, the IEEE PELS Distinguished Service Award in 2009, the EPE-PEMC Council Award in 2010, the IEEE William E. Newell Power Electronics Award 2014, the Villum Kann Rasmussen Research Award 2014, the Global Energy Prize in 2019 and the 2020 IEEE Edison Medal. He was the Editor-in-Chief of the IEEE TRANSACTIONS ON POWER ELECTRONICS from 2006 to 2012. He has been Distinguished Lecturer for the IEEE Power Electronics Society from 2005 to 2007 and for the IEEE Industry Applications Society from 2010 to 2011 as well as 2017 to 2018. In 2019-2020 he served as a President of IEEE Power Electronics Society. He has been Vice-President of the Danish Academy of Technical Sciences.

He is nominated in 2014-2021 by Thomson Reuters to be among the most 250 cited researchers in Engineering in the world.

Abstract:

The global energy system is undergoing a significant transition in order to be carbon neutral – and with at least two consequences. The energy generation will be renewables and much more energy will be carried by electricity. In order to control electricity, we need electrical energy conversion and, thereby, the key enabling technology - Power Electronics. The presentation will discuss the power electronics technology, where it is applied and what are the main future challenges for the technology in the efforts to create a carbon neutral society – which is believed to be dominantly electrical based. Topics to be covered will be renewable energy systems, power-2-X and Reliable Power Electronic Based Power Systems.

KEYNOTE II

Materializing the Vision of "Flying Carpets" — Ultra-Lightweight/Efficient Power Electronics Enabling Future Urban Transport

JOHANN W. KOLAR
ETH Zürich
Switzerland

Johann W. Kolar is a Fellow of the IEEE, an International Member of the US NAE and a Full Professor and Head of the Power Electronic Systems Laboratory at the Swiss Federal Institute of Technology (ETH) Zürich.

He has proposed numerous novel converter concepts, incl. the Vienna Rectifier, spearheaded the development of x-million rpm motors, and pioneered fully automated multi-objective power electronics design procedures. He has supervised 85 Ph.D. students to completion, has published 1000+ IEEE journal and conference papers, 4 book chapters, and has filed 200+ patents.

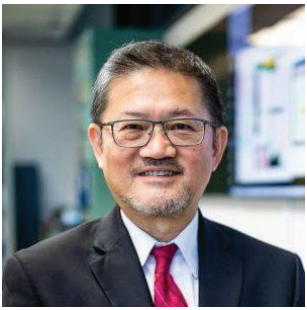
He has served as IEEE PELS Distinguished Lecturer from 2012 - 2016. He has received numerous awards, incl. 45 IEEE transactions and conference Prize Paper Awards, the 2016 IEEE William E. Newell Power Electronics Award, and 2 ETH Zurich Golden Owl Awards for excellence in teaching. The focus of his current research is on ultra-compact/efficient WBG converter systems, ANN-based design procedures, Solid-State Transformers, ultra-high speed drives, bearingless actuators, and life cycle analysis of power electronics converter systems.

Abstract:

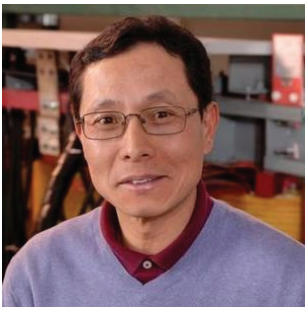
Urban Air Mobility (UAM) based on electric vertical take-off and landing (eVTOL) aircraft – a 21st century materialization of the legendary "Magic/Flying Carpet" – are based on multi-rotor or tilt-rotor/duct/wing designs, can carry four to six occupants and operate from vertiports without runways. Compared to terrestrial alternatives, this allows for a two- to six-fold faster means of point-to-point mobility. Aircraft electrification enables considerably higher overall efficiency as a larger number of small high-efficiency electric motors, i.e., distributed electric propulsion, can be used instead of conventional low-efficiency combustion-based propulsion architectures with few large units, resulting in reduced drag and greater flexibility to leverage the benefits of aero-propulsive coupling. Accordingly, urban and regional eVTOL aerial travel services are expected to massively expand over the next decades. The talk first introduces key eVTOL aircraft designs currently in the R&D, prototyping or production planning phases, discusses trade-offs of key performance indicators like range and payload using first-order principles and highlights critical enabling technologies like high gravimetric energy density and/or high-power-density batteries and fuel cells, low-specific-weight electric motors, and advanced power electronics. Hybrid battery/fuel cell power supplies of eVTOL aircraft enable high peak power capability as well as long-range operation. However, the typically wide and overlapping voltage ranges of the batteries and the fuel cells require interconnecting bidirectional DC-DC converters with buck-boost capability. Accordingly, the second part of the presentation comparatively evaluates performance limits of fully soft-switched, flying-capacitor-multilevel, and partial-power-processing buck-boost candidate converter topologies by means of comprehensive Pareto optimizations considering mission profile efficiency and gravimetric power density, and finally presents a 15kW 450V...730V / 480V...800V three-level flying capacitor converter module of a 150kW system featuring 98.5% efficiency and an unprecedented gravimetric power density of 62kW/kg. Finally, a summary of first assessments of the primary energy and Greenhouse Gas Emissions impacts of eVTOLs vs. ground-based light-duty vehicles for passenger mobility is presented, which surprisingly indicates partly higher energy efficiencies than equivalent terrestrial alternatives at faster and more predictable travel times, and indicates a possible niche role of eVTOLs in future sustainable urban transportation.

KEYNOTE III

Envisioning the Future Renewable and Resilient Energy Grids — a Power Grid Revolution Enabled by Renewables, Energy Storage, and Power Electronics



CHEN-CHING LIU
Virginia Tech
USA



FANG Z. PENG
Florida State University
USA

Chen-Ching Liu (Fellow, IEEE) is American Electric Power Professor and Director, Power and Energy Center, at Virginia Tech. During 1983-2017, he was on the faculty of University of Washington, Iowa State University, University College Dublin (Ireland), and Washington State University.

Professor Liu received an IEEE Third Millennium Medal in 2000 and the Power and Energy Society Outstanding Power Engineering Educator Award in 2004. He chaired the IEEE Power and Energy Society Fellow Committee, Technical Committee on Power System Analysis, Computing and Economics, and Outstanding Power Engineering Educator Award Committee. Professor Liu is the U.S. representative on the CIGRE Study Committee D2, Information Systems and Telecommunication.

He is a Life Fellow of the IEEE, Member of Virginia Academy of Science, Engineering, and Medicine, and Member of the U.S. National Academy of Engineering.

Fang Z. Peng (M'92–SM'96–F'05) received the B.S. degree in electrical engineering from Wuhan University, China, in 1983 and the M.S. and Ph.D. Degrees in electrical engineering from Nagaoka University of Technology, Japan, in 1987 and 1990, respectively.

From 1990 to 1992, he was a Research Scientist with Toyo Electric Manufacturing Company, Ltd., Japan, and engaged in the research, development, and commercialization of active power filters, flexible ac transmission system (FACTS) applications, and motor drives. From 1992 to 1994, he was a Research Assistant Professor at the Tokyo Institute of Technology, Japan, and he initiated a multilevel inverter program for FACTS applications and speed-sensorless vector control of motors. From 1994 to 2000, he was with the Oak Ridge National Laboratory, the Lead (Principal) Scientist for the Power Electronics and Electric Machinery Research Center from 1997 to 2000. In 2000, he became an Associate Professor at Michigan State University, where he founded and directed the Power Electronics and Motor Drives Center. He became a Full Professor in 2006 and was designated as a University Distinguished Professor in 2012.

Since 2018, Dr. Peng has been with Florida State University as the inaugural Distinguished Professor of Engineering.

Abstract:

Today's power grids are facing tremendous challenges and barriers in terms of the system complexity, infrastructure cost, "worst-case problem," knowledge base, and policy issues to achieve instant supply-demand power balance and resiliency with respect to extreme weather events and cyber-attacks, especially when the transition to 100% intermittent renewable energy sources is considered. To transform and revolutionize the existing power grids, we propose the concept of community-centric asynchronous renewable and resilient energy grids with Natural Source frequencies (NSf), energy storage, Direct energy Conversion and Fault protection (DeCaF), and high efficiency Energy Consumption and Buffering (heCaB) technology, to transform the existing synchronous power grids to asynchronous energy grids. The proposed energy grid concept has the potential to 1) greatly reduce power outages and power system restoration time, 2) increase energy delivery capacity by many folds with the existing power grid infrastructure, 3) achieve much more efficient integration of all-electric transportation to energy grids and increase renewable energy plus energy storage capacity to 100%. From device to the system level, we further explore the energy grid concept by preliminary investigation of NSf energy transmission, delivery, energy storage, power electronics-enabled DeCaF and heCaB device implementation, and system level issues such as community centric resilient networked microgrids and cyber security. Finally, we discuss important research topics for the proposed asynchronous energy grids.

KEYNOTE IV

Smart Battery — The Next Generation Of Battery Management Technology!

Remus Teodorescu
Aalborg University
Denmark

Remus Teodorescu (Fellow, IEEE) received the Dipl.Ing. degree in electrical engineering from the Polytechnical University of Bucharest, Bucharest, Romania, in 1989, Ph.D. degree in power electronics from the University of Galati, Romania, in 1994, and Dr.HC in 2016 from Transilvania University of Brasov. In 1998, he joined the Department of Energy Technology at Aalborg University, where he is currently a Full Professor. Between 2013 and 2017, he has been a Visiting Professor at Chalmers University.

He has been IEEE/PELS Fellow since 2012 for contributions to grid converters technology for renewable energy systems.

In 2022 he became a Villum Investigator and leader of Center of Research for Smart Battery at Aalborg University.

His main current research areas are: AI-based Smart Battery and Modular Multilevel Converters (MMC) for HVDC/FACTS

Abstract:

Lithium-ion batteries are extensively used in a wide range of applications from portable electronics to electric vehicles and grid storage systems. Although the performance parameters in terms of energy density and cost have almost met the targets, the still remaining challenges are improved safety and longer lifetime. Especially for battery packs with many cells, the degradation process is accelerated due to the difference between cells electrical characteristics leading to a limited lifetime and safety issues.

This keynote introduces the novel concept of Smart Battery that combines batteries with advanced power electronics and artificial intelligence (AI) with the purpose to develop a new generation of battery management solutions for transportation and grid storage with extended lifetime. The key feature is the bypass device, a half-bridge parallel to each cell, for cell-level load management without affecting the load. Bypassing cells results in pulsed current that is known to reduce the pace of the degradation mechanisms (LAM, LLI) leading to extended lifetime. The first step is to use the bypass device for high-efficiency balancing in more dimensions including SoC, SoT and SoH with some extended lifetime as a consequence. The second step is to show how a reward-based optimization like AI Reinforcement Learning, trained to recognize early signs of stressed cells and decide to insert optimal amount of relaxation time with significant lifetime extension as outcome. The smart battery technology is currently at proof of concept stage.

KEYNOTE V

Digital Energy

Pavol Bauer
TU Delft
The Netherlands

Pavol Bauer is currently a full Professor with the Department of Electrical Sustainable Energy of Delft University of Technology and head of DC Systems, Energy Conversion and Storage group. He is also professor in Czech Republic and honorary professor at Politehnica University Timisioira in Romania where he got also a honorary doctorate (Dr.h.c). From 2002 to 2003 he was working partially at KEMA (DNV GL, Arnhem) on different projects related to power electronics applications in power systems.

He published over 170 journal and over 500 conference papers in his field (with H factor Google scholar 54, Web of Science 40), he is an author or co-author of 8 books, holds 10 international patents and organized several tutorials at the international conferences. He has worked on many projects for industry concerning wind and wave energy, power electronic applications for power systems such as Smarttrafo; HVDC systems, projects for smart cities such as PV charging of electric vehicles, PV and storage integration, contactless charging; and he participated in several Leonardo da Vinci, H2020 and Electric Mobility Europe EU projects as project partner (ELINA, INETELE, E-Pragmatic, Micact, Trolly 2.0, OSCD, P2P, Progressus, Tulip, Flow) and coordinator (PEMCWebLab.com-Edipe, SustEner, Eranet DCMICRO). His main research interest is power electronics for charging of electric vehicles and DC grids.

He is a Senior Member of the IEEE ('97), former chairman of Benelux IEEE Joint Industry Applications Society, Power Electronics and Power Engineering Society chapter, chairman of the Power Electronics and Motion Control (PEMC) council, chairman of Benelux IEEE Industrial Electronics chapter, member of the Executive Committee of European Power Electronics Association (EPE) and also member of international steering committee at numerous conferences.

Abstract:

The shift towards an energy system based on renewable sources is a shift from a hierarchically controlled system with centralized generation to a system with less controllable fluctuating and distributed energy supply, with electricity as the main carrier of the generated energy. The challenge is to create an energy system that is open to diverse emerging and future technologies and organizational forms is fundamental. A key conceptual step here is digitization. **Digitization** allows us to separately consider technologies that make up the energy system, the organizations and citizens that make use of the services of the energy system and the mechanisms that govern their interactions. This is a significant step away from the current system, where these elements are highly dependent and determined by the constraints of the initial system configuration. Simply put, the transition to variable renewable energy sources poses new challenges and requirements for the organization and control of the energy system, but also offers a great opportunity to build a novel energy system. The Digital Energy Framework is inspired by concepts like energy cells, energy conversion hubs, energy packets, virtualization, and energy communities (described below), and will allow trading, management, control, and organization of physical components by interactions within a digital variant of the energy system, which is flexible as most of its functions are software-defined. Scientific concepts for the **intelligent hardware** required for the integration of energy generation, storage, conversion, and transportation into digital energy concepts (inspired by energy cells and energy conversion hubs, among others) are developed. It focuses on designing and analyzing the intelligent hardware that enables and facilitates the physical formation of digital energy concepts (energy cells, energy conversion hubs, virtualization, energy communities) and integrates them in the existing power system. Furthermore, this intelligent hardware enables the intelligent algorithms to control and coordinate the energy system and achieve the desired techno-economical, legal and social objectives. For the interconnected digital energy technologies and infrastructure (energy cells, energy conversion hubs, etc.) to achieve sustainability, modularity and intelligence, novel concepts for the generation, conversion, storage and transportation of renewable energy are required. Within the energy cells and energy conversion hubs, it is anticipated that solar energy, electrochemical conversions, power electronic converters, various forms of energy storage and dc links will play pivotal roles in achieving the desired objectives.

KEYNOTE VI

Surface Power Delivery – the Future of High-Performance Computing

José A. Cobos
Universidad Politécnica de Madrid
Spain

José Antonio Cobos (Fellow, IEEE) is a Full Professor with the Universidad Politécnica de Madrid and Founder of the company DPx (Differential Power S.L.). He was RCC Fellow at Harvard University and Fulbrighter at UC Berkeley. His contributions are focused on the field of power supply systems for industrial, aerospace, telecom, automotive, renewable energy and medical applications. His research interests include energy efficiency in digital systems and RF amplifiers, magnetic components, piezoelectric transformers, transcutaneous energy transfer and the generation of EM fields for water supercooling and biomedical applications. He advised over 50 Master Thesis, 16 Doctoral dissertations, published 300+ technical papers and holds patents co-authored with 8 companies. He conducted professional seminars and tutorials in USA, UK, Austria, Germany, Italy, Sweden, Switzerland, Syria, Mexico, Denmark, Macedonia and China. In 2006, he was the founder Director of the “Centro de Electrónica Industrial, CEI-UPM”, a university research center leading a strong industrial program in power electronics and digital systems. In 2016, he was the founder President of the “Industrial Council @ CEI” to coordinate Education & Research with Industry. In 2019, he started DPx, a startup from UPM to synthesize advanced power converters for high-performance computing.

Abstract:

High-performance computing requires high performance dc-dc power converters, supplying low voltages 0.5-1.2V with AVS (adaptive voltage scaling), high current (up to 2000A) with very demanding load steps (up to 5000A/us) and very high and variable voltage gain (from 40 to 120) to regulate an input voltage in the range 40-60V. Low losses (peak efficiency >97%) and high surface current density (>1A/mm2) complete these high-performance requirements. Proposed “SURFACE power delivery” is an extension of the “VERTICAL power delivery” trend that is replacing “LATERAL power delivery” in high current applications to reduce copper losses in the power delivery path. Three novel concepts are described in this talk: a) “extended duty cycle” (60-95%) in both primary and secondary power switches; b) “segmented winding transformer, SWT” and c) “edge dynamics”. These three concepts are implemented in a novel “Direct Power Converter with High Voltage inside, DPx-HV”.

KEYNOTE VII

Principles of Wireless Power Transfer in Applications with "Almost Known" Coupling

Alon Kuperman
Ben-Gurion University of the Negev
Israel

Alon Kuperman (Senior Member, IEEE) is a Full Professor with the School of Electrical and Computer Engineering, Ben-Gurion University of the Negev, Beer-Sheva, Israel, and the Director of Applied Energy Laboratory. He holds multiple international patents and owns an independent consultancy services company. He is also a co-founder of two start-up companies focusing on wireless power transfer. His research interests include all aspects of energy conversion and applied control.

Abstract:

Inductive wireless power transfer technology is rapidly gaining popularity nowadays, being applied in systems where conventional power transfer is impossible or undesirable. In some applications (e.g., power transfer through rigid barriers, electric vehicles charging with automatic alignment, etc.) coil's coupling coefficient remains nearly constant and thus "almost known," allowing the inductive wireless power transfer link to be simplified while theoretically attaining load-independent voltage/current output without feedback. However, the range of attainable output current/voltage values is typically limited for a given input voltage. Moreover, practical effects such as parasitics and system nonlinearity under light loading may impose the use of feedback. Consequently, the talk focuses on operational principles and design trade-offs of inductive wireless power transfer links operating with "almost known" coupling.

IMPORTANT INFORMATION

Registration

The registration desk will be open between 17:00 and 20:00 on June 13, and from 08:30 on three days of the conference.

Conference Badges

Please always wear your participant badge for access to lunches and sessions.

Emergency contacts

For conference-related emergencies:

Dmitri Vinnikov: +372 51907446 **Andrii Chub:** +372 54592062

Ambulance: +372 6000 112 when calling in roaming.

Social Events

You MUST present the corresponding ticket from your conference package to gain entry to the social event.

Public Transportation and Taxi

Tallinn offers an extensive public transportation network. You can plan your journey by visiting **transport.tallinn.ee** and buy a ticket at **tallinn.pilet.ee.**

We recommend using **BOLT** app for getting a taxi at a reasonable fare – scan QR code:

Official taxis display their rates on a yellow sticker on the right rear window. Be sure to check it before you take a ride.

Weather

The weather looks very promising (as of June 7), but we still urge you to check the forecast daily as the weather could be intermittent in the Baltic Sea Region.

	Night	Morning	Afternoon	Evening	Max/Min Temp.	Precip.	Wind
June 12					23 / 10 °C	-	3 m/s
June 13					25 / 12 °C	-	3 m/s
June 14					25 / 13 °C	-	3 m/s
June 15					25 / 14 °C	-	3 m/s
June 16					25 / 15 °C	-	3 m/s
June 17					25 / 16 °C	-	3 m/s