



IEEE ENERGY CONVERSION CONGRESS & EXPO | PITTSBURGH, PA, USA | SEPTEMBER 14-18, 2014



# Your Bridge to a Clean and Sustainable Energy Future

## > PROGRAM

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**Dr. Ayman EL-Refaie**  
ECCE 2014 General Chair

Dear friends and colleagues,

Welcome to the city of Pittsburgh, Pennsylvania and the Sixth Annual IEEE Energy Conversion Congress and Exhibition (ECCE 2014), *“Your Bridge to a Clean and Sustainable Energy Future”*.

Pittsburgh is ranked as America’s “Most Livable City”. Once a center for heavy industry, today Pittsburgh’s skyline has been transformed. Riverfronts are thoughtfully developed, utilized for recreation now more than ever. Businesses look to the environment as an asset, not a challenge. And, best of all, “green” has replaced “smoky” for good. This is very fitting with the ECCE 2014 theme of clean and sustainable energy future. The following words best summarize the magnitude of transformation Pittsburgh has experienced:

“Pittsburgh was a perfect venue for this work (G20 Pittsburgh Summit) ... It serves as a model for turning the page to a 21st century economy, and a reminder that the key to our future prosperity lies not just in New York or Los Angeles or Washington — but in places like Pittsburgh.”

— **President Barack Obama**  
remarks at closing G20 press conference, September 25, 2009

# Your Bridge to a Clean and Sustainable Energy Future

The conference venue is the David L. Lawrence Convention Center which raises the bar to a new level for meeting and exhibit space, services and amenities. Located in the hub of Pittsburgh’s cultural, business and entertainment district, the Center effectively blends unparalleled functionality with cutting-edge technology to offer meeting planners, exhibitors and attendees an unforgettable meeting experience.

Pittsburgh has a very strong IEEE section that hosted the highest attended IEEE PES conference, with over 2,300 attendees. Pittsburgh also previously hosted the IAS Annual Meeting in 2002. Pittsburgh is historically the home of Westinghouse Electric and so there is a very strong residual presence of George Westinghouse, Nikola Tesla and the Electrical Engineering field in the city.

Pittsburgh has a strong industry presence in the area of energy conversion including Westinghouse, Eaton, Siemens, and GE Power Conversion. Ansoft/Ansys is also located in Pittsburgh. There is also University of Pittsburgh: Center of Energy, The National Energy Technology Laboratory (NETL) as well as several Renewable Energy Equipment Manufacturers. This city has a broad and very healthy mix of big and small companies as well as national labs and educational institutes that will provide great support to ECCE 2014.

ECCE 2014 received a record number of 1,400 digests. Through the hard and dedicated work of all the volunteer reviewers, topic chairs, vice chairs and last but not least our technical program chairs, the conference will have a strong and diverse technical program.

This year's conference will build on ECCE 2013 as well as the previous versions of the conference in terms of presenting energy conversion solutions to the community. The conference will have twelve very timely tutorials covering the various areas of energy conversion including electrical machines, power converters, control, semiconductor devices, soft and hard magnetic materials as well as fast-growing applications like subsea electrification. There are four stellar keynote speakers. They will address several of the key trends and challenges in energy conversion including critical materials, effect of renewables in developing countries, battery technologies for transportation electrification and key innovations in high power electronics.

As usual, there is the lively and exciting exhibition program, including the popular Industrial Seminars, and student project presentations focused on the area of Emerging Technologies. It is expected that ECCE 2014 will also break the record for number of exhibitors. Special Topics sessions will serve the immediate needs of the practicing engineer with the state of the art solutions. The successful format of Town Hall Meetings that started at ECCE 2013 will continue. There are two exciting sessions covering two very timely topics which are wide bandgap devices and transportation electrification. As can be seen there are several consistent topics and themes that cut across the tutorials, plenary presentations, special sessions and the town hall meetings as well as the technical program.

As always, the technical sessions coalesce around two major thematic areas: those topics that are focused on broad Energy Conversion System solutions, and those that are more specifically focused on the Components and Subsystems solutions. There are smart grids, appliances, and buildings sessions alongside power semiconductor devices sessions, renewable energy systems sessions alongside electric machine sessions, transportation application sessions alongside electric motor drive sessions, telecommunication system sessions alongside power converter sessions, energy harvesting sessions alongside component and sub-component packing sessions.

We have taken advantage of our presence in Pittsburgh and planned an exciting tour to Eaton Power Systems Experience Center (PSEC). This promises to be an outstanding tour. Based on all of this, the ECCE 2014 organizing committee is very proud and excited about the conference program and hope that it will meet your expectations.

I am indebted to the ECCE 2014 organizing committee, the vice chairs and topic chairs of the technical programs committee and the members of the exhibits committee for the hard work and long hours that they have put in voluntarily. Thanks are also due to the officers of the two sponsoring societies, PELS and IAS, for their steadfast support of the conference. A very enthusiastic thank you to the Courtesy Associates team who has supported ECCE since its inception, their assistance has been invaluable.

Finally, I would like to express our gratitude to our sponsors: ABB, our Platinum Partner, GE, our Gold Partner, and Halla Mechatronics our Silver Partner as well as our many other partners and exhibitors. Our mission would be impossible without your continued support.



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**Wen Soong**, University of Adelaide, Australia

**Pierluigi Tenca**, GE Global Research Europe, Germany

**Lixiang Wei**, Rockwell Automation, USA

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### Publicity Chair

**Shashank Krishnamurthy**, United Technologies Research Center, USA

### Social Media Chair

**Jennifer Vining**, Daimler Trucks, USA

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**Andy Knight**, University of Calgary, Canada

### Publications Chair

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### Students Activities

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### Townhall Chair

**Mohammad Islam**, Halla Mechatronics, USA

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**Burak Ozpineci**, Oak Ridge National Lab, USA

### Web Chair

**Yoon Ha**, USA

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**Lauren Deaton**, Courtesy Associates, USA

**Ella Greenberg**, Courtesy Associates, USA

**Timothy Thoms-Cappello**, Courtesy Associates, USA

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**Ayman EL-Refaie**, GE Global Research, USA

**Mohammad Islam**, Halla Mechatronics, USA

**Shashank Kristnamurthy**, United Technologies Research Center, USA

**Tomy Sebastian**, Halla Mechatronics, USA

**Kal Sen**, Sen Microelectronisc, USA

**Steve Sprague**, Proto Laminations, Inc., USA

**Jennifer Vining**, Daimler Trucks, USA

**Timothy Thoms-Cappello**, Exposition Manager, Courtesy Associates, USA

**Jessica Pachler**, Courtesy Associates, USA

## Program Subcommittees

### Renewable and Sustainable Energy Technologies

**Pedro Rodriguez** (Vice Chair), Abengoa Research, Spain

**Yilmaz Sozer** (Vice Chair), University of Akron, USA

**Bilal Akin**, University of Texas at Dallas, USA

**Javier Chivite**, Ingeteam Power Technology, Spain

**Seungdeog Choi**, University of Akron, USA

**Ahmed Elasser**, GE Global Research, USA

**Ion Etxeberria-Otadui**, IK4-Ikerlan, Spain

**Jesus Lopez**, Public University of Navarre, Spain

**Alvaro Luna**, Technical University of Catalonia, Spain

**Behrooz Mirafzal**, Kansas State University, USA

**Adel Nasiri**, University of Wisconsin-Milwaukee, USA

**Dezso Sera**, Aalborg University, Denmark

### Transportation Applications

**Ozpineci Burak** (Vice Chair), Oak Ridge National Laboratory, USA

**Carl Ho** (Vice Chair), ABB Switzerland Ltd., Switzerland

**Eric Cheng**, The Hong Kong Polytechnic University, Hong Kong

**Drazen Dujic**, École Polytechnique Fédérale de Lausanne (EPFL), Switzerland

**Shaahin Filizadeh**, University of Manitoba, Canada

**Guanghai Gong**, ABB Switzerland Ltd., Switzerland

**River Li**, ABB (China) Limited, China

**Udaya Madawala**, The University of Auckland, New Zealand

### Components, Packaging, Materials and Other Enabling Technologies

**Filippo Chimento** (Vice Chair), ABB Corporate Research, Sweden

**Shashank Krishnamurthy** (Vice Chair), United Technologies Research Center, USA

**Bram Ferreira**, University of Delft, Netherlands

**Yehui Han**, University of Wisconsin Madison, USA

**Jerry Hudgins**, University of Nebraska-Lincoln, USA

**Jelena Popovic**, University of Delft, Netherlands

**Angelo Raciti**, University of Catania, Italy

**Juan Rivas-Davila**, University of Stanford, USA

**Enrico Santi**, University of South Carolina, USA

**Jean-Luc Schanen**, University of Grenoble, France

**Adam Skorek**, Université du Québec, Canada

**Charles Sullivan**, Thayer School of Engineering at Dartmouth, USA

**Craig Winterhalter** (Vice Chair), Rockwell Automation, USA

**Smart Grid & Utility Applications**

Khurram Afridi (Vice Chair), University of Colorado Boulder, USA  
Luca Solero (Vice Chair), University Roma Tre, Italy  
Yang Wang (Vice Chair), United Technologies Research Center, USA  
Sandeep Bala, ABB Corporate Research, USA  
Rolando Burgos, Virginia Polytechnic Institute and State University, USA  
Petar Grbovic, HUAWEI Technologies, Germany  
Mahesh Illindala, Ohio State University, USA  
Qin Lei, General Electric Global Research Center, USA  
Alessandro Lidozzi, University Roma Tre, Italy  
Dragan Maksimovic, University of Colorado Boulder, USA  
Madhav Manjrekar, University of North Carolina at Charlotte, USA  
Omer Onar, Oak Ridge National Laboratory, USA  
Zhiguo Pan, ABB Corporate Research, USA  
David Perreault, Massachusetts Institute of Technology, USA  
Robert Pilawa-Podgurski, University of Illinois at Urbana-Champaign, USA  
Miaosen Shen, United Technologies Research Center, USA  
Yongsug Suh, Chonbuk National University, Korea  
Navid Zargari, Rockwell Automation, Canada

**Power Converter Topologies**

Faisal Khan (Vice Chair), University of Utah, USA  
Grant Pitel (Vice Chair), Magna-Power Electronics, USA  
Marcello Pucci (Vice Chair), ISSIA-CNR, Italy  
Pericle Zanchetta (Vice Chair), University of Nottingham, UK  
Norma Anglani, University of Pavia, Italy  
Sandeep Bala, ABB Corporate Research, USA  
Juergen Biela, ETH Zurich, Switzerland  
Stefano Bifaretti, University of Roma Tor Vergata, Italy  
Radu Bojoi, Politecnico di Torino, Italy  
Sarlioglu Bulent, University of Wisconsin-Madison, USA  
Braz Cardoso filho, Dep.to de Engenharia Elétrica, Brasil  
Patricio Cortes, ETH Zurich, Switzerland  
Rob Cuzner, DRS Power and Control Technologies, USA  
Maria Carmela Di Piazza, ISSIA -CNR, Italy  
Baoming Ge, Michigan State University, USA  
Junichi Itoh, Nagaoa University of Technology, Japan  
Philip Krein, University of Illinois at Urbana-Champaign, USA  
Marta Molinas, Norwegian University of Science and Technology, Norway  
Wei Qiao, University of Nebraska-Lincoln, USA  
Marco Esteban Rivera, University of Talca, Chile  
Lixin Tang, Oak Ridge National Laboratory, USA  
Jin Wang, The Ohio State University, USA  
Alan Watson, University of Nottingham, UK

**Control and Applications of Power****Converters**

Brian Welchko (Vice Chair), General Motors Company, USA  
Luca Zarri (Vice Chair), University of Bologna, Italy  
Mahshid Amirabadi, University of Illinois at Chicago, USA  
Federico Barrero, University of Sevilla, Spain  
Daniel Costinett, University of Tennessee, USA  
David Diaz Reigosa, University of Oviedo, Spain  
Dong Jiang, United Technologies Research Center, USA  
Madhav Manjrekar, The University of North Carolina at Charlotte, USA  
Sébastien Mariéthoz, ETH Zurich, Switzerland  
Antonio Marques Cardoso, University of Beira Interior, Portugal  
Rosa Anna Mastromauro, Technical University of Bari, Italy  
Michele Mengoni, University of Bologna, Italy  
Milijana Odavic, University of Sheffield, UK  
Jaedo Park, University of Colorado Denver, USA  
Sung Yeul Park, University of Connecticut, USA

**Electrical Machines**

Emmanuel Agamloh (Vice Chair), Advanced Energy, USA, USA  
Andy Knight (Vice Chair), University of Calgary, Canada, Canada  
Jonathon Bird, UNC Charlotte, USA  
Andrea Cavagnino, Politecnico di Torino, Italy  
Akira Chiba, Tokyo Institute of Technology, Japan  
Jessica Colton, Boulder Wind Power, USA  
Francesco Cupertino, Politecnico di Bari, Italy  
Giulio De Donato, Università di Roma, La Sapienza, Italy  
Abraham Gebregergis, Halla Mechatronics, USA  
Greg Heins, Regal Beloit, Australia  
Ed Lovelace, XL Hybrids, USA  
Ronghai Qu, Huazhong University of Science and Technology, China  
Jagadeesh Tangudu, United Technologies, USA  
Rajeev Vyas, GM, USA  
Rafal Wrobel, Bristol University, UK  
Thomas Wu, University of Central Florida, USA  
Julia Zhang, Oregon State University, USA  
Pinjia Zhang, GE, USA

**Computer and Telecommunication Applications**

Ozpineci Burak (Vice Chair), Oak Ridge National Laboratory, USA  
Carl Ho (Vice Chair), ABB Switzerland Ltd., Switzerland  
Ka-Hong Loo, The Hong Kong Polytechnic University, Hong Kong  
Grover Torrico-Bascope, Huawei Technologies Sweden AB, Sweden

**Electric Drives**

Fernando Briz (Vice Chair), University of Oviedo, Spain  
Mahesh Swamy (Vice Chair), Yaskawa America, Inc., USA  
Ali M. Bazzi, University of Connecticut, USA  
Vladimir Blasko, UTRC, USA  
Radu Bojoi, Politecnico di Torino, Italy  
Bimal Bose, University of Tennessee, USA  
Robert Cuzner, DRS, USA  
Uday Deshpande, IR, USA  
David Diaz-Reigosa, University of Oviedo, Spain  
Tobias Geyer, ABB, Switzerland  
Lei Hao, GM, USA  
Thomas Jahns, U Wisconsin-Madison, USA  
Sanjib Kumar Panda, Nat. Univ. of Singapore, Singapore  
Qin Lei, GE, USA  
Peter Liu, Toshiba, USA  
Elena Lomonova, TU Eindhoven, Netherlands  
A.J. Marques Cardoso, Univ. of Beira Interior, Portugal  
Mario Pacas, University of Siegen, Germany  
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Akshay Rathore, NUS Singapore, Singapore  
Giacomo Scelba, University of Catania, Italy  
Stefan Schroeder, GE, Germany  
Jul-Ki Seok, Yeungnam University, South Korea  
Gui-Jia Su, Oak Ridge Nat. Lab., USA  
Long Wu, John Deere, USA

**Other Energy Conversion Related Topics**

Dan Ionel (Vice Chair), Regal Beloit Corp., USA  
Yan-Fei Liu (Vice Chair), Queen's University, Canada  
Yao Duan, FMC Technologies, USA  
Gerry Moschopoulos, Western University, Canada  
Ahmed Sayed-Ahmed, Rockwell Automation, USA  
Peng Zhang, General Motors R&D, USA  
Zhiliang Zhang, Nanjing University of Aeronautics and Astronautics (NCAA), China

**Special Session Organizers**

Frede Blaabjerg, Aalborg University, Denmark  
Ozpineci Burak, Oak Ridge National Laboratory, USA  
Mircea Popescu, Motor Design Ltd., UK  
Pedro Rodriguez, Abengoa Research, Spain  
Krishna Shenai, Argonne National Laboratory, USA

# > Downtown Pittsburgh Map



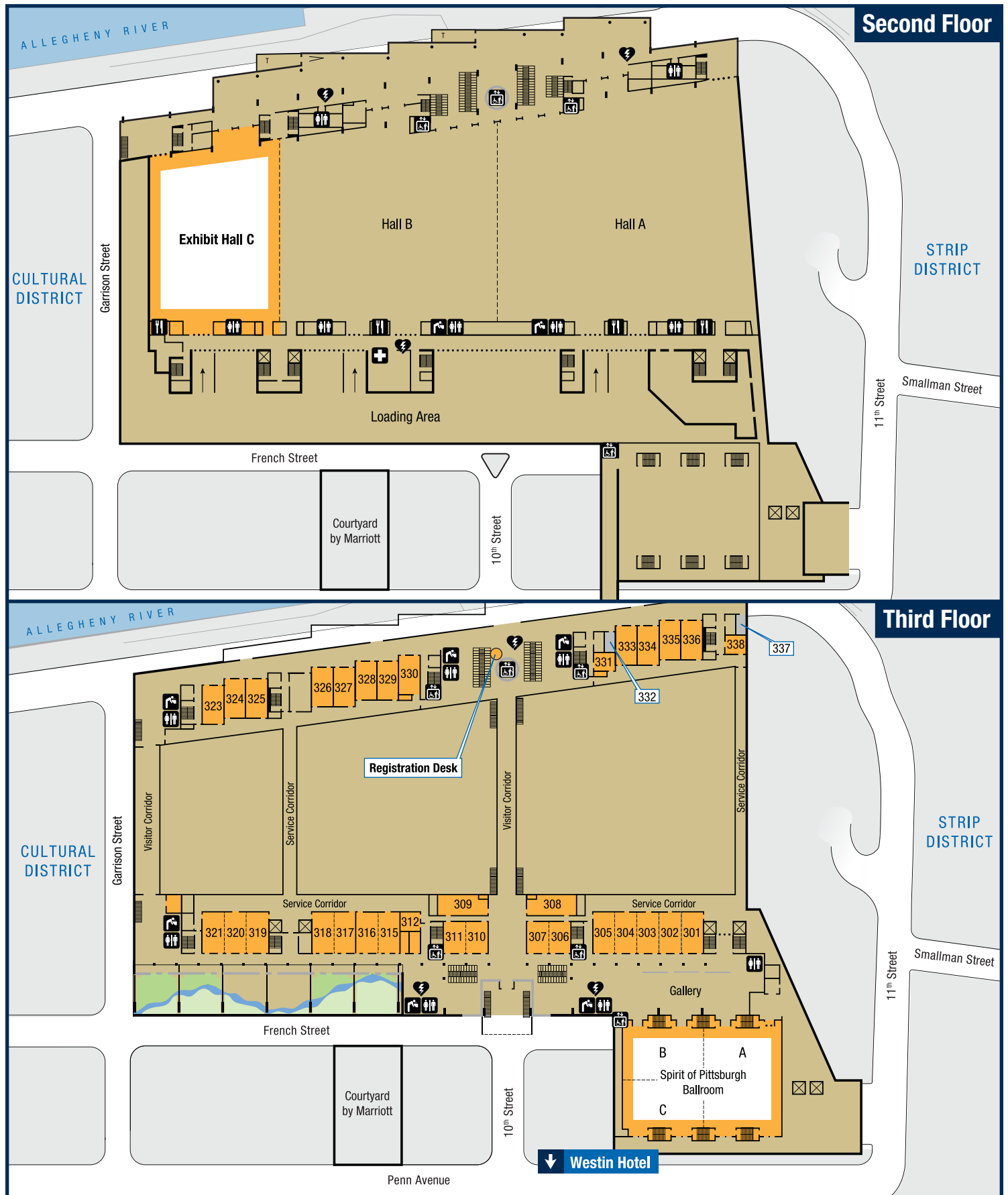
## Map Legend

- 1** David L. Lawrence Convention Center
- 2** CONSOL Energy Center
- 3** Heinz Field
- 4** PNC Park
- W** Westin Convention Center Hotel (1000 Penn Avenue)
- T** Subway Stations
- Three Rivers Park Trail
- 🚲** Bike rental
- 🚣** Kayak rental

For bus schedules and maps, visit [portauthority.org](http://portauthority.org)



# > David L. Lawrence Convention Center Floor Plans



# Sunday, September 14

7:00 am – 7:00 pm Registration ..... Noresco Foyer

## Tutorials Group 1 • 8:00 am – 12:00 pm

323	324	325	326	327	328
<b>T1-1:</b> Design Challenges of High-power Converters with Low Switching Frequencies	<b>T1-2:</b> Predictive Control — a Simple and Powerful Method to Control Power Converters and Drives	<b>T1-3:</b> The Technology and Market Issues of Magnetic Materials	<b>T1-4:</b> Electromechanical Power Loss Analysis in Design and Optimisation of Electrical Machines: Practical Aspects of Accurate Loss Estimation and Mitigation Techniques	<b>T1-5:</b> Power Semiconductor Modules: Design, Applications, Manufacturing & Reliability	<b>T1-6:</b> Electrification of Subsea Process Plants, Why and How

12:00 pm – 1:00 pm Lunch on Own

## Tutorials Group 2 • 1:00 pm – 5:00 pm

323	324	325	326	327	328
<b>T2-1:</b> Feedback-loop Design Issues of DC-DC Converters in High-power Energy Harvesting Applications	<b>T2-2:</b> Design for Reliability of Power Electronic Systems	<b>T2-3:</b> Impedance-based Modeling and Analysis of 3-phase Grid-connected Converters	<b>T2-4:</b> GaN Transistors for Efficient Power Conversion	<b>T2-5:</b> The Rediscovery of Synchronous Reluctance and Ferrite PM Motors as Valid Competitors to Induction and Rare-earth PM Motors	<b>T2-6:</b> Soft Crystalline Magnetic Materials

4:00 pm – 5:00 pm Newcomers Session ..... Room 335

5:00 pm – 7:00 pm Opening Reception ..... 4th Floor North Terrace

# Monday, September 15

7:00 am – 7:00 pm Registration ..... Noresco Foyer

8:00 am – 10:00 am Plenary Session ..... Spirit of Pittsburgh Ballroom

10:00 am – 10:20 am AM Break ..... Noresco Foyer

## Oral Sessions • 10:20 am – 12:00 pm

323	324	325	326	327	328	329	330	333	334	335
<b>S1:</b> MPPT for Solar PV Systems	<b>S2:</b> Power Converters for Photovoltaic Applications	<b>S3:</b> Microgrid Control I	<b>S4:</b> Widebandgap Devices I	<b>S5:</b> Reliability and Diagnostics in Grid Converters	<b>S6:</b> Telecom Power Supplies	<b>S7:</b> Modulation for Power Converters	<b>S8:</b> Control and Modulation of Multi-level Converters I	<b>S9:</b> Assorted Issues in Electric Drives I	<b>S10:</b> Induction Machines	<b>S11:</b> Flux-switching Machines

12:00 pm – 1:00 pm Lunch on Own

## Oral Sessions • 1:30 pm – 3:35 pm

323	324	325	326	327	328	329	330	333	335	334
<b>S12:</b> Power Converters for Transportation Applications I	<b>S13:</b> Control of Power Converters in Renewable Energy	<b>S14:</b> Utility-scale Battery Systems	<b>S15:</b> Widebandgap Devices II	<b>S16:</b> Modular Multi-level Converters for HVDC	<b>S17:</b> Control of 3-phase Converters	<b>S18:</b> AC-AC Converters	<b>S19:</b> Single-phase PFC Converters	<b>S20:</b> Diagnostics of Electric Machines	<b>S21:</b> Inductive Power Transfer I	<b>SS1:</b> US Government Power Electronics and Electric Motors Research for Electric Motors

4:00 pm – 6:30 pm Exhibit Hall Open ..... Exhibit Hall C

4:00 pm – 6:30 pm Student Demonstrations ..... Exhibit Hall C

4:00 pm – 6:30 pm Expo Reception *Supported by Ingersoll Rand* ..... Exhibit Hall C

5:00 pm – 6:30 pm Poster Session I ..... Exhibit Hall C

# Tuesday, September 16

7:00 am – 6:00 pm Registration ..... Noresco Foyer

## Oral Sessions • 8:00 am – 9:40 am

323	324	325	326	328	329	330	333	334	335	336	327
<b>S22:</b> Wind Energy: Control and Operation I	<b>S23:</b> Power Converters for Smart Grid and Utility Applications	<b>S24:</b> Grid Stability	<b>S25:</b> Widebandgap Devices III	<b>S26:</b> Modular Multi-level Converters I	<b>S27:</b> Resonant Control in Power Converters	<b>S28:</b> Switched-capacitor Converters	<b>S29:</b> Voltage Control Issues in Electric Drives	<b>S30:</b> Synchronous Machines	<b>S31:</b> Inductive Power Transfer II	<b>S32:</b> Losses in Electrical Machines	<b>SS2:</b> Wide Band Gap (WBG) Power Switch Modules — Requirements and Challenges

9:00 am – 6:00 pm Exhibit Hall Open ..... Exhibit Hall C

9:40 am – 10:00 am AM Break ..... Exhibit Hall C

10:00 am – 11:30 am Poster Session II ..... Exhibit Hall C

## Town Hall Meetings • 10:00 am – 12:00 pm

329	330
Wide Band Gap Devices — Potentials versus Reality	Hybrid/Electric Vehicles — Today and Tomorrow

12:00 pm – 2:00 pm Lunch ..... Exhibit Hall C

1:00 pm – 1:15 pm Presentation by SMMA – the Motor and Motion of Association ..... Exhibit Hall Stage

2:00 pm – 2:30 pm Powerex, Inc. Industrial Seminar ..... Exhibit Hall Stage

2:30 pm – 3:00 pm Keysight Technologies Industrial Seminar ..... Exhibit Hall Stage

3:00 pm – 3:30 pm Ford Motor Company Industrial Seminar ..... Exhibit Hall Stage

3:30 pm – 5:00 pm Poster Session III ..... Exhibit Hall C

## Tuesday, September 16 (Continued)

4:15 pm – 4:30 pm	PM Break .....	Exhibit Hall C
5:00 pm – 5:30 pm	Ingersoll Rand Industrial Seminar .....	Exhibit Hall Stage
5:30 pm – 6:00 pm	Student Exhibit Hall Contest Prizes — <i>Sponsored by Ingersoll Rand</i> .....	Exhibit Hall Stage

## Wednesday, September 17

7:00 am – 7:00 pm	Registration .....	Noresco Foyer
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### Oral Sessions • 8:00 am – 9:40 am

323	324	326	327	328	329	330	333	334	335	336	325
<b>S33:</b> Solar PV Technologies	<b>S34:</b> Energy Management in Residential Applications	<b>S35:</b> DC-DC Boost Converters	<b>S36:</b> Stability and Quality I	<b>S37:</b> Modular Multi-level Converters II	<b>S38:</b> Control of DC-DC Converters	<b>S39:</b> Active Power Filters and Power Quality	<b>S40:</b> Fault Diagnostics in Power Converters	<b>S41:</b> Control Issues in Electric Drives II	<b>S42:</b> IPM Machine Design	<b>S43:</b> Induction Motor Drives I	<b>SS3A:</b> Harmonic Resonance in Renewable Energy Systems

9:40 am – 10:00 am	AM Break .....	Noresco Foyer
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### Oral Sessions • 10:00 am – 11:40 am

323	324	326	327	328	329	330	334	335	336	325	333
<b>S44:</b> LED Drivers I	<b>S45:</b> LCL Filters for Grid Converters	<b>S46:</b> DC-DC Buck Converters	<b>S47:</b> Stability and Quality II	<b>S48:</b> Control and Modulation of Multi-level Converters II	<b>S49:</b> Modeling and Control of DC-DC Converters	<b>S50:</b> Power Converters for Transportation Applications II	<b>S51:</b> Performance and Reliability Issues in Electric Drives	<b>S52:</b> Switched-reluctance Machines	<b>S53:</b> Induction Motor Drives II	<b>SS3B:</b> Harmonic Regulation and Mitigation	<b>SS4:</b> Optimization of Electric Motors and Multi-physics Analysis

11:40 am – 1:30 pm	Lunch on Own
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### Oral Sessions • 1:30 pm – 3:10 pm

323	324	325	326	327	328	329	330	333	334	335	336
<b>S54:</b> Wave and Wind Generation Systems	<b>S55:</b> Power Converters for Smart Grid and Utility Applications II	<b>S56:</b> Microgrid Control II	<b>S57:</b> Battery Models	<b>S58:</b> Grid Emulation	<b>S59:</b> Device Temperature Estimation	<b>S60:</b> Resonant DC-DC Converters I	<b>S61:</b> AC-DC Multi-phase Converters	<b>S62:</b> Control of Power Converters I	<b>S63:</b> Sensorless Control: HF Injection	<b>S64:</b> IPM Analysis	<b>S65:</b> Magnetic Materials

3:10 pm – 3:30 pm	PM Break .....	Noresco Foyer
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### Oral Sessions • 3:30 pm – 5:10 pm

323	324	325	326	327	328	329	330	333	334	335	336
<b>S66:</b> Utility Interactive Solar PV System	<b>S67:</b> Power Converters for Renewable Energy Applications	<b>S68:</b> Microgrid Control III	<b>S69:</b> Battery Energy Management	<b>S70:</b> Other Power Electronics Topics for Grid Applications	<b>S71:</b> Power Electronic Modules I (high T and SiC)	<b>S72:</b> Multi-level DC-DC Converters	<b>S73:</b> DC-AC Converters	<b>S74:</b> Control of Power Converters II	<b>S75:</b> Sensorless Control II	<b>S76:</b> IPM Machines for Automotive Applications	<b>S77:</b> Solid State Transformers

7:00 pm – 9:00 pm	ECCE Banquet .....	Spirit of Pittsburgh Ballroom
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## Thursday, September 18

7:00 am – 3:00 pm	Registration .....	Noresco Foyer
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### Oral Sessions • 8:00 am – 9:40 am

323	324	325	326	327	328	329	330	333	334	335	336
<b>S78:</b> Energy Storage Systems	<b>S79:</b> Power Converters for Wind Energy Applications	<b>S80:</b> Microgrid Modeling	<b>S81:</b> Cascaded Converters for Grid Applications	<b>S82:</b> Power Electronic Modules II	<b>S83:</b> Multi-level Converters	<b>S84:</b> Resonant DC-DC Converters II	<b>S85:</b> EMI and Power Converters	<b>S86:</b> Electric Vehicle Technologies	<b>S87:</b> Asymmetry and Forces in Electric Machines	<b>S88:</b> Permanent Magnet Machine Drives I	<b>S89:</b> Non-conventional Electric Machines

9:40 am – 10:00 am	AM Break .....	Noresco Foyer
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### Oral Sessions • 10:00 am – 11:40 am

323	324	325	326	327	328	329	330	333	334	335	336
<b>S90:</b> Wind Energy: Control and Operation II	<b>S91:</b> Voltage Control Issues in Renewable Energy Applications	<b>S92:</b> Grid Devices	<b>S93:</b> Power Converters for Grid Applications	<b>S94:</b> Control of Power Converters based on Physical and Virtual Models	<b>S95:</b> DC-AC Multi-phase Converters	<b>S96:</b> Soft-switching Bridge DC-DC Converters	<b>S97:</b> Flux and Direct Torque Control	<b>S98:</b> Synchronous Reluctance Machines	<b>S99:</b> Modeling of Electric Machines	<b>S100:</b> Permanent Magnet Machine Drives II	<b>S101:</b> Magnetic Materials and Design

11:50 am – 1:20 pm	Awards Lunch .....	Spirit of Pittsburgh Ballroom
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### Oral Sessions • 1:30 pm – 3:10 pm

323	324	325	326	327	328	329	330	333	334	335	336
<b>S102:</b> LED Drivers II	<b>S103:</b> DC-DC Converters for Renewable Energy Applications	<b>S104:</b> Smart Grid Technologies I	<b>S105:</b> HVDC Systems	<b>S106:</b> Dual Active Bridge DC-DC Converters	<b>S107:</b> Multi-level Converter Topologies I	<b>S108:</b> Low-power Resonant Converters	<b>S109:</b> Modulation for Power Converters II	<b>S110:</b> Power Electronics Reliability Assessment	<b>S111:</b> High Power Drives	<b>S112:</b> High Speed Electric Machines	<b>S113:</b> Manufacturing Issues of Electric Machines

3:10 pm – 3:30 pm	PM Break .....	Noresco Foyer
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### Oral Sessions • 3:30 pm – 5:10 pm

323	324	325	326	327	328	329	330	333	334	335	336
<b>S114:</b> Converters for Solar PV Systems	<b>S115:</b> Stability Analysis and Power Quality	<b>S116:</b> Smart Grid Technologies II	<b>S117:</b> DC Grids	<b>S118:</b> Gate Drive Techniques	<b>S119:</b> Multi-level Converter Topologies II	<b>S120:</b> DC-DC Converter Applications	<b>S121:</b> Control of Power Converters III	<b>S122:</b> Energy-efficient Motor Drives	<b>S123:</b> Wound-field Machines	<b>S124:</b> Axial-flux Machines	<b>S125:</b> Traction and Heavy-duty Vehicle Systems

# Sunday, September 14

7:00 am - 7:00 pm		Registration..... Noresco Foyer									
	<b>Tutorials Group 1 • 8:00 am - 12:00 pm</b>										
	<b>Room: 323</b>	<b>Room: 324</b>	<b>Room: 325</b>	<b>Room: 326</b>	<b>Room: 327</b>	<b>Room: 328</b>					
	<b>T1-1:</b> Design Challenges of High-power Converters with Low Switching Frequencies	<b>T1-2:</b> Predictive Control — a Simple and Powerful Method to Control Power Converters and Drives	<b>T1-3:</b> The Technology and Market Issues of Magnetic Materials	<b>T1-4:</b> Electromechanical Power Loss Analysis in Design and Optimisation of Electrical Machines: Practical Aspects of Accurate Loss Estimation and Mitigation Techniques	<b>T1-5:</b> Power Semiconductor Modules: Design, Applications, Manufacturing & Reliability	<b>T1-6:</b> Electrification of Subsea Process Plants, Why and How					
	<b>Tutorials Group 2 • 1:00 pm - 5:00 pm</b>										
	<b>Room: 323</b>	<b>Room: 324</b>	<b>Room: 325</b>	<b>Room: 326</b>	<b>Room: 327</b>	<b>Room: 328</b>					
<b>12:00 pm - 1:00 pm</b>	Lunch on Own	<b>T2-2:</b> Design for Reliability of Power Electronic Systems	<b>T2-3:</b> Impedance-based Modeling and Analysis of 3-phase Grid-connected Converters	<b>T2-4:</b> GaN Transistors for Efficient Power Conversion	<b>T2-5:</b> The Rediscovery of Synchronous Reluctance and Ferrite PM Motors as Valid Competitors to Induction and Rare-earth PM Motors	<b>T2-6:</b> Soft Crystalline Magnetic Materials					
<b>4:00 pm - 5:00 pm</b>	Newcomers Session..... Room 335										
<b>5:00 pm - 7:00 pm</b>	Opening Reception..... 4th Floor North Terrace										
	<b>Monday, September 15</b>										
	Registration..... Noresco Foyer										
<b>7:00 am - 7:00 pm</b>	Plenary Session..... Spirit of Pittsburgh Ballroom										
<b>8:00 am - 10:00 am</b>	AM Break..... Noresco Foyer										
<b>10:00 am - 10:20 am</b>	<b>Oral Sessions • 10:20 am - 12:00 pm</b>										
	<b>Room: 323</b>	<b>Room: 324</b>	<b>Room: 325</b>	<b>Room: 326</b>	<b>Room: 327</b>	<b>Room: 328</b>	<b>Room: 329</b>	<b>Room: 330</b>	<b>Room: 333</b>	<b>Room: 334</b>	<b>Room: 335</b>
<b>10:20 am - 10:45 am</b>	<b>S1:</b> MPPT for Solar PV Systems	<b>S2:</b> Power Converters for Photovoltaic Applications	<b>S3:</b> Microgrid Control I	<b>S4:</b> Widebandgap Devices I	<b>S5:</b> Reliability and Diagnostics in Grid Converters	<b>S6:</b> Telecom Power Supplies	<b>S7:</b> Modulation for Power Converters	<b>S8:</b> Control and Modulation of Multilevel Converters I	<b>S9:</b> Assorted Issues in Electric Drives I	<b>S10:</b> Induction Machines	<b>S11:</b> Flux-switching Machines
	Distributed Control of PV Strings with Module Integrated Converters in Presence of a Central MPPT	Low-voltage Ride through Capability of 3-phase Grid-connected Photovoltaic Inverters with Slim Film Capacitors	Dual Sequence Current Controller without Current Sequence Decomposition Implemented on DSRF for Unbalanced Grid Voltage Conditions	Modeling and Characterization of a 300 V GaN based Boost Converter with 96% Efficiency at 1 MHz	Detection of Capacitor Degradation in LC Filters for AC Drives	Hyper-efficient (98%) and Super-compact (3.3kW/dm3) Isolated AC-DC Supply Module based on Multi-cell Converter Approach	Decoupled Modulation Techniques for a Four-level 5-phase Open-end Winding Drive	A Generalised Natural Balance Model and Balance Booster Filter Design for Three Level Neutral Point Clamped Converters	Self-Commissioning of Inverter Dead-time Compensation by Multiple Linear Regression based on a Physical Model	Modeling and Performance of Novel Scheme Dual Winding Cage Rotor Variable Speed Induction Generator with DC Link Power Delivery	Analysis of Flux Switching Permanent Magnet Machine Design for High-speed Applications
<b>10:45 am - 11:10 am</b>	Maximum Power Point Tracking for Multiple Photovoltaic Modules using Root-finding Methods	Modular Photovoltaic Inverter with High-Frequency DC-DC Stage based on Low-voltage FETs	Voltage-frequency Control of an Islanded Microgrid using the Intrinsic Droop Characteristics of Resonant Current Regulators	Analytical Loss Model of Low Voltage Enhancement Mode GaN HEMTs	Improved Reliability of Single-phase PV Inverters by Limiting the Maximum Feed-in Power	Adaptive Implementation Strategy of Virtual Impedance for Paralleled Inverters UPS	Common-mode Voltage Reduction of Three Level Four Leg PWM Converter	A Reduced Switching Loss PWM Strategy to Eliminate Common Mode Voltage in Multilevel Inverters	Current Reconstruction Method with Single DC-Link Current Sensor based on the PWM Inverter and AC Motor	A Differential Evolution Algorithm for Designing Inverter-driven Induction Motors	Analysis of the Torque Production Mechanism for Flux-switching Permanent Magnet Machines

Oral Sessions • 10:20 am – 12:00 pm (Continued)

	Room: 323	Room: 324	Room: 325	Room: 326	Room: 327	Room: 328	Room: 329	Room: 330	Room: 333	Room: 334	Room: 335
11:10 am – 11:35 am	<b>S1: MPPT for Solar PV Systems</b>	<b>S2: Power Converters for Photovoltaic Applications</b>	<b>S3: Microgrid Control I</b>	<b>S4: Widebandgap Devices I</b>	<b>S5: Reliability and Diagnostics in Grid Converters</b>	<b>S6: Telecom Power Supplies</b>	<b>S7: Modulation for Power Converters</b>	<b>S8: Control and Modulation of Multilevel Converters I</b>	<b>S9: Assorted Issues in Electric Drives I</b>	<b>S10: Induction Machines</b>	<b>S11: Flux-switching Machines</b>
	PV Generation with Enhancement with a Virtual Inertia Emulator to Provide Inertial Response to the Grid	Control Approach to Achieve Burst Mode Operation with DC-link Voltage Protection in Single-phase Two-stage PV Inverters	Plug and Play Nonlinear Droop Construction Scheme to Optimize Microgrid Operations	Avoiding Si MOSFET Avalanche and Achieving True Zero-voltage-switching for Cascode Device	Improved Dual Second-order Generalized Integrator PLL for Grid Synchronization under Non-ideal Grid Voltages including DC Offset	Modeling the Output Impedance of 3-phase Uninterruptible Power Supply in D-Q Frame	A Dead-time Compensation Method for Parabolic Current Control with Improved Current Tracking Precision	Capacitor Voltage Balancing of a Five-level Diode-clamped Converter using Minimum Loss SVPWM Algorithm for Wide Range Modulation Indices	Dynamic Effects of Mismatched Time Constants in DC-DC Converters with Inductor DCR Current Sensing	A 5-phase Induction Machine Model using Multiple DQ Planes Considering the Effect of Magnetic Saturation	Reduced Rare-earth Flux Switching Machines for Traction Applications
11:35 am – 12:00 pm		Optimized Control of Isolated Residential Power Router for Photovoltaic Applications	Transient Droop for Improved Transient Load Sharing in Microgrids	Characterization and Modeling of a Gallium Nitride Power HEMT	Single Phase Synchronous Reference Frame Power Control of Grid Connected Multi Level Inverter	A Series-Stacked Architecture for Highly-efficiency Data Center Power Delivery	Investigation into the Control Methods to Reduce the DC-link Capacitor Ripple Current in a Back-to-back Converter	A New Control Scheme of Five-level Active NPC Converters for Common Mode Voltage Mitigation in Medium Voltage Drives	Insulated Signal Transmission System using Planar Resonant Coupling Technology for High Voltage IGBT Gate Driver	Analysis of Non-intrusive Efficiency Estimation of Induction Machines Compared to the IEEE 112B and IEC 34-2-1 Standards	Investigation of On-loaded Performances of Hybrid-excitation Flux-switching Brushless Machines for HEV/EV Applications

Lunch on Own

Oral Sessions • 1:30 pm – 3:35 pm

	Room: 323	Room: 324	Room: 325	Room: 326	Room: 327	Room: 328	Room: 329	Room: 330	Room: 333	Room: 335	Room: 334
1:30 pm – 1:55 pm	<b>S12: Power Converters for Transportation Applications I</b>	<b>S13: Control of Power Converters in Renewable Energy</b>	<b>S14: Utility-scale Battery Systems</b>	<b>S15: Widebandgap Devices II</b>	<b>S16: Modular Multilevel Converters for HVDC</b>	<b>S17: Control of 3-phase Converters</b>	<b>S18: AC-AC Converters</b>	<b>S19: Single-phase PFC Converters</b>	<b>S20: Ernest W. Weidenbrug Memorial Session: Diagnostics of Electric Machines</b>	<b>S21: Inductive Power Transfer I</b>	<b>S22: US Government Power Electronics and Electric Motors Research for Electric Motors</b>
	Comparison of Multi-port Converter Topologies with Bidirectional Energy Flow for Automotive Energy Net Applications	Analysis and Design of Grid-current-feedback Active Damping for LCL Resonance in Grid-connected Voltage Source Converters	Centralized Control of Large Capacity Parallel Connected Power Conditioning System for Battery Energy Storage System in Microgrid	Investigating the Reliability of SiC MOSFET Body Diodes using Fourier Series Modelling	Control of Hybrid HVDC Transmission System with LCC and FB-MMC	Power Converter Control Framework for Agile Research and Development without Common DC-link Capacitor	Single-phase AC-AC Double-star Chopper-cells (DSCC) Converter without Common DC-link Capacitor	A Single-stage Three-level Isolated PFC Converter	Advanced Rotor Assessment of Motors Operating under Variable Load Conditions in Mining Facilities	A Dual-side Controlled Inductive Power Transfer System Optimized for Large Coupling Factor Variations	Advanced Power Electronics and Electric Motors Overview
1:55 pm – 2:20 pm	<b>S23: Power Converter Applications I</b>	<b>S24: Power Converter Applications II</b>	<b>S25: Power Converter Applications III</b>	<b>S26: Power Converter Applications IV</b>	<b>S27: Power Converter Applications V</b>	<b>S28: Power Converter Applications VI</b>	<b>S29: Power Converter Applications VII</b>	<b>S30: Power Converter Applications VIII</b>	<b>S31: Power Converter Applications IX</b>	<b>S32: Power Converter Applications X</b>	<b>S33: Power Converter Applications XI</b>
	An Asymmetrical ΓZ-source Hybrid Power Converter with Space Vector Pulse-width Modulation	Investigation on Series Active Filter Compensated High Power Grid-connected Voltage Source Inverters with LCL Filter	Performance Analysis of LiFePO4 Battery Energy Storage for Utility-scale PV System	10 kV - 15 kV Silicon Carbide Power MOSFETs for Next-generation Energy Conversion and Transmission Systems	A Switching Frequency Reduction and Mitigation of Voltage Fluctuation of Modular Multilevel Converter for HVDC	Grid Frequency Tracking Control Strategy without PLL for 3-phase Inverter	A Novel Single-phase Cascaded Multilevel AC-AC Converter without Commutation Problem	A Ripple-free Input Current PFC using Power Semiconductor Filter	PM Synchronous Machine Drive Response to Asymmetrical Short-circuit Faults	Magnetic Integration of LLC Compensated Resonant Converter for Inductive Power Transfer Applications	WBG Power Electronics for Electric Vehicles
2:20 pm – 2:45 pm	<b>S34: Power Converter Applications XII</b>	<b>S35: Power Converter Applications XIII</b>	<b>S36: Power Converter Applications XIV</b>	<b>S37: Power Converter Applications XV</b>	<b>S38: Power Converter Applications XVI</b>	<b>S39: Power Converter Applications XVII</b>	<b>S40: Power Converter Applications XVIII</b>	<b>S41: Power Converter Applications XIX</b>	<b>S42: Power Converter Applications XX</b>	<b>S43: Power Converter Applications XXI</b>	<b>S44: Power Converter Applications XXII</b>
	Design of a Solid-state DC Circuit Breaker for Light Rail Transit Power Supply Network	Input Current Ripple Cancellation of Current-fed Switched Inverter	Optimization of Power Dispatch to Minimize Battery Storage Capacity in Wind Farm	15-kV 100-A Single-bias All-optical SiC Emitter Turn-off Thyristor	Maximum Modulation Index for Modular Multilevel Converter with Circulating Current Control	An Improved Direct Power Control of PWM Rectifier with Active Power Ripple Minimization	Evaluation of a Maximum Power Density Design Method for Matrix Converter using SiC-MOSFET	A Family of Single-phase Hybrid Step-down PFC Converters	Online Broadband Insulation Spectroscopy of Induction Machines using Signal Injection	A 3.5kW Wireless Charger for Electric Vehicles with Ultra High Efficiency	Thermal Management for Electric Vehicles

Oral Sessions • 1:30 pm – 3:35 pm (Continued)

	Room: 323	Room: 324	Room: 325	Room: 326	Room: 327	Room: 328	Room: 329	Room: 330	Room: 333	Room: 335	Room: 334
	<b>S12: Power Converters for Transportation Applications I</b>	<b>S13: Control of Power Converters in Renewable Energy</b>	<b>S14: Utility-scale Battery Systems</b>	<b>S15: Widebandgap Devices II</b>	<b>S16: Modular Multilevel Converters for HVDC</b>	<b>S17: Control of 3-phase Converters</b>	<b>S18: AC-AC Converters</b>	<b>S19: Single-phase PFC Converters</b>	<b>S20: Ernesto Weidenbrug Memorial Session: Diagnostics of Electric Machines</b>	<b>S21: Inductive Power Transfer I</b>	<b>Room: 334</b>
2:45 pm – 3:10 pm	Design of Coupled Inductor for Minimum Inductor Current Ripple in Rapid Traction Battery Charger Systems	Advanced Techniques for Integration of Energy Storage and Photovoltaic Generator in Renewable Energy Systems	Residential Usage Profile Optimization and Experimental Implementation of the Retired HEV Battery with a Hybrid Microgrid Testbed	Physics-based Electro-thermal Saber Model and Parameter Extraction for High-voltage SiC Buffer IGBTs	Modulation and Control of MMC based Multiterminal HVDC	Capacitor Voltage Balancing Control of a Fully Integrated Three-level Isolated AC-DC PFC Converter for Reliable Operations	Several-hundred-kHz Single-phase to Commercial Frequency 3-phase Matrix Converter using Delta-sigma Modulation with Space Vector	A Bridgeless Hybrid-resonant PWM Zero Voltage Switching Boost AC-DC Power Factor Corrected Converter	Evaluation of the Influence of Rotor Magnetic Anisotropy on Condition Monitoring of 2 Pole Induction Motors	Loosely Coupled Inductive Wireless Power Transfer Systems with Class-E Transmitter and Multiple Receivers	<b>SS1: US Government Power Electronics and Electric Motors Research for Electric Motors</b>
3:10 pm – 3:35 pm	Asymmetric Interleaving in Low-voltage CMOS Power Management with Multiple Supply Rails	Analysis and PWM Control of 3-phase Boost-derived Hybrid Converter	A Hybrid Wind-solar-storage Energy Generation System Configuration and Control	High-efficiency 3-phase Inverter with SiC MOSFET Power Modules for Motor-drive Applications	A Peak Current Limit Control Technique in Low-voltage Ride through Operation of the Star-connected Cascaded H-bridges Converter	Discrete Time Modeling, Implementation and Design of Current Controllers	The Impact of Switching Frequency on Input Filter Design for High Power Density Matrix Converter	Design and Evaluation of GaN-based Dual-phase Interleaved MHz Critical Mode PFC Converter	Electrical Discharge and its Impact on Drivetrains of Wind Turbines	Transformer Coupled Asymmetrical Half Bridges for Voltage Balancing of Floating Capacitor Converters	CMI/Rare Earth Magnets
4:00 pm – 6:30 pm	Exhibit Hall Open	Exhibit Hall Open	Exhibit Hall Open	Exhibit Hall Open	Exhibit Hall Open	Exhibit Hall Open	Exhibit Hall C	Exhibit Hall C	Exhibit Hall C	Exhibit Hall C	Exhibit Hall C
4:00 pm – 6:30 pm	Student Demonstrations	Student Demonstrations	Student Demonstrations	Student Demonstrations	Student Demonstrations	Student Demonstrations	Exhibit Hall C	Exhibit Hall C	Exhibit Hall C	Exhibit Hall C	Exhibit Hall C
4:00 pm – 6:30 pm	Expo Reception	Expo Reception	Expo Reception	Expo Reception	Expo Reception	Expo Reception	Expo Reception	Expo Reception	Expo Reception	Expo Reception	Expo Reception
5:00 pm – 6:30 pm	Poster Session I	Poster Session I	Poster Session I	Poster Session I	Poster Session I	Poster Session I	Poster Session I	Poster Session I	Poster Session I	Poster Session I	Poster Session I

Tuesday, September 16

Registration..... Noreasco Foyer

Oral Sessions • 8:00 am – 9:40 am

	Room: 323	Room: 324	Room: 325	Room: 326	Room: 328	Room: 329	Room: 330	Room: 333	Room: 334	Room: 335	Room: 336	Room: 337
	<b>S22: Wind Energy: Control and Operation I</b>	<b>S23: Power Converters for Smart Grid and Utility Applications</b>	<b>S24: Grid Stability</b>	<b>S25: Widebandgap Devices III</b>	<b>S26: Modular Multilevel Converters I</b>	<b>S27: Resonant Control in Power Converters</b>	<b>S28: Switched-capacitor Converters</b>	<b>S29: Voltage Control Issues in Electric Drives</b>	<b>S30: Prof. D. Howe Memorial Session: Synchronous Machines</b>	<b>S31: Inductive Power Transfer II</b>	<b>S32: Losses in Electrical Machines</b>	<b>Room: 337</b>
8:00 am – 8:25 am	Reduced Cost of Reactive Power in Doubly Fed Induction Generator Wind Turbine System with Optimized Grid Filter	Development of the Active Capacitor Converter for PFC Converters	Sub-Synchronous Resonance Analysis in DFIG-based Wind Farms: Mitigation Methods — TCSC, GCSC, and DFIG Controllers — Part II	SiC MOSFETs based Split Output Half Bridge Inverter: Current Commutation Mechanism and Efficiency Analysis	Branch Energy Control for the Modular Multilevel Direct Converter Hexverter	Selective Harmonic Control for Power Converters	A High Step-up Converter based on Switched-capacitor Voltage Accumulator	An Optimal Solution for Operating a 3-phase Variable Frequency Drive from a Single-phase AC Source	PMSM Magnetization State Estimation based on Stator-reflected PM Resistance using High Frequency Signal Injection	Methods for Reducing Leakage Electric Field of a Wireless Power Transfer System for Electric Vehicles	Combined Experimental and Numerical Method for Loss Separation in Permanent Magnet Brushless Machines	Single-chip Data Sheets and Circuit Models — Do We Have Them Right for WBG Devices?
8:25 am – 8:50 am	Direct Power Control for DFIG under Unbalanced and Harmonically Distorted Grid Voltage in Stationary Frame	An Improved DPWM Method for Reduction of Resonant Problem in the Inverter	Impedance Matching based Stability Criteria for AC Microgrids	Dynamic Behavior Analysis and Characterization of a Cascode Rectifier based on a Normally-on SiC JFET	Realization of a Conceptual Approach for Power VLSI using Integrated Full-bridge Cells in Modular Multilevel Converters	Reduced Order Generalized Integrators based Selective Harmonic Compensation Current Controller for Shunt Active Power Filters	Analysis of Coupled Microconductors for Power-supply-on-chip Applications	Hexagon Voltage Manipulating Control (HVMC) for AC Motor Drives Operating at Voltage Limits	Comparison of Different Methods for Incipient Fault Diagnosis in PMSMs with Coaxial Insulated Windings	Reducing Leakage Flux in IPT Systems by Modifying Pad Ferrite Structures	Vibration Reduction of One-Axis Actively Position Regulated Single-drive Bearingless Motor with Repulsive Passive Magnetic Bearings	WBG Usage in Automotive: Do Challenges Outweigh Advantages?

Oral Sessions • 8:00 am – 9:40 am (Continued)

	Room: 323	Room: 324	Room: 325	Room: 326	Room: 328	Room: 329	Room: 330	Room: 333	Room: 334	Room: 335	Room: 336	Room: 327
8:50 am – 9:15 am	<b>S22: Wind Energy: Control and Operation I</b> Impacts of Providing Inertial Response on Dynamic Loads of Wind Turbine Drivetrains	<b>S23: Power Converters for Smart Grid and Utility Applications</b> Extremely Sparse Parallel AC-Link Universal Power Converters	<b>S24: Grid Stability</b> A Review of Low Voltage Ride-through Techniques for Photovoltaic Generation Systems	<b>S25: Widebandgap Devices III</b> Evaluation of Switching Performance of SIC Devices in PWM Inverter Fed Induction Motor Drives	<b>S26: Modular Multilevel Converters I</b> A Low-speed, High-torque Motor Drive using the Modular Multilevel Cascade Converter based on Triple-star Bridge Cells (MMCC-TSBC)	<b>S27: Resonant Control in Power Converters</b> Flexible Grid Connection Technique of Voltage Source Inverter under Unbalanced Grid Conditions based on Direct Power Control	<b>S28: Switched-capacitor Converters</b> Current Source Converter with Switched-inductor DC Link Circuit for Reduced Converter Losses	<b>S29: Voltage Control Issues in Electric Drives</b> Interleaved PWM Control for Neutral Point Balancing in Dual 3-level Traction Drives	<b>S30: Prof. D. Howe Memorial Session: Synchronous Machines</b> Analysis of FSCW SPM Servo Motor with Static, Dynamic and Mixed Eccentricity in Aspects of Radial Force and Vibration	<b>S31: Inductive Power Transfer II</b> Design Methodology of a Series-series Inductive Power Transfer System for Electric Vehicle Battery Charger Application	<b>S32: Losses in Electrical Machines</b> Winding Design for Minimum Power Loss and Low-Cost Manufacture in Application to Fixed-speed PM Generator	<b>S32: Wide Band Gap (WBG) Power Switch Modules — Requirements and Challenges</b> Package and Assembly Requirements for SIC-based Power Modules in Industrial Applications
9:15 am – 9:40 am	<b>S32: Wind Energy: Control and Operation I</b> A Flux Vector-based Discrete-time Direct Torque Control for Salient-pole Permanent-magnet Synchronous Generators	<b>S23: Power Converters for Smart Grid and Utility Applications</b> Low Frequency Signal Injection for Grid Impedance Estimation in Three Phase Systems	<b>S24: Grid Stability</b> Frequency Stability of Hierarchically Controlled Hybrid Photovoltaic-Battery-Hydropower Microgrids	<b>S25: Widebandgap Devices III</b> Exploration of a Switching Loop Snubber for Parasitic Ringing Suppression	<b>S26: Modular Multilevel Converters I</b> Capacitor Voltage Balancing based on Fundamental Frequency Sorting Algorithm for Modular Multilevel Converter	<b>S27: Resonant Control in Power Converters</b> Resonant Controllers with Three-degree of Freedom for AC Power Electronic Converters	<b>S28: Switched-capacitor Converters</b> Analysis and Design of a 1-kW 3X Interleaved Switched-capacitor DC-DC Converter	<b>S29: Voltage Control Issues in Electric Drives</b> Identification of the Magnetic Model of Permanent Magnet Synchronous Machines using DC-biased Low Frequency AC Signal Injection	<b>S30: Prof. D. Howe Memorial Session: Synchronous Machines</b> The Structure Optimization of Novel Harmonic Current Excited Brushless Synchronous Machines based on Open Winding Pattern	<b>S31: Inductive Power Transfer II</b> Analysis of Co-planar Intermediate Coil Structures in Inductive Power Transfer Systems	<b>S32: Losses in Electrical Machines</b> Cylindrical Rotor Design for Acoustic Noise and Windage Loss Reduction in Switched Reluctance Motor for HEV Applications	<b>S32: Wide Band Gap (WBG) Power Switch Modules — Requirements and Challenges</b> Reducing Cost in High-performance SIC Power Modules
9:00 am – 6:00 pm	Exhibit Hall Open.....											Exhibit Hall C
9:40 am – 10:00 am	AM Break.....											Exhibit Hall C
10:00 am – 11:30 am	Poster Session II.....											Exhibit Hall C
<b>329</b>												
Wide Band Gap Devices — Potentials versus Reality												
12:00 pm – 2:00 pm	Lunch.....											Exhibit Hall C
1:00 pm – 1:15 pm	Presentation by SMMA – the Motor and Motion of Association.....											Exhibit Hall Stage
2:00 pm – 2:30 pm	Powerex, Inc. Industrial Seminar.....											Exhibit Hall Stage
2:30 pm – 3:00 pm	Keysight Technologies Industrial Seminar.....											Exhibit Hall Stage
3:00 pm – 3:30 pm	Ford Motor Company Industrial Seminar.....											Exhibit Hall Stage
3:30 pm – 5:00 pm	Poster Session III.....											Exhibit Hall C
4:15 pm – 4:30 pm	PM Break.....											Exhibit Hall C
5:00 pm – 5:30 pm	Ingersoll Rand Industrial Seminar.....											Exhibit Hall Stage
5:30 pm – 6:00 pm	Student Exhibit Hall Contest Prizes — Sponsored by Ingersoll Rand.....											Exhibit Hall Stage

Town Hall Meetings • 10:00 am – 12:00 pm

	Room: 329	Room: 330
12:00 pm – 2:00 pm	Wide Band Gap Devices — Potentials versus Reality	Hybrid/Electric Vehicles — Today and Tomorrow

	Room: 323	Room: 324	Room: 326	Room: 327	Room: 328	Room: 329	Room: 330	Room: 333	Room: 334	Room: 335	Room: 336	Room: 325
8:00 am – 8:25 am	<b>S33: Solar PV Technologies</b> Power Electronic Components and System Installation for Plug-and-play Residential Solar PV	<b>S34: Energy Management in Residential Applications</b> Modeling the Energy Features of a Vehicle-to-home System to Provide User-specific Technical Requirements	<b>S35: DC-DC Boost Converters</b> A High-efficiency High Step-up DC-DC Converter with Passive Clamped Coupled-inductor and Voltage Double Cells	<b>S36: Stability and Quality I</b> Dynamic Phasor Models for AC Microgrids Stability Studies	<b>S37: Modular Multilevel Converters II</b> Design Considerations on the DC Capacitor of Each Chopper Cell in a Modular Multilevel Cascade Inverters (MMC-DSCC) for Medium-voltage Motor Drives	<b>S38: Control of DC-DC Converters</b> An Adaptive Ramp Compensation Scheme to Improve Stability of DC-DC Converters with Ripple-based Constant On-time Control	<b>S39: Active Power Filters and Power Quality</b> Selected Harmonic Resistance Control based Series Active Power Filter	<b>S40: Fault Diagnostics in Power Converters</b> A Novel Online ESR and C Identification Method for Output Capacitor of Buck Converter	<b>S41: Control Issues in Electric Drives II</b> Near Time-optimal Model Predictive Control using an L1-norm based Cost Functional	<b>S42: IPM Machine Design</b> Design of High Torque Density Variable Flux Permanent Magnet Machine using Alnico Magnets	<b>S43: Induction Motor Drives I</b> Input-output Feedback Linearization Control of Linear Induction Motors Including the Dynamic End-Effects	<b>S43A: Harmonic Resonance in Renewable Energy Systems</b> Harmonic Stability in Renewable Energy Systems: an Overview
8:25 am – 8:50 am	<b>S33: Solar PV Technologies</b> High-density Power Converters for Sub-module Photovoltaic Power Management	<b>S34: Energy Management in Residential Applications</b> Performance Characteristics of a Hybrid CERTS Microgrid Electric Vehicle Charging Station	<b>S35: DC-DC Boost Converters</b> High Power Step-up Modular Resonant DC-DC Converter for Offshore Wind Energy Systems	<b>S36: Stability and Quality I</b> Modeling and Resonant Characteristics Analysis of Multiple Paralleled Grid-connected Inverters with LCL Filter	<b>S37: Modular Multilevel Converters II</b> Study of Overcurrent Protection for Modular Multilevel Converter	<b>S38: Control of DC-DC Converters</b> Resonant Augmentation Circuits for a Buck Converter Achieving Minimum-time Voltage Recovery from Load Transients	<b>S39: Active Power Filters and Power Quality</b> Waveform Control Method for Mitigating of Harmonics of Inverter Systems with Nonlinear Load	<b>S40: Fault Diagnostics in Power Converters</b> A New Fault-tolerant Realization of the Active Three-level NPC Converter	<b>S41: Control Issues in Electric Drives II</b> Reformulation of the Long-horizon Direct Model Predictive Control Problem to Reduce the Computational Effort	<b>S42: IPM Machine Design</b> Saliency Ratio and Power Factor of IPM Motors Optimally Designed for High Efficiency and Low Cost Objectives	<b>S43: Induction Motor Drives I</b> Generalized Two-Vectors-based Model Predictive Torque Control of Induction Motor Drives	<b>S43A: Harmonic Resonance in Renewable Energy Systems</b> Modeling and Analysis of Supersynchronous Resonance by Sequence Impedances
8:50 am – 9:15 am	<b>S33: Solar PV Technologies</b> Cost-effective Photovoltaic Water Pumping System for Remote Regions Communities	<b>S34: Energy Management in Residential Applications</b> Energy Management System Control and Experiment for Future Home	<b>S35: DC-DC Boost Converters</b> A New Hybrid Boosting Converter	<b>S36: Stability and Quality I</b> Strategies for the Connection of Distributed Power Generation Units to Distorted Networks	<b>S37: Modular Multilevel Converters II</b> Independent Control of Input Current, Load and Capacitor Voltage Balancing for a Modular Matrix Converter	<b>S38: Control of DC-DC Converters</b> Digital Control of a High-voltage (2.5 kV) Bidirectional DC-DC Converter for Driving a Dielectric Electro Active Polymer (DEAP) based Capacitive Actuator	<b>S39: Active Power Filters and Power Quality</b> Shunt Active Power Filter based on the Interconnection of Single-phase and 3-phase Converters for 3-phase Four-wire Systems	<b>S40: Fault Diagnostics in Power Converters</b> Detection and Isolation of Multiple Faults in a Modular Multilevel Converter based on a Sliding Mode Observer	<b>S41: Control Issues in Electric Drives II</b> On the Benefit of Long-horizon Direct Model Predictive Control for Drives with LC Filters	<b>S42: IPM Machine Design</b> Design Methodology for Variable Leakage Flux IPM Traction Drives	<b>S43: Induction Motor Drives I</b> Induction Motor Speed Estimation based on Rotor Slot Effects	<b>S43A: Harmonic Resonance in Renewable Energy Systems</b> Influence of Harmonic Grid Resonance on the Operation of Grid-connected Converters
9:15 am – 9:40 am	<b>S33: Solar PV Technologies</b> PV Arc-fault Detection using Spread Spectrum Time Domain Reflectometry (SSTDRF)	<b>S34: Energy Management in Residential Applications</b> A Review of Faults and Fault Diagnosis in Micro-grids Electrical Energy Infrastructure	<b>S35: DC-DC Boost Converters</b> Identification and Robust Control of a Quadratic DC-DC Boost Converter by Hammerstein Model	<b>S36: Stability and Quality I</b> Analysis of Sinusoidal Current Reference Generation with Flat Instantaneous Active Power for Unbalanced Grids	<b>S37: Modular Multilevel Converters II</b> Analysis of the 5-cell Single Phase MMC Natural Balancing Mechanism	<b>S38: Control of DC-DC Converters</b> Variable Frequency Multiplier Technique for High Efficiency Conversion over a Wide Operating Range	<b>S39: Active Power Filters and Power Quality</b> Adaptive Resonant Current-control for Active Power Filtering within a Microgrid	<b>S40: Fault Diagnostics in Power Converters</b> Short-circuit Current Control Strategy for Full-bridge LLC Converter	<b>S41: Control Issues in Electric Drives II</b> Discrete-time Control of High Speed Salient Machines	<b>S42: IPM Machine Design</b> Design of a Spoke Type IPM Synchronous Motor with Segmented Rotor for Low DC Voltage Applications	<b>S43: Induction Motor Drives I</b> Induction Motor Control with Small DC-link Capacitor Inverters-fed by 3-phase Diode Front-end Rectifiers	<b>S43A: Harmonic Resonance in Renewable Energy Systems</b> Risk of DC-side Instabilities in VSC-based HVDC Systems



	Room: 323	Room: 324	Room: 326	Room: 327	Room: 328	Room: 329	Room: 330	Room: 334	Room: 335	Room: 336	Room: 325	Room: 333
10:00 am – 10:25 am	S44: LED Drivers I Harmonics Compensation and Power Factor Improvement using LED Driver	S45: LCL Filters for Grid Converters New Optimal Design Method for Trap Damping Sections in Grid-connected LCL Filters	S46: DC-DC Buck Converters A Series-capacitor Tapped Buck (Sc-Tab) Converter for Regulated High Voltage Conversion Ratio DC-DC Applications	S47: Stability and Quality II A Real-time Selective Harmonic Elimination based on a Transient-Free, Inner Closed-loop Control for Cascaded Multilevel Inverters	S48: Control and Modulation of Multilevel Converters II PWM for Active Thermal Protection in Three Level Neutral Point Clamped Inverters	S49: Modeling and Control of DC-DC Converters A Detection Method of DC Magnetization Utilizing Local Inhomogeneity of Flux Distribution in Power Transformer Core	S50: Power Converters for Transportation Applications II Reduced Switching Loss based DC-bus Voltage Balancing Algorithm for Three-level Neutral Point Clamped (NPC) Inverter for Electric Vehicle Application	S51: Performance and Reliability Issues in Electric Drives Improving Position Sensor Accuracy through Spatial Harmonic Decoupling, and Sensor Scaling, Offset, and Orthogonality Correction using Self-commissioning MRAS-methods	S52: Switched-reluctance Machines A Continuous Toroidal Winding SRM with 6 or 12 Switch DC Converter	S53: Induction Motor Drives II Current Ripple Analysis of PWM Methods for Open-end Winding Induction Motor	SS3B: Harmonic Regulation and Mitigation Harmonic Issues in Distribution Networks: Past and Future	SS4: Optimization of Electric Motors and Multi-physics Analysis High Fidelity and Efficient Computation of Losses in Brushless Permanent Magnet Machines
10:25 am – 10:50 am	Multi-channel LED Driver with CLL Resonant Converter	Active Damping for Grid-connected LCL Filter based on Optimum Controller Design using Injected Grid Current Feedback Only	A Cost-effective Circuit for Three-level Flying-capacitor Buck Converter Combining the Soft-start, Flying Capacitor Pre-charging and Snubber Functions	A Voltage Regulator using Multi-parallel-connected Series-voltage Compensator	Control Strategy of a Multilevel Converter with Multi-winding MFT/HFT Isolation	Equivalent Circuit Model of Constant On-time Current Mode Control with External Ramp Compensation	An Electrical-magnetic Hybrid Power Quality Compensation System and its Control Strategy for VV Tractron Power Supply System	Current Sharing Strategies for Fault Tolerant AC Multi-drives	Digital PWM Control-based Active Vibration Cancellation for Switched Reluctance Motors	New Optimal Pulsewidth Modulation for Single DC-link Dual Inverter fed Winding Induction Motor Drives	Active Filtering Techniques for Harmonic Damping	Modern Design Optimisation of PM and Reluctance Synchronous Machines
10:50 am – 11:15 am	Design Consideration of a Current-source-output Inductive Power Transfer LED Lighting System	Comparison of PR Controller and Damped PR Controller for Grid Current Control of LCL Filter based Grid-Tied Inverter under Frequency Variation and Grid Distortion	100 MHz, 20V, 90% Efficient Synchronous Buck Converter with Integrated Gate Driver	A Voltage Regulator based in a Voltage-controlled DSTATCOM with Minimum Power Point Tracker	Carrier Interleaved PWM Techniques in Modular Multilevel Converters: A Comparison based on Same Voltage Level Waveforms	Dynamic Analysis of Hysteresis Control Strategy based on Ripple Characteristics	High Frequency Active-clamp Buck Converter for Low Power Automotive Applications	Performance Evaluation of a Bearingless Flux-switching Slice Motor	Practical Considerations for the Design and Construction of a High Speed SRM with a Flux-bridge Rotor	Hybrid Open-end and NPC AC Six-phase Machine Drive Systems	Harmonic Interaction in High Populations of Distributed Power Resources	Design for Manufacturing Employing Automated Optimization and Multi-physics Analysis — an Academic and Industrial Point of View
11:15 am – 11:40 am	Electrolytic-capacitor-less High-power LED Driver	Rectifier Stage Operation and Controller Design for a Medium Voltage Solid State Transformer with LCL Filter	Modeling and Control of a Tapped-inductor Buck Converter with Pulse Frequency Modulation	Stability Analysis of the High Voltage DC Link between the FEC and DC-DC Stage of a Transformer-less Intelligent Power Substation	A State Machine Decoder for Phase Disposition Pulse Width Modulation of 3-phase Coupled-inductor Semi-bridge Converters	A Generic and Accurate Frequency-domain Model for Buck, Boost and Buck-boost Converters	Analysis, Modeling and Control of Half-bridge Current-source Converter for Supercapacitor Applications	Novel Discontinuous PWM Control Method to Improve IGBT Reliability at Low Speed	Design of a Switched Reluctance Machine for Off-road Vehicle Applications based on Torque Speed-curve Optimization	A Time-varying Observer for the Flux Magnitude of the Induction Motor using the Synchronous Reference Frame Model	LCL-Trap Grid Harmonics Mitigation and Potential Resonance Identification in Large Scale Distributed Power Plants	Multiphysics Analysis of Electric Machines for Tractor Applications Considering Complex Duty Cycles

11:40 am – 1:30 pm Lunch on Own

	Room: 323	Room: 324	Room: 325	Room: 326	Room: 327	Room: 328	Room: 329	Room: 330	Room: 333	Room: 334	Room: 335	Room: 336
1:30 pm – 1:55 pm	<b>S54: Wave and Wind Generation Systems</b> Hybrid Generator for Wind Generation Systems	<b>S55: Power Converters for Smart Grid and Utility Applications II</b> Novel, Simple Reactive Power Control Strategy with DC Capacitor Voltage Control for Active Load Balancer in 3-phase Four-wire Distribution Systems	<b>S56: Microgrid Control II</b> Application of Intelligent Agent Systems for Real-time Coordination of Power Converters (RCPC) in Microgrids	<b>S57: Battery Models</b> A Transient Reduced Order Model for Battery Thermal Management based on Singular Value Decomposition	<b>S58: Grid Emulation</b> Development of Converter based Reconfigurable Power Grid Emulator	<b>S59: Device Temperature Estimation</b> Online Junction Temperature Extraction with Turn-off Delay Time for High Power IGBTs	<b>S60: Resonant DC-DC Converters I</b> AZCS-PWM Bidirectional DC-DC Converter with a Two-terminal Resonant Tank-based Auxiliary Switching Cell	<b>S61: AC-DC Multi-phase Converters</b> DC Voltage Balancing of Flying Converter Cell Active Rectifier	<b>S62: Control of Power Converters I</b> A Dual Voltage Control Strategy for Single-phase PWM Converters with Power Decoupling Function	<b>S63: Sensorless Control: HF Injection</b> Analysis of Carrier Signal Injection based Sensorless Control of PMSM Drives under Limited Inverter Switching Frequency Condition	<b>S64: Prof. B. Chalmers Memorial Session: IPM Analysis</b> Analysis of Torque versus Current Capability of Reluctance and Interior PM Machines under Limited Current and Flux-linkage Operation	<b>S65: Magnetic Materials</b> Characterization of Electrical Steels for High Speed Induction Motor Applications: Going Beyond the Standards
1:55 pm – 2:20 pm	<b>S66: Wave and Wind Generation Systems</b> A GA-SVM Hybrid Classifier for Multiclass Fault Identification of Drivetrain Gearboxes	<b>S67: Power Converters for Smart Grid and Utility Applications II</b> A Flexible DC Voltage Balancing Control based on the Power Flow Management for Star-connected Cascaded H-bridge Converter	<b>S68: Microgrid Control II</b> Investigation of Extra Power Loss Sharing among Photovoltaic Inverters Caused by Reactive Power Management in Distribution Networks	<b>S69: Battery Models</b> Near-real-time Parameter Estimation of an Electrical Battery Model with Multiple Time Constants and SOC-dependent Capacitance	<b>S70: Grid Emulation</b> A Power-HIL Microgrid Testbed: Smart Energy Integration Lab (SELL)	<b>S71: Device Temperature Estimation</b> P-I-N Diode Chip Temperature Extraction Method by Investigation into Maximum Recovery Current Rate dI/dt	<b>S72: Resonant DC-DC Converters I</b> Single-inductor Resonant Switched Capacitor Voltage Multiplier with Safe Commutation	<b>S73: AC-DC Multi-phase Converters</b> Multilevel Multichannel Interleaved AC-DC Converter for High Current Applications	<b>S74: Control of Power Converters I</b> Hybrid Interleaving with Adaptive PLL Loop for Adaptive On-time Controlled Switching Converters	<b>S75: Sensorless Control: HF Injection</b> Position Sensorless Control Method at Zero Speed Region for Permanent Magnet Synchronous Motors using the Neutral Point Voltage of Stator Windings	<b>S76: Prof. B. Chalmers Memorial Session: IPM Analysis</b> Analysis of Iron Loss in Interior PM Machines with Distributed Windings under Deep Field-weakening	<b>S77: Magnetic Materials</b> Design Considerations of 2-D Magnetizers for High Flux Density Measurements
2:20 pm – 2:45 pm	<b>S78: Wave and Wind Generation Systems</b> Marine Current Turbine Generator System with Induction Machine Growing Neural Gas (GNG) MPPT based on Sensorless Sea Speed Estimation	<b>S79: Power Converters for Smart Grid and Utility Applications II</b> Multilevel, Multiport, Switched-capacitor based Inverter for Utility Applications	<b>S80: Microgrid Control II</b> DC-bus Voltage Regulation Strategy for 3-phase Back-to-back Active Power Conditioners	<b>S81: Battery Models</b> An Enhanced Circuit-based Battery Model with Considerations of Temperature Effect	<b>S82: Grid Emulation</b> Power Hardware-in-the-loop Simulation of Integrated Voltage Regulation and Islanding Detection for Distributed PV Systems on GRU Model	<b>S83: Device Temperature Estimation</b> Evaluation of Thermo-sensitive Electrical Parameters based on the Forward Voltage for On-line Chip Temperature Measurements of IGBT Devices	<b>S84: Resonant DC-DC Converters I</b> Analysis, Design and Implementation of Quadrupler based High Voltage Full Bridge Series Resonant DC-DC Converter	<b>S85: AC-DC Multi-phase Converters</b> Voltage Sequence Control based High-current Rectifier System	<b>S86: Control of Power Converters I</b> Dynamic Physical Limits of Boost Converters: A Benchmarking Tool for Transient Performance	<b>S87: Sensorless Control: HF Injection</b> High Frequency D-Q Modeling of Synchronous Machines for Sensorless Control	<b>S88: Prof. B. Chalmers Memorial Session: IPM Analysis</b> Permanent Magnet Volume Minimization of Spoke Type Fractional Slot Synchronous Motors	<b>S89: Magnetic Materials</b> A Simple Method to Minimize Effects of Temperature Variation on IPMSM Control in Real-time Manner
2:45 pm – 3:10 pm	<b>S90: Wave and Wind Generation Systems</b> Pole-modulated PM Direct-drive Generator for Wave Energy Conversion	<b>S91: Power Converters for Smart Grid and Utility Applications II</b> Black Start Operation for the Solid State Transformer Created Micro-grid under Islanding with Storage	<b>S92: Microgrid Control II</b> An Effective Smooth Transition Control Strategy using Droop Based Synchronization for Parallel Inverters	<b>S93: Battery Models</b> Static and Dynamic Power System Load Emulation in Converter-based Reconfigurable Power Grid Emulator	<b>S94: Grid Emulation</b> Frequency-domain Transient Temperature Estimation and Aging Analysis for Weak Points of IGBT Modules	<b>S95: Resonant DC-DC Converters I</b> A Transformerless Step-up Resonant Converter for Grid-connected Renewable Energy Sources	<b>S96: AC-DC Multi-phase Converters</b> Modulation Scheme for Delta-type Current Source Rectifier to Reduce Input Current Distortion	<b>S97: Control of Power Converters I</b> On-chip Frequency Compensation Control Scheme with Independently Tuning Parameters and Green Native Adaptive Voltage Position (GNAVP) for Voltage Regulators	<b>S98: Sensorless Control: HF Injection</b> Carrier Signal Injection Method in Three Shunt Sensing Inverter for Sensorless AC Machine Drive	<b>S99: Prof. B. Chalmers Memorial Session: IPM Analysis</b> Impact of the Field Weakening on the Iron Losses in the Stator of an Interior Permanent Magnet Synchronous Machine	<b>S100: Magnetic Materials</b> Effect of Magnet Properties on Power Density and Flux-weakening Performance of High-speed Interior Permanent Magnet Synchronous Machines	

3:10 pm – 3:30 pm **PM Break**..... Noreesco Fryer

	Room: 323	Room: 324	Room: 325	Room: 326	Room: 327	Room: 328	Room: 329	Room: 330	Room: 333	Room: 334	Room: 335	Room: 336
3:30 pm – 3:55 pm	<b>S66: Utility Interactive Solar PV System</b> Comprehensive Modeling of Single-phase Quasi-Z-source Photovoltaic Inverter to Investigate Low-frequency Voltage and Current Ripples	<b>S67: Power Converters for Renewable Energy Applications</b> A Single-switch High Step-up DC-DC Converter with Coupled Inductor	<b>S68: Microgrid Control III</b> Control Design of Coordinated Droop Control for Hybrid AC-DC Microgrid Considering Distributed Generation Characteristics	<b>S69: Battery Energy Management</b> Loss Minimization-based Charging Strategy for Lithium-ion Battery	<b>S70: Other Power Electronics Topics for Grid Applications</b> New Power Electronic Interface Combining DC Transmission, a Medium-frequency Bus and an AC-AC Converter to Integrate Deep-Sea Facilities with the AC Grid	<b>S71: Power Electronic Modules I (high T and SiC)</b> Novel IGBT Module Design, Material and Reliability Technology for 175°C Continuous Operation	<b>S72: Multilevel DC-DC Converters</b> A Bidirectional Multiple-input Multiple-output Modular Multilevel DC-DC Converter	<b>S73: DC-AC Converters</b> Generalized Active Power Decoupling Method for H-bridge with Minimum Voltage and Current Stress	<b>S74: Control of Power Converters II</b> Utilization of Proportional Filter Capacitor Voltage Feedforward to Realize Active Damping for Digitally-controlled Grid-Tied Inverter Operating under Wide Grid Impedance Variation	<b>S75: Sensorless Control II</b> An Integral Method Combining V/Hz and Vector Control of Permanent Magnet Motor	<b>S76: IPM Machines for Automotive Applications</b> Experimental Comparison of PM Assisted Synchronous Reluctance Motors	<b>S77: Solid-state Transformers</b> Resonant Power Electronic Transformer for Power Grid
3:55 pm – 4:20 pm	<b>A High-efficiency Single-phase Inverter for Transformerless Photovoltaic Grid-connection</b>	<b>High Gain Single-stage Boosting Inverter</b>	<b>Power-based Control of Low-voltage Microgrids</b>	<b>Enhanced Coulomb Counting Method with Adaptive SOC Reset Time for Estimating OCV</b>	<b>Operational Study of a Modular Direct Current Power System for Subsea Power Delivery</b>	<b>A High Temperature Silicon Carbide MOSFET Power Module with Integrated Silicon-on-insulator based Gate Drive</b>	<b>A Family of the New Interleaved Multi-channel Three-level DC-DC Converters</b>	<b>Analysis and Design of Modified Half-bridge Series Resonant Inverter with DC-link Neutral Point Clamped Cell</b>	<b>Observer-based State-Space Current Controller for a Grid Converter Equipped with an LCL Filter: Analytical Method for Direct Discrete-time Design in Synchronous Coordinates</b>	<b>High-speed Sensorless Control of a PMSM Operating under Periodic Magnetic Saturation Conditions</b>	<b>Influence of Magnet Arrangement on the Performance of IPMSMs for Automotive Applications</b>	<b>Multiple Objectives Tertiary Control Strategy for Solid State Transformer Interfaced DC Microgrid</b>
4:20 pm – 4:45 pm	<b>Multiphase Parallel Interleaved and Primary-parallel Secondary-series Forward Micro-inverter Comparison</b>	<b>PV Power Conditioning System with LLC Resonant Converter in DCM</b>	<b>Secondary Coordinated Control of Islanded Microgrids based on Consensus Algorithms</b>	<b>Equalization System for Serially-connected Battery Cells based on the Wave-trap Concept</b>	<b>Investigation on Dynamic Voltage Restorer with Two DC-links and Series Converters for 3-phase Four-wire Systems</b>	<b>Evaluation of Commercially Available SiC Devices and Packaging Materials for Operation Up to 350°C</b>	<b>AZVS Bidirectional Three-level DC-DC Converter with Direct Current Slow Rate Control of Leakage Inductance</b>	<b>Operation of Current Source Inverters in Discontinuous Conduction Mode</b>	<b>Gain-scheduled Control using Voltage Controlled Oscillator with Variable Gain for a LLC Resonant Converter</b>	<b>Sensorless Control of 3-phase BLDC Motors using DC Current Model</b>	<b>Effect of Magnet Types on Performance of High Speed Spoke Interior Permanent Magnet Machines Designed for Traction Applications</b>	<b>Volume/Weight/Cost Comparison of a T.MVA 10kV/400V Solid-state against a Conventional Low-frequency Distribution Transformer</b>
4:45 pm – 5:10 pm	<b>A High Efficiency PV Micro-inverter with Grid Support Functions</b>	<b>High Efficiency Multilevel Flying-capacitor DC-DC Converter for Distributed Generation Applications</b>	<b>A Controller for the Smooth Transition from Grid-connected to Autonomous Operation Mode</b>	<b>Modular Approach for Continuous Cell-level Balancing to Improve Performance of Large Battery Packs</b>	<b>Locking Frequency Band Exposure Method for Islanding Detection and Prevention in Distributed Generation</b>	<b>All-SiC Power Module for Delta-type Current Source Rectifier</b>	<b>High Voltage Cell Power Supply for Modular Multilevel Converters</b>	<b>A Hybrid Modulation Method for Single-phase Quasi-Z Source Inverter</b>		<b>Sensorless Control of Linear Permanent Magnet Synchronous Motor using a Combined Sliding Mode Adaptive Observer</b>	<b>Variable Leakage Flux (VLF) IPMSMs for Reduced Losses over a Driving Cycle while Maintaining the Feasibility of High Frequency Injection-based Rotor Position Self-Sensing</b>	<b>Design and Operation of a 3.6kV High Performance Solid State Transformer based on 13kV SiC MOSFET and JBS Diode</b>

7:00 pm – 9:00 pm **ECCE Banquet**..... Spirit of Pittsburgh Ballroom

	Room: 323	Room: 324	Room: 325	Room: 326	Room: 327	Room: 328	Room: 329	Room: 330	Room: 333	Room: 334	Room: 335	Room: 336
8:00 am – 8:25 am	<b>S78: Energy Storage Systems</b> Converter-fed Synchronous Machine for Pumped Hydro Storage Plants	<b>S79: Power Converters for Wind Applications</b> Flyback-type di/dt Snubber for 10kV IGCT in MW Wind Turbines	<b>S80: Microgrid Modeling</b> High Resolution Output Power Estimation of Large-scale Distributed PV Systems	<b>S81: Cascaded Converters for Grid Applications</b> Optimization of Fundamental Frequency Modulation for Cascaded Multilevel Inverter based Transformer-less UPFC	<b>S82: Power Electronic Modules II</b> Substrate Layout Evaluation for T-type Three-level IGBT Modules	<b>S83: Multi-level Converters</b> Multi-phase Multilevel LLC Resonant Converter with Low Voltage Stress on the Primary-side Switches	<b>S84: Resonant DC-DC Converters II</b> Design and Implementation of a Half-bridge Dual LLC Converter with Symmetrical Autotransformer	<b>S85: EMI and Power Converters</b> Development of a Frequency-analysis Equipment Capable of Judging Propagation Direction of Conductive EMI	<b>S86: Electric Vehicle Technologies</b> A New Integrated Onboard Charger and Accessory Power Converter for Plug-in Electric Vehicles	<b>S87: Asymmetry and Forces in Electric Machines</b> Effects of Unbalanced Magnetic Pull in Large Permanent Magnet Machines	<b>S88: Permanent Magnet Machine Drives I</b> Plug-in, Direct Flux Vector Control of PM Synchronous Machine Drives	<b>S89: Non-conventional Electric Machines</b> Transient Analysis of a Line Start Hysteresis Interior Permanent Magnet Motor
8:25 am – 8:50 am	<b>S80: Microgrid Modeling</b> Modeling, Analysis and Evaluation of Smart Load Functionality in the CERTS Microgrid	<b>S79: Power Converters for Wind Applications</b> Nine-switch Converter-based DFIG Wind Power System and its Dynamic DC Voltage Assigned Approach for Low Voltage Riding through (LVRT)	<b>S80: Microgrid Modeling</b> Modeling, Analysis and Measurement of Impedance for 3-phase AC Distributed Power System	<b>S81: Cascaded Converters for Grid Applications</b> One Dimensional Cell Inversion: A Modulation Strategy for Hybrid Cascaded Converters	<b>S82: Power Electronic Modules II</b> A Compact Planar Rogowski Coil Current Sensor for Active Current Balancing of Parallel-connected Silicon Carbide MOSFETs	<b>S83: Multi-level Converters</b> 3-phase Three-level LC-type Series Resonant DC-DC Converter with Variable Frequency Control	<b>S84: Resonant DC-DC Converters II</b> LLC Resonant DC Transformer (DCX) with Parallel PWM Tight Regulation	<b>S85: EMI and Power Converters</b> DC-link Input EMI Filter Design in a Centralized Architecture PV Inverter: Impedance Approach	<b>S86: Electric Vehicle Technologies</b> Optimal Sizing of Propulsion Systems Applied to Fuel Cell based Vehicles	<b>S87: Asymmetry and Forces in Electric Machines</b> Experimental Verification of 6th Radial Force Control for IPMSMs based on Flux Linkage	<b>S88: Permanent Magnet Machine Drives I</b> Analysis and Control of Mono Inverter Dual Parallel SPMSM Drive System	<b>S89: Non-conventional Electric Machines</b> Bearingless Transverse Flux Permanent Magnet Machine for Large Direct-Drive
8:50 am – 9:15 am	<b>S78: Energy Storage Systems</b> Diagnosis of Lithium-ion Batteries State-of-health based on Electrochemical Impedance Spectroscopy Technique	<b>S79: Power Converters for Wind Applications</b> 13.8 kV Five Level ANPC Inverter for Wind Power	<b>S80: Microgrid Modeling</b> Modeling, Analysis, and Measurement of Impedance for 3-phase AC Distributed Power System	<b>S81: Cascaded Converters for Grid Applications</b> Efficiency and Improved Current Balanced 3-phase Modular Cascaded H-bridge Multilevel PV Inverter for Grid-connected Applications	<b>S82: Power Electronic Modules II</b> Realization and Characterization of an IGBT Module based on the Power Chip-on-chip 3D Concept	<b>S83: Multi-level Converters</b> Five-level Unidirectional T-rectifier for High Speed Gen-set Applications	<b>S84: Resonant DC-DC Converters II</b> A Bidirectional Resonant DC Converter with Frequency Tracking Control	<b>S85: EMI and Power Converters</b> Shielding-cancellation Technique for Suppressing Common Mode EMI in Isolated Power Converters	<b>S86: Electric Vehicle Technologies</b> Transverse Flux Permanent Magnet Motor with Double-C Stator Hoops and Flux-concentrated Rotor for In-wheel Drive Electric Vehicle	<b>S87: Asymmetry and Forces in Electric Machines</b> The Measurement and Indexing of Unbalanced Magnetic Pull in Electrical Machines	<b>S88: Permanent Magnet Machine Drives I</b> Mechanical Parameter Estimation of Permanent Magnet Synchronous Machines with Aiding from Rotor PM Flux Linkage	<b>S89: Non-conventional Electric Machines</b> Hardware Integration for an Integrated Modular Motor Drive Including Distributed Control
9:15 am – 9:40 am	<b>S78: Energy Storage Systems</b> Derivation of an Equivalent Electrical Circuit Model for Degradation Mechanisms in High Temperature PEM Fuel Cells in Performance Estimation	<b>S79: Power Converters for Wind Applications</b> Single-stage 3-phase AC-DC Step-up Medium Voltage Resonant Converter for Offshore Wind Power Systems	<b>S80: Microgrid Modeling</b> Design of the Fort Sill Microgrid	<b>S81: Cascaded Converters for Grid Applications</b> Zero-sequence Voltage Injection for DC Capacitor Voltage Balancing Control of the Star-connected H-bridge PWM Converter under Unbalanced Grid	<b>S82: Power Electronic Modules II</b> Develop Parasitic Inductance Model for the Planar Busbar of an IGBT H Bridge in a Power Inverter	<b>S83: Multi-level Converters</b> Characterization of the Voltage and Electric Field Stresses in Multicell Solid-state Transformers	<b>S84: Resonant DC-DC Converters II</b> Analysis on the Influence of Secondary Parasitic Capacitance to ZVS Transient in LLC Resonant Converter	<b>S85: EMI and Power Converters</b> Analysis and Filter Design of Differential Mode EMI Noise for GaN-based Interleaved MHz Critical Mode PFC Converter	<b>S86: Electric Vehicle Technologies</b> Integrated Capacitor for Common-mode EMI Mitigation Applicable to High Frequency Planar Transformers used in Electric Vehicles DC-DC Converters	<b>S87: Asymmetry and Forces in Electric Machines</b>	<b>S88: Permanent Magnet Machine Drives I</b> Flux Regulation Strategies for Hybrid Excitation Synchronous Machines	<b>S89: Non-conventional Electric Machines</b> Modeling of Dual Mechanical Port Machine with Squirrel-cage Outer Rotor for Hybrid Electric Vehicles
9:40 am – 10:00 am	<b>AM Break</b>											

	Room: 323	Room: 324	Room: 325	Room: 326	Room: 327	Room: 328	Room: 329	Room: 330	Room: 333	Room: 334	Room: 335	Room: 336
10:00 am – 10:25 am	<b>S90: Wind Energy: Control and Operation II</b>	<b>S91: Voltage Control Issues in Renewable Energy Applications</b>	<b>S92: Grid Devices</b>	<b>S93: Power Converters for Grid Applications</b>	<b>S94: Control of Power Converters based on Physical and Virtual Models</b>	<b>S95: DC-AC Multi-phase Converters</b>	<b>S96: Soft-switching Bridge DC-DC Converters</b>	<b>S97: Flux and Direct Torque Control</b>	<b>S98: Synchronous Reluctance Machines</b>	<b>S99: Modeling of Electric Machines</b>	<b>S100: Permanent Magnet Machine Drives II</b>	<b>S101: Magnetic Materials and Design</b>
	Control of a Small Wind Turbine in the High Wind Speed Region	Estimation of Synchronization Signal using Sinusoidal Amplitude Integrator in Synchronous Reference Frame	A Six-switch Solid State Variable Capacitor with Minimum DC Capacitance	An Isolated Multiport Bidirectional DC-DC Converter for PV-battery-DC Microgrid Applications	Estimation of the Plant Time Constant of Current-controlled Voltage Source Converters	A New Four-level $\pi$ -type Converter with Neutral Point Voltage Balancing Capability	A Low-RMS-current Passive Auxiliary Circuit for ZVS Operation of Full Bridge Converters	A Novel Stator Flux Oriented V/f Control Method in Sensorless Induction Motor Drives for Accuracy Improvement and Oscillation Suppression	FE-aided Analytical Method to Predict the Capabilities of Line-start Synchronous Motors	Ultrafast Steady-state Multi-physics Model for PM and Synchronous Reluctance Machines	Low Switching Frequency Stator Flux Linkage Observer for Interior Permanent Magnet Synchronous Machines	A New Core Loss Model for Rectangular AC Voltages
10:25 am – 10:50 am	Sideband Torque Ripple in Direct Drive Permanent Magnet Wind Power Generator System	High-dynamic Single-phase Hilbert-based PLL for Improved Phase-jump Ride-through in Grid-connected Inverters	Verification by Current Control of Multi-phase Transformer-linked Type Boost Chopper Circuit using Current Sensorless Method	Bidirectional DC-AC Converter for Isolated Microgrids with Voltage Unbalance Reduction Capabilities	Model Predictive Current Control for Modular Multilevel Converters	SVPWM-based D-Z Digital Control for $\phi$ Grid-connected Inverter with Wide Inductance Variation	The Cost-efficient, Full ZVS Range Hybrid Full-bridge/Half-bridge Family with Shared Lagging Leg: Topology Derivation, Optimization Design and Experimental Results	Loss Manipulation Capabilities of Deadbeat-direct Torque and Flux Control Induction Machine Drives	A Mechanically Robust Rotor with Transverse-laminations for a Synchronous Reluctance Machine for Traction Applications	Coupled Electromagnetic/Thermal Machine Design Optimization based on Finite Element Analysis with Application of Artificial Neural Network	Using D-Q Transformation to Variable Switching Frequency PWM Control for Interior Permanent Magnet Synchronous Motor Drives	Allowable Power Analysis for High Power Density DC-DC Converters using Integrated Magnetic Components
10:50 am – 11:15 am	Intelligent Maximum Power Extraction Control for Wind Energy Conversion Systems based on Online Q-learning with Function Approximation	Output Voltage Control of 3- $\phi$ Switched Boost Inverter for Standalone Renewable Energy based Distribution Generation Systems	An Alternative Topology for Fault Current Limiting and Interrupting Devices	A Multiport Power Sharing Converter Topology for Renewable-to-grid Interface	Virtual Impedance Current Sharing Control of Parallel Connected Converters for AC Motor Drives	Switched Coupled-inductor Z-source Inverters with Large Conversion Ratio and Soft-switching Condition	3-phase Current-fed Zero Current Switching Phase-shift PWM DC-DC Converter	A Novel Method of Maximum Torque per Ampere Control for a Direct Torque-controlled PMSM in a Stator Flux-linkage Synchronous Frame	Design of a 50,000 rpm Synchronous Reluctance Machine for an Aeronautic Diesel Engine Compressor	A Multi-physics Design Methodology Applied to a High-force-density Short-duty Linear Actuator	Permanent Magnet Temperature Estimation in PMSMs using Pulsating High Frequency Current Injection	Design and Evaluation of the Constant-flux Inductor with Enclosed-winding
11:15 am – 11:40 am	Proportional Derivative based Stabilizing Control of Parallel Grid Converters with Cables in Renewable Power Plants	Decoupled Capacitor Voltage Control of Modular Multilevel Converters	A Silicon Carbide Fault Current Limiter for Distribution Systems	Y-connected Three-leg Converters Applied in Three or Four-wire Shunt Compensator	Improving Power Quality with Multi-objective Modulated Model Predictive Control	A Novel P-Q Variations Method using a Decoupled Injection of Reference Currents for a Precise Estimation of Grid Impedance	A Novel High Efficiency High Power Density Three-port Converter based on Interleaved Half-bridge Converter for Renewable Energy Applications	Super-twisting Sliding Mode Direct Torque Control of Induction Machine Drives	On the Feasibility of Integer and Fractional Number Pole Distributed Winding Designs for Synchronous Reluctance Motors	A Methodology for Predicting the Thermal Behaviour of Modular-wound Electrical Machines	Operating within Dynamic Voltage Limits during Magnetization State Increases in Variable Flux PM Synchronous Machines	Gap Design for Nonlinear Ferrite Cores to Maximize Inductance

11:50 am – 1:20 pm Awards Lunch ..... Spirit of Pittsburgh Ballroom

	Room: 323	Room: 324	Room: 325	Room: 326	Room: 327	Room: 328	Room: 329	Room: 330	Room: 333	Room: 334	Room: 335	Room: 336
1:30 pm – 1:55 pm	<b>S102: LED Drivers II</b> An Input-adaptive Self-oscillating Synchronous Boost Converter for LED Driving with Ultra-low Wide-range Voltage Input	<b>S103: DC-DC Converters for Renewable Energy Applications</b> Frequency-based Control of a Micro-grid with Multiple Renewable Energy Sources	<b>S104: Smart Grid Technologies I</b> Medium Voltage AC Collection Grid for Large Scale Photovoltaic Plants based on Medium Frequency Transformers	<b>S105: HVDC Systems</b> A DC-DC Circuit Suitable for HVDC Applications with Large Step-ratios	<b>S106: Dual Active Bridge DC-DC Converters</b> Dual-input High Gain DC-DC Converter based on the Cockcroft-Walton Multiplier	<b>S107: Multi-level Converter Topologies I</b> A Non-regenerative Five-level Rectifier	<b>S108: Low-power Resonant Converters</b> On-line DC-link Voltage Control of LLC Resonant Converter for Server Power Applications	<b>S109: Modulation for Power Converters II</b> Critical Modulation Method based on PWM in Back-to-back 3-phase System	<b>S110: Power Electronics Reliability Assessment</b> Mission Profile Translation to Capacitor Stresses in Grid-connected Photovoltaic Systems	<b>S111: High Power Drives</b> Improved Selective Harmonics Elimination (SHE) Scheme with Online Harmonic Compensation for High-power PWM Converters	<b>S112: High Speed Electric Machines</b> High Speed Operation of Electrical Machines, a Review on Technology, Benefits and Challenges	<b>S113: Manufacturing Issues of Electric Machines</b> Roll Up Stator Development for 56 Frame PM Synchronous Motor
1:55 pm – 2:20 pm	A Parallel LED String Driver using Capacitors for Source and String Ground Separation	A Family of Dual-input DC-DC Converters based on Quasi-switched-capacitor Circuit	Towards Fully Controllable Multi-terminal DC Grids using Flexible DC Transmission Systems	DC Impedance Modelling of a MMC-HVDC System for DC Voltage Ripple Prediction under a Single-line-to-ground Fault	Novel Multiobjective Optimization of MF Transformers for Soft-switching Converters using a Genetic Algorithm	Optimised Operation Mode for the Hexverter Topology based on Adjacent Compensating Power	Modeling and Experimentation of Misalignment-tolerant Loosely-coupled Coil Structure	A Comparative Investigation of Various Advanced Bus Clamped Space Vector Pulse Width Modulation (SVPWM) Techniques	Reliability Assessment of Power MOSFETs Working in Mode Avalanche on a Thermal Strain Direct Measurement Approach	Model Predictive Control with Very Fast Transient Responses	High Frequency AC Machines Winding Model-parameters Estimation	Reduction of Cogging Torque due to Production Tolerances of Rotor by using Partially Placed Dummy Slots in Axial Direction
2:20 pm – 2:45 pm	Control Scheme for Decoupling Auxiliary Power Supply in Dimmable LED Drivers	Multi-input Transformer Coupled DC-DC Converter for PV-wind based Stand-alone Power Generating System	Standalone ESS Modeling and Dual-loop Control using Zn-Br Redox Flow Battery	Optimization of Limiting Reactors Design for DC Fault Protection of Multi-terminal HVDC Networks	An Isolated Hybrid Switched C-L DC-DC Circuit with High Step-up Ratio and Reduced Switch Voltage Stress	Low-speed Drive Operation of the Modular Multilevel Converter Hexverter Down to Zero Frequency	Comparison of Two High Frequency Converters for Capacitive Power Transfer	A Control Mechanism to Compensate Nonlinearity of Discontinuous Modulation based Grid-connected Cuk Inverter	Transient Modelling of Loss and Thermal Dynamics in Power Semiconductor Devices	A Voltage Controlled Current Source Gate Drive Method for IGBT Devices	Minimization of Proximity Losses in Electrical Machines with Tooth-wound Coils	Performance and Core Loss of Concentrated Winding IPMSM with Different Core Treatment
2:45 pm – 3:10 pm	Inductive Power Transfer System for Driving Multiple OLED Lighting Panels	Inductive-boost Switched-capacitor DC-DC Converter for Maximum Power Point Tracking Photovoltaic Systems	Storage System Requirements for Grid Supporting PV-power Plants	Implementation and Testing of High-power IGBT-based Cascaded-converter Cells	A Series Compensation Enabled ZVS Range Enhancement of a Dual Active Bridge Converter for Wide Range Load Conditions	A Cross Connected Submodule Topology for Hybrid Multilevel Converters	Optimal Operation and Burst-mode Control for Improving the Efficiency of the Quasi-switched-capacitor Resonant Converter	A New Space Vector Modulation Technique for Common-mode Voltage Reduction in both Magnitude and Third-order Component	An Icepak-PSpice Co-simulation Method to Study the Impact of Bond Wires Fatigue on the Current and Temperature Distribution of IGBT Modules under Short-circuit	Modulation Schemes for a 30 MVA IGBT Converter using NPC H-bridges	AC Losses in High Frequency Electrical Machine Windings formed from Large Section Conductors	Manufacturing Influence on the Magnetic Properties and Iron Losses in Cobalt-Iron Stator Cores for Electrical Machines

3:10 pm – 3:30 pm **PM Break**

Noresco Foyer

	Room: 323	Room: 324	Room: 325	Room: 327	Room: 328	Room: 329	Room: 330	Room: 333	Room: 334	Room: 335	Room: 336
3:30 pm – 3:55 pm	<b>S114: Converters for Solar PV Systems</b> Analysis and Experimental Verification of Series-connected Micro-converter Photovoltaic System	<b>S115: Stability Analysis and Power Quality</b> Stability Analysis of Single-phase Grid-connected Inverter with L-filter	<b>S116: Smart Grid Technologies II</b> Evaluation and Control Design of Virtual-synchronous-machine-based Grids with High Penetration of Renewable Energy	<b>S118: Gate Drive Techniques</b> Thermal Analysis and Improvement of Cascode GaN HEMT in Stack-die Structure	<b>S119: Multi-level Converter Topologies II</b> Partial 5/3 Level Topology for Solar Grid-tie Inverters	<b>S120: DC-DC Converter Applications</b> Downsizing Effects of Integrated Magnetic Components in High Power Density DC-DC Converters for EV and HEV	<b>S121: Control of Power Converters III</b> Control and Experiment of High Frequency Isolated Modular Converter under Normal and AC Fault Operating Condition	<b>S122: Energy-efficient Motor Drives</b> Minimum Copper Loss Control of a Single-phase Grid-connected Wound Rotor Machine over Full Speed Range	<b>S123: Wound-field Machines</b> Separately Excited Synchronous Motor with Rotary Transformer for Hybrid Vehicle Application	<b>S124: Axial-flux Machines</b> Increase in Operating Range and Efficiency for Variable Gap Axial Flux Motors	<b>S125: Traction and Heavy-duty Vehicle Systems</b> A Non-dissipative Controllable Charging Equalizer for Series Connected High-capacity Super-capacitors Urban Rail Transport System
3:55 pm – 4:20 pm	Photovoltaic Power Conversion Circuit using a Symmetric Boost Converter for Low-voltage Distribution Systems	Comparison of Modulation Techniques for Active Split-DC-bus 3-phase Four-leg Inverters	Islanding Detection in 3-phase and Single-phase Systems using Pulsating High Frequency Signal Injection	Gate-driver for Safe Operation of Depletion-mode SiC JFETs	Design and Implementation of a Novel Multilevel DC-AC Inverter	A Linear-assisted DC-DC Hybrid Power Converter for Envelope Tracking RF Power Amplifiers	Integrated Grid Inductance Estimation Technique for Finite Control Set Model Predictive Control in Grid Connected Converters	Power Loss, System Efficiency, and Leakage Current Comparison between Si IGBT VFD and SiC FET VFD with Various Filtering Options	Investigation of an Improved Hybrid-excitation Flux Switching Brushless Machine for HEV/ EV Applications	Closed-form Solution for Winding Types of Axial Flux Permanent Magnet Machines	Hybrid Railway Power Conditioner with Partial Compensation for Rating Optimization
4:20 pm – 4:45 pm	New Control Strategy for DCM-232 3-phase PV Inverter with Constant Common Mode Voltage and Anti-islanding Capability	Shunt Active Power Filter based on Source Current Detection with a Fast Transient Response	Analysis of $\Delta P - \Delta Q$ Area of Uncontrolled Islanding in Low Voltage Grids with PV Generators	Transformer Isolated Gate Drive with Protection for SiC MOSFET in High Temperature Application	A High Voltage Gain Multilevel Modular Switched-capacitor DC-DC Converter	A 98.7% Efficient Composite Converter Architecture with Application-tailored Efficiency Characteristic	Finite State Model Predictive Control for 3x3 Matrix Converter based on Switching State Elimination	Pulsating Torque Control with Voltage Suppression Period for Position-dependent Load Torque Applications	Design of SPM and IPM Rotors in Novel One-axis Single-drive Bearingless Motor	Examination for the Higher Efficiency in a Ferrite Permanent Magnet 10 kW In-wheel Axial-gap Motor with Coreless Rotor Structure	DC Side Ripple Cancellation in a Cascaded Multilevel Topology for Automotive Applications
4:45 pm – 5:10 pm	Single-switch Single-magnetic PWM Converter Integrating Voltage Equalizer for Series-connected Photovoltaic Modules under Partial Shading	An Inrush Limited, Surge Tolerant Hybrid Resonant Bridgeless PWM AC-DC PFC Converter	Design, Simulation and Testing of Semiconductor Assisted OLTC for Grid Voltage Regulator	Design and Experimental Validation of a High Frequency Gate Driver for Silicon Carbide Power Modules	Modification of Cascaded H-bridge Multilevel Inverter to Increase Output Voltage Level with a Single DC Voltage Source	Discontinuous Conduction Mode Operation of the 2-phase Integrated-magnetic Boost Converter	Control Strategy for 3-phase Converter under Unbalanced Grid Voltage Conditions Considering Line Loss		Design and Control Strategy of a 2-phase Brushless Exciter for Three-stage Starter/Generator	Analysis and Development of an Axial Flux Magnetic Gear	Experimental Evaluation of E-motor Engine Start in a Heavy-duty Hybrid Vehicle under Cold Soak Conditions

### Registration

Saturday through Thursday  
Noresco Foyer

On-site registration will be open during the following hours:

Sunday, September 14.....	7:00 am – 7:00 pm
Monday, September 15.....	7:00 am – 7:00 pm
Tuesday, September 16.....	7:00 am – 6:00 pm
Wednesday, September 17.....	7:00 am – 7:00 pm
Thursday, September 18.....	7:00 am – 3:00 pm

### Full Conference and Tutorial Registration

Full Conference Registration admits one entrance into all technical sessions, plenary sessions, townhall meetings, access to the exhibition and all social functions. Additional guest tickets for receptions can be purchased at the Registration Desk.

Tutorials will take place on Sunday, September 14, 2014. You may select one morning session and one afternoon session. The rates are outlined below. The registration rate is the same if you choose to attend either one or two tutorials. The registration fee includes materials for all 12 tutorials.

### On-Site Registration Rates

	Conference Only	Tutorial Only*	Conference & Tutorial
<b>IEEE Member</b>	\$900.00	\$475.00	\$1,300.00
<b>Student IEEE Member</b>	\$400.00	\$350.00	\$750.00
<b>Student Non-Member</b>	\$450.00	\$475.00	\$800.00
<b>Society Member</b>	\$850.00	\$425.00	\$1,250.00
<b>Life Member</b>	\$400.00	\$350.00	\$750.00
<b>Non-Member</b>	\$1050.00	\$475.00	\$1,450.00

### One-Day Registration

One-Day Registration admits one entrance into that day's technical sessions, the plenary sessions\*, townhall meetings\*, industrial seminars\*, and access to the exhibition.

### One-Day Registration Rates

Society Member.....	\$400.00
IEEE Member.....	\$450.00
Non-Member.....	\$525.00

\*Access to specified sessions is permitted only if applicable for that day's activities.

### Certificate of Attendance

Certificates of Attendance will not be provided for ECCE 2014.

### Receipts

All who register online will receive a receipt/confirmation via email. All registrants will also receive a receipt attached to their badge, which can be obtained upon check-in. If you need additional paperwork, please contact the customer service staff, located in the Registration Desk.

### Expo Only

Expo Only Registration allows access to the exhibit hall on Tuesday, September 16. Registration is complimentary and tickets can be picked up at the Registration Desk located in the Noresco Foyer.

### Guest Tickets

Guests may purchase a registration for \$175, which includes admission to the opening reception, awards luncheon and conference banquet. A limited number of awards luncheon and conference banquet tickets will be sold onsite. You can still include your guests' name on the registration form, even if he or she does not want to attend the social functions. You may also purchase individual event tickets per the rates below.

Full Guest Ticket.....	\$175.00
Opening Reception Only.....	\$60.00
ECCE Banquet Only.....	\$100.00
Awards Luncheon Only.....	\$60.00

### Badges

Badges should be worn at all official functions of the meeting. Badge checkers will be stationed throughout the meeting areas. Only those with technical registrations will be allowed into sessions. If you forget or lose your badge, you may obtain a second badge at the Registration Desk with proof of registration.

### Consent to Use of Photographic Images

Registration and attendance at, or participation in, ECCE constitutes an agreement by the registrant to ECCE's use and distribution (both now and in the future) of the registrant or attendee's image or voice in photographs, videotapes, electronic reproductions and audiotapes of such events and activities.

### Creative Digression

Sunday through Thursday  
Rooms: 332 and 337

Creative Digressions is what we call a space reserved for those conference attendees who need to go someplace to think, to discuss, to organize their minds around the hubbub of active ties around them. ECCE 2014 is packed with activities that fully engage mental capacities of the participants, the din of activity and the excitement of absorbing and understanding new information and knowledge can sometimes be overwhelming. Think of Creative Digressions as an oasis within the conference. The rooms have been set aside with large tables set up for relaxed conversations rather than for presentation purposes; note pads, easels and white boards are provided in place of cocktail napkins and backs of envelopes to facilitate one-on-one discussions, idea generation sessions, business meetings, or social interactions. Coffee and tea, the lifeblood of engineering, will be provided to fuel the physical mind so that the innovative process can continue apace.



## > General Information

### Accessibility for Registrants with Disabilities

The meeting staff will work with attendees to provide reasonable accommodations for those who require special needs. To request assistance on-site, please check in at the Registration Desk.

### Business Center

The Westin Convention Center Pittsburgh features a 24-hour Business Center on the 2<sup>nd</sup> floor, offering 3 computers, a printer and a copy machine. Copies and print outs are charged at 25 cents per page (black and white) and 30 cents per page (color). Wired High Speed Internet Access is available for a fee of \$6.95 per 15 minutes used at the Westin.

### Cameras and Recording Devices

The use of cameras and/or recorders is strictly prohibited during the oral and poster sessions. Limited use is allowed for Exhibitors in their own booth area. Personal photography is allowed at social functions.

### First Aid

If you are in need of emergency services or hospital care, the nearest hospitals are as follows:

#### UPMC Mercy

1400 Locust Street  
Pittsburgh, PA 15219  
Phone: 412.232.8111

#### Allegheny General Hospital

320 E. North Avenue  
Pittsburgh, PA 15212  
Phone: 412.359.3988

### Hotels

The ECCE 2014 headquarters hotel is the Westin Convention Center Pittsburgh.

#### Westin Convention Center Pittsburgh

1000 Penn Avenue  
Pittsburgh, PA 15222  
Phone: 412.281.3700 or 888.627.7053

### Internet Access

Guest Room Internet is complimentary in IEEE Guestrooms at the Westin Convention Center Pittsburgh. There is complimentary wifi in various areas throughout the David L. Lawrence Convention Center. Please note that wifi will be marked for 30 minutes at a time.

### Local Transportation

Taxi stands are located at the *East Lobby Cut Out* of the David L. Lawrence Convention Center.

### Lost & Found

Lost and found is located at the *Registration Desk* of the David L. Lawrence Convention Center.

### Meals & Refreshments

Full conference registration includes all meals, refreshments and social functions (except the Industry Student Dinner) provided by ECCE 2014.

#### Morning Refreshments

Monday, Wednesday and Thursday — *Noresco Foyer*  
Tuesday — *Exhibit Hall C*

Monday, September 15 ..... 10:00 am – 10:20 am  
Tuesday, September 16 ..... 9:40 am – 10:00 am  
Wednesday, September 17 ..... 9:40 am – 10:00 am  
Thursday, September 18 ..... 9:40 am – 10:00 am

#### Lunch

Tuesday — *Exhibit Hall C*

Tuesday, September 16 ..... 12:00 pm – 2:00 pm

#### Awards Luncheon

Thursday — *Spirit of Pittsburgh Ballroom*

Thursday, September 18 ..... 11:50 am – 1:20 pm

#### Afternoon Refreshments

Monday, Wednesday and Thursday — *Noresco Foyer*  
Tuesday — *Exhibit Hall C*

Tuesday, September 16 ..... 4:15 pm – 4:30 pm  
Wednesday, September 17 ..... 3:10 pm – 3:30 pm  
Thursday, September 18 ..... 3:10 pm – 3:30 pm

### Parking

#### Convention Center:

**Self-Parking** — \$12 USD per day

#### Hotel Parking:

**Self-Parking** — \$20 USD per day

**Valet Parking** — \$24 USD per day (vehicles up to 6')

### Visitor Information Desk

Visit Pittsburgh has a desk at the David L. Lawrence Convention Center on the concourse outside of Exhibit Hall C. This desk is staffed between 7:00 am and 7:00 pm on Sunday and Monday, and 7:00 am and 6:00 pm on Tuesday. The staff specializes in Pittsburgh recommendations: restaurants, dining reservations, attractions, tours, things to do, and transportation options. The desk is also stocked with brochures.

### Newcomers Orientation

Sunday, 4:00 pm – 5:00 pm  
Room: 335

The orientation will consist of a short session intended to act as a guide for those who are new to ECCE. The content of this session, however, contains information that should be of interest to anyone who wishes to organize their conference calendar in a meaningful way or to gain a behind the curtains feel for the content and organization of the conference. Many members of the organizing committee will describe the program elements that they were responsible for. Vice chairs of the Technical Programs Committee will briefly discuss the trends and topics that they felt dominated the submissions in various tracks, as well as the submissions to the Special Sessions. The Town Hall Meeting features student programs, exhibition programs, and Industrial Seminars. We hope to give everyone present a concise briefing on the upcoming conference.

### Meet and Greet the Fellows Reception

Sunday, 5:00 pm – 7:00 pm  
Fourth Floor North Terrace

Join us for a Meet and Greet the Fellows Reception within the Sunday evening Opening Reception of ECCE 2014. A chance to chat, take photos and congratulate the 2014 IEEE Power Electronics Society Class of Fellows that have chosen to receive their award at ECCE.

### PELS Fellows



**Cursino Jacobina**  
Federal University of Campina Grande/DEE

*Honored for contributions to the development of power converters and machine drives.*



**Pedro Rodriguez**  
Abengoa Research

*Honored for contributions to the control of distributed power generation.*



**Charles Sullivan**  
Dartmouth University

*Honored for contributions to the design of power electronic circuits and magnetics.*

### IAS Fellows

**Muhammed Fazlur Rahman**  
University of New South Wales

*Honored for contributions to direct torque control of integrated permanent magnet machines.*

### Opening Reception

Sunday, 5:00 pm – 7:00 pm  
Fourth Floor North Terrace

Catch up with your industry partners and friends! Grab a drink and relax before the week ahead.

### Expo Reception

Monday, 4:00 pm – 6:30 pm  
Exhibit Hall C  
*Supported by Ingersoll Rand*



Enjoy a drink and light snacks while you mingle with industry partners and friends and explore the latest advances in products and services to meet the needs of current and future challenges facing the energy conversion industry.

### Student Paper Awards

A special thank you to the following companies who have funded this year's student paper awards:

**United Technologies Research Center**  
Best Student Papers

**Wiley**  
Best Student Papers

### ECCE on Social Media



[@ieee\\_ecce.com](https://twitter.com/ieee_ecce) #ecce\_2014



[facebook.com/ieee.ecce](https://facebook.com/ieee.ecce)



Join the **IEEE Energy Conversion and Exposition Group**.

## Student-Industry Visit with Exhibits Passport Game

Tuesday, 9:00 am – 5:00 pm

Exhibit Hall C

Supported by Ingersoll Rand



We are happy to introduce the ECCE 2014 Student-Industry Visit with Exhibits Passport Game. This is a great way of highlighting the important relationship between students and industry companies that exhibit every year.

All students will receive an official Passport game-card at registration and have a chance to win great prizes at the official drawing on Tuesday afternoon in the exhibit hall. Directions on how to complete the game will be included on the game card available to students at the registration desk.

## > Presenter Information

### Oral Presenters

#### Speaker Ready Room

The Speaker Ready Room is located in **Room 331** at the David L. Lawrence Convention Center.

The hours of operation of the Speaker Ready Room are as follows:

Saturday, September 13 .....	3:00 pm – 5:00 pm
Sunday, September 14.....	8:30 am – 5:00 pm
Monday, September 15 .....	8:30 am – 5:00 pm
Tuesday, September 16.....	8:30 am – 12:00 pm
Wednesday, September 17 .....	8:30 am – 5:00 pm
Thursday, September 18.....	8:30 am – 12:00 pm

#### Presentations

The oral presentation time slots are 25 minutes each. Please prepare a presentation for 20 minutes and leave 5 minutes for setting up, and questions & answers. Please strictly observe this time limit in order to facilitate people moving between sessions. All oral presenters are required to prepare PowerPoint slides for their visual presentations. You do not need to submit a hard copy of your slides and you do not need to bring a computer onsite, as all presentations will be pre-loaded onto the Seminar computer that will be in your session room.

## Industry Tours

Wednesday, 10:00 am – 12:30 pm

Location: Please meet at the David L. Lawrence Convention Center East Lobby Cutout

### Eaton Power Systems Experience Center

Cost: \$40/person (transportation cost)

Limited to 50 people

At the Power Systems Experience Center (PSEC), Eaton's full-scale laboratory and demonstration facility near Pittsburgh, visitors can see firsthand the latest advances in electrical power quality, energy management and safety. In this controlled environment, visitors observe product testing and performance, participate in live demonstrations and learn about power management technologies from Eaton experts.

Please inquire at the registration desk for more information.

### ECCE Banquet

Wednesday, 7:00 pm – 9:00 pm

Spirit of Pittsburgh Ballroom

Join your colleagues for great food, drinks, entertainment and networking.

#### Presentation Upload

**All presentations must be uploaded in the Speaker Ready Room at ECCE 2014!** We will not have an advanced upload site this year as ALL speakers will be directed to the speaker ready room (room 331) to upload their presentation. If you are speaking before 12:00 pm, you will need to upload your presentation the day prior to your session. If you are speaking after 1:00 pm, you will need to upload your presentation by 10:00 am.

For your reference, see the following grid showing the due date/time for your presentation upload, based on the day/time you are speaking:

Speaking Day/Time	Presentation Upload Cutoff Day/Time
Sunday 8:00 am – 12:00 pm .....	No later than Saturday 5:00 pm
Sunday 1:00 pm – 5:00 pm .....	No later than Sunday 10:00 am
Monday 8:00 am – 12:00 pm .....	No later than Sunday 5:00 pm
Monday 1:00 pm – 5:00 pm .....	No later than Monday 10:00 am
Tuesday 8:00 am – 12:00 pm .....	No later than Monday 5:00 pm
Wednesday 8:00 am – 12:00 pm .....	No later than Tuesday 12:00 pm
Wednesday 1:00 pm – 5:10 pm .....	No later than Wednesday 10:00 am
Thursday 8:00 am – 12:00 pm .....	No later than Wednesday 5:00 pm
Thursday 1:00 pm – 5:10 pm .....	No later than Thursday 10:00 am

If you have edits to your presentation after the cutoff time listed above, you will need to bring your updated presentation with you on a flash drive directly to the session room.

### Oral Presenters (Continued)

#### Oral Presenters' Orientation

A Presenters' orientation will be held for oral presenters and session chairs from 7:00 am – 8:00 am, Monday through Thursday at the David L. Lawrence Convention Center:

- Monday - Tuesday: *Allegheny Overlook*
- Wednesday - Thursday: *Spirit of Pittsburgh Ballroom*

Oral presenters should meet with their respective session chairs to review the format and timing of their session and alert conference management of any changes.

Oral Presenters should attend the orientation each day that they are scheduled to provide an oral presentation (or chair a session); you may only attend on days on which you are scheduled to speak.



### Poster Presenters

#### Poster Presentation Schedule

Tuesday  
*Exhibit Hall C*

Poster Session I .....Monday, September 15, 5:00 pm – 6:30 pm  
Poster Session II ..... Tuesday, September 16, 10:00 am – 11:30 am  
Poster Session III ..... Tuesday, September 16, 3:30 pm – 5:00 pm

Posters will be on display on Monday and Tuesday in *Exhibit Hall C* at the David L. Lawrence Convention Center. The poster presenters should be available for questions at their display boards during their scheduled poster presentation time. If you are unsure in which session your poster should be presented, please review the complete Technical Session schedule starting on page 32.

Poster Presenters will have access to *Exhibit Hall C* at the David L. Lawrence Convention Center to set up and tear down their posters at the times listed below for each of the Poster Sessions.

#### Poster Presenters' Orientation

A Presenters' orientation will be held for poster presenters on Monday and Tuesday at the David L. Lawrence Convention Center. The orientation will be located at the stage in *Exhibit Hall C* as follows:

Monday..... 1:30 pm – 2:00 pm  
Tuesday ..... 7:30 am – 8:00 am

Poster Presenters should attend the orientation each day that they are scheduled to provide a poster presentation; you may only attend on days on which you are scheduled to present.

#### Poster Session I Setup

Setup.....Monday, September 15, 2:00 pm – 4:00 pm  
Poster Session .....Monday, September 15, 4:00 pm – 6:30 pm  
Breakdown .....Monday, September 15, 6:30 pm – 7:30 pm

Presenters for Poster Session I must have their posters set-up no later than 4:00 pm. Any posters that remain on the poster boards at 7:30 pm, and do not belong in Poster Session II will be removed and kept at the Registration Desk.

#### Poster Session II Setup

Setup..... Tuesday, September 16, 8:00 am – 9:00 am  
Poster Session ..... Tuesday, September 16, 10:00 am – 11:30 am  
Breakdown ..... Tuesday, September 16, 11:30 am – 12:30 pm

Presenters for Poster Session II must have their posters set-up no later than 9:00 am. Any posters that remain on the poster boards at 12:30 pm, and do not belong in Poster Session III will be removed and kept at the Registration Desk.

#### Poster Session III Setup

Setup..... Tuesday, September 16, 2:00 – 3:00 pm  
Poster Session ..... Tuesday, September 16, 3:30 – 5:00 am  
Breakdown ..... Tuesday, September 16, 6:00 – 7:00 pm

Presenters for Poster Session I must have their posters set-up no later than 3:00 pm. Any posters that remain on the poster boards at 7:00 pm, will be removed and kept at the Registration Desk.

Uncollected posters will be discarded.

#### Poster Boards & Push-pins

4' x 8' poster boards will be provided, so please keep these dimensions in mind when printing your posters. Push pins will be provided for all poster presenters.

Monday, September 15

8:00 am – 10:00 am

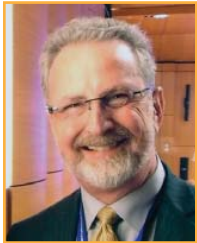
*Spirit of Pittsburgh Ballroom*

The distinguished plenary speakers were invited this year to share their insights on the trends and the future of various aspects of energy conversion. The topics cover materials, components, subsystems and systems of energy conversion. The diverse mix of presentations from the leaders in their field will set the tone for this year's conference. The organizing committee is pleased to welcome each of these speakers and offers warm appreciation for their contribution to the success of the conference.

Tomy Sebastian  
IEEE ECCE Plenary Session Chair

### “Critical Materials for Energy Systems Manufacturing”

**Dr. Alex King**, *Director of the Critical Materials Institute, The Ames Laboratory, Ames, Iowa, USA*



Dr. Alex King is the Director of the US Department of Energy's Critical Materials Institute; and the former Director of the Ames Laboratory, in Ames, Iowa. He has been a Visiting Fellow of the Japan Society for the Promotion of Science; and a US Department of State Jefferson Science Fellow. He is a Fellow of the Institute of Mining Minerals and Materials; ASM International; and the Materials Research Society. Dr. King has also been the President of the Materials Research Society; Chair

of the University Materials Council; and Chair of the American Physical Society's Group on Energy Research and Applications.

### “High Power Electronics Innovation”

**Dr. Peter K. Steimer**, *General Manager of the R&D Department for Drives & Power Electronics, ABB Switzerland*



Dr. Peter K. Steimer received his MSc in 1981 and his PhD in 1991 from the Swiss Federal Institute of Technology in Zurich. From 1990 till 1996 he has been the general manager of the R&D department for drives & power electronics. From 1994 till 1997 he has been responsible for ABB's high impact program focused on the development of the new IGCT power semiconductors technology. In 1998/99 he served as an adjunct professor at the University of Wisconsin in Madison.

From 1999 onwards he has been responsible for the technology and innovation management of ABB's business unit for medium voltage drives and power electronics systems. In 2002 he successfully graduated in the program “Mastering technology enterprise” of IMD, a management school for executive education. Since 2013 Dr. Peter K. Steimer is serving as Vice President of Innovation for ABB's newly established global ABB Business Unit Power Conversion covering Renewables (wind, solar), Power protection, Power control, Energy storage, Transportation and Electric Vehicle charging markets. His research interests are with high power semiconductors, multi-level topologies and new applications. He is the inventor or co-inventor of more than 50 patents and has authored or co-authored more than 90 technical papers. He is an IEEE fellow and an ABB Corporate Executive Engineer.

### “Barriers to the Electrification of the Automobile”

**Peter Savagian**, *General Director, Electrification Systems and Electric Drive Engineering, General Motors Corp, Pontiac, Michigan, USA*



Peter Savagian has worked on electric vehicles and systems since 1990. He now serves as General Director of GM's Electrification Systems and Electric Drive Engineering organization. For the past 16 years he has managed product and technology development for GM's hybrid and electric vehicles, including architecture development, electronics and motor design and development, systems engineering, systems analysis, and control algorithms development. Prior to his current assignment, Pete was Chief Engineer for GM's EV1 Electric Vehicle Electric Drive at General Motors and at Delco Electronics. He has also worked at Hughes Aircraft Company and Sundstrand Aviation in various engineering roles. Pete holds a BS in Mechanical Engineering from the University of Wisconsin, a MS in Operations Research Engineering from the University of Southern California, and an MBA from Duke University.

### “Impact of Renewable Energy Sources on the Power Scenario in Developing Countries”

**S.S. Mani**, *General Manager of Renewable Energy Projects, NTPC Ltd, Belgaum, Karnataka, India*



S.S. Mani received his Bachelors Degree in Electrical Engineering from Regional Engineering College (Presently, National Institute of Technology), Calicut in 1979, MS in Quality management from Birla Institute of Technology, Pilani, in 2012 & Post Graduate Certificate Program in Project Management from Indian Institute of Management, Indore during 2013-14. Currently, he is the General Manager of Renewable Energy Projects in NTPC Ltd, India. NTPC is India's Largest Power Utility Company and, as on Nov 2013 NTPC is having an Installed Capacity of 42 GW with 10 MWp of Solar PV Power Capacity & another 20 GW including 100 MWp Solar PV Projects are under construction. He was responsible for the Construction & Commissioning of 5 MWp Solar PV Project in Port Blair/Andaman & Nicobar Island in India. This Project is NTPC's 'Numero-Uno' Green Field Renewable Energy Project & was commissioned in a Benchmarking Schedule, thereby bagging the Company Award for Best Performance in Project Management (Renewable Projects) for 2012-13. He was also Head of Technical Services/Planning & Systems at NTPC's 2600 MW Coal Based Project at Ramagundam & 350 MW Naphta Based Combined Cycle Power Project at Kayamkulam. Mani is a Qualified Assessor of CII-Exim Bank Award for Business Excellence (EFQM Model) & IPMA Award Assessor for Project Management.

**Tuesday, September 16**

**10:00 am – 12:00 pm**

There will be two Townhall meeting sessions this year at ECCE for attendees to engage in debate concerning critical issues in state of the art and emerging technologies. This year's format is less formal to allow attendees to feel at ease and engage in open discussion with expert panelists. Each panelist will make a brief presentation to initiate the discussion.

The meetings will be led by a moderator in order to keep the meandering digressions to a minimum, yet stimulate and promote innovative tangents. Participants are strongly encouraged to contribute to the debate, discussion, and discourse surrounding the selected topics. We are hoping for honest discussion about the topics in a passionate and intelligent way.

The two sessions this year will focus on hybrid/electric vehicles and wide band gap devices.

### **Townhall: Wide Band Gap Devices — Potentials versus Reality**

*Room: 329*

Power electronics are an enabling technology for almost every modern electrical system from the smart grid to consumer electronics. One reason for the success and implementation of power electronics is the ever increasing efficiency, performance and reliability, which is further enhanced by wide band gap devices such as GaN, SiC etc. This meeting will focus on the potentials, current trends and the state of the art of WBG device technologies.

#### **Moderator**

Burak Ozpineci, *Oak Ridge National Laboratory, USA*

#### **Panelists**

Anant Argarwal, *Wide Band Gap Initiative, EERE*

Sharon Beerman-Curtin, *Sea Warfare and Weapons Department,*

*Office of Naval Research*

Jeff Casady, *CREE*

Alex Lidlow, *Efficient Power Conversion*

Ranbir Singh, *GeneSiC Semiconductor Inc.*

Ljubisa Stevanovic, *GE Global Research*

### **Townhall: Hybrid/Electric Vehicles — Today and Tomorrow**

*Room: 330*

Hybrid/Electric vehicles are vital for energy efficiency and to reduce the dependency on oil. Many topologies have been proposed and developed to meet this desire. However there are challenges and uncertainties to overcome to penetrate the market profoundly. This meeting will focus on the latest technologies, policies and the future of hybrid/electric vehicles.

#### **Moderator**

Chris Mi, *University of Michigan - Dearborn, USA*

#### **Panelists**

Mohamed Alamgir, *LG Chem Power Inc.*

Bing Cheng, *Chrysler Group LLC*

David Fulton, *Remy Inc.*

Chun T. Rim, *Department of NQE, KAIST*

V. Anand Sankaran, *Ford Motor Company*



Note: All tutorials are held on September 14, 2014. Pre-registration for each tutorial is required. Please visit the Registration Desk for space availability.

Sunday, September 14

8:00 am – 12:00 pm

Morning Sessions

## T1-1 Design Challenges of High-power Converters with Low Switching Frequencies

Room: 323

Instructors: Dr. Jie Shen, Dr. Stefan Schroeder, *GE Global Research Europe*

This tutorial focuses on industrial high-power medium-voltage converters that use high-power medium-voltage devices like IGBTs and IEGTs. Such converters reach high power ratings (e.g. 10 – 30 MVA) with minimum quantity of switching devices. However, medium-voltage devices have typically high switching losses, which limit the switching frequency of converters at only several hundred Hertz. As a result, the optimization of the converter performance like the power capability, power quality and the control dynamics becomes challenging. This tutorial discusses the design of such converters in three aspects: converter topology, modulation scheme and current controller. It should be noted that several special phenomena occur due to the low switching frequency, and they may lead to a significant performance degradation of the converter. In this tutorial, several modeling methodologies are introduced, which are explicitly developed to explore the mechanism of these special phenomena at low switching frequencies. Based on this, generalized design guidelines for the design and optimization are summarized, which have been developed, implemented and experimentally validated. Comparative analysis of converters with low switching frequencies versus high switching frequencies will be conducted throughout the tutorial, since the latter ones are more familiar to most audience (as reference). Moreover, some design examples will be given.

## T1-2 Predictive Control — A Simple and Powerful Method to Control Power Converters and Drives

Room: 324

Instructors: Prof. Dr.-Ing. Ralph Kennel, *Technische Universität München, Germany*, Prof. José Rodríguez, *Universidad Técnica Federico Santa María, Chile*, Prof. Marian Kazmierkowski, *Warsaw University of Technology, Poland*

Up to now the control of electrical power using power converters has been based on the principle of mean value, using pulse width modulation with linear controllers in a cascaded structure. Recent research works have demonstrated that it is possible to use Predictive Control to control electrical energy with the use of power converters, without using modulators and linear controllers. This is a new approach that will have a strong impact on control in power electronics in coming decades. The main advantages of predictive control are: (1) Concepts are very intuitive and easy to understand; (2) It can be applied to a great variety of systems; (3) The multivariable case can be easily considered; (4) Dead times can be compensated; (5) Easy inclusion of non-linearities in the model; (6) Simple treatment of constraints; (7) The resulting controller is easy to implement; and (8) This methodology is open to include modifications and extensions depending on specific applications. The participants of this tutorial will learn: (1) The basic concepts and ideas; (2) Different types of predictive controllers; (3) Detailed examples of predictive controllers; and (4) Several applications in different converter topologies.

## T1-3 The Technology and Market Issues of Magnetic Materials

Room: 325

Instructor: Steve Constantinides, *Arnold Magnetic Technologies Corporation, USA*

Proper selection and optimized utilization of permanent and soft magnetic materials requires an understanding of their magnetic and physical properties, how each material reacts to temperature, and the environment and what the application requires regarding a full set of magnetic and physical properties under either or both DC and AC applied field conditions. This tutorial is designed to introduce the fundamental principles of magnetism, explore a full range of magnetic materials and learn how to interpret manufacturer's specifications. Also covered, the market for magnetic materials, sources, supply security, and forecast for material availability.

## T1-4 Electromechanical Power Loss Analysis in Design and Optimisation of Electrical Machines: Practical Aspects of Accurate Loss Estimation and Mitigation Techniques

Room: 326

Instructors: Dr. Rafal Wrobel, *University of Bristol, UK*, Dr. Mircea Popescu, *Motor Design Ltd., UK*

Continuous drive towards high-power density and high-efficiency machine designs has resulted in increased interest in more accurate design and optimization methodologies, where the multi-disciplinary and multi-physics phenomena are accounted for. In depth understanding of the electromagnetic, thermal and mechanical interactions are essential when developing new machine designs or evaluating existing solutions. The electromechanical power loss is of particular interest as it determines the power output capability and power conversion efficiency of an electrical machine. The theoretical analysis of the power loss allows for identifying and quantifying the loss mechanisms that would be difficult to determine if a common testing procedure on complete machine hardware was used instead. It is important to note that the power loss and thermal effects are strongly interdependent and their accurate derivation requires a careful consideration. Importance of this research theme has been acknowledged by numerous authors and documented by the wide body of work devoted to the high-performance electrical machines and many others. The most commonly reported industrial applications are focused, but not limited to the 'More Electric Aircraft', 'Hybrid Vehicle' and 'Electrical Vehicle' concepts. The aim of this tutorial is to outline and overview various power loss mechanisms generated in electrical machines under normal operation. Particular emphasis is placed on methods of predicting and mitigating the loss. Various practical examples from the instructors experience are given in detail including both theoretical and experimental techniques and methodologies. The loss mechanisms discussed in the tutorial include: mechanical loss, winding loss, core loss, permanent magnet loss and retaining sleeve loss. More specifically, the latest developments in timely topics such as proximity loss in windings, core loss in electric motors within variable speed systems, loss in high-energy permanent magnets (NdFeB and SmCo), loss in stator and rotor retaining sleeves (carbon fibre), mechanical and bearings loss are discussed. Some details regarding loss thermal dependence at high-frequency AC operation is also provided.

## T1-5 Power semiconductor modules: Design, Applications, Manufacturing & Reliability

Room: 327

Instructor: Dr. Andre Christmann, *Infineon Technologies North America Corp.*

This tutorial will provide an overview of power semiconductor modules in automotive HEV/EV inverter applications. The tutorial will cover four major aspects of power module: design, applications, manufacturing and reliability. These four aspects are inter-related. A power module is designed to meet specific HEV/EV inverter applications. The broad module reliability specification is also driven by the applications requirements (vehicle drive cycles). However, the specific module reliability target will depend on module design (material, size etc.) and manufacturing process. The tutorial will cover the basics of power module design: structure, interconnections, thermal and electrical performance. Although the focus of this tutorial is power module design, the fundamentals of the semiconductor devices (IGBT/diodes) used in these modules will be summarized. The design of the power module strongly depends on the device characteristics. The characteristics of the devices can be tuned to optimize power module performance. Both the device and module performance strongly influences the inverter efficiency, which, in turn, impacts MPG rating of the vehicle. Heat losses from the devices and module thermal performance determine the silicon and module size and therefore the cost of the inverter. The mechanical stresses that vehicle operating conditions (duty cycle) imposes on an inverter also depends on device and module characteristics. The tutorial will connect various aspects of power device and module characteristics for Hybrid-Electric Vehicle inverter applications. Basic production processes will be discussed via a video of actual module production facility. A brief introduction to simulations for life time expectation of the modules will be presented and a couple of practical examples will be discussed. Special emphasis will be provided on the influence of power module design on lifetime and the impact of various external thermal and electrical parameters. The tutorial will prepare engineers and managers to answer in three questions: (1) how does the power device and module characteristics impact fuel economy? (2) how can I specify power module reliability requirements based on vehicle drive cycles? and (3) how is power module designed, manufactured and qualified?

## T1-6 Electrification of Subsea Process Plants, Why and How

Room: 328

Instructor: Svend Erik Rocke, *GE Oil & Gas, Norway*

Exploitation of Oil and Gas deposits from below sea surface is increasing and the production technology is moving from using fixed platforms/floating vessels towards locating all production and processing equipment on the seabed. Processing equipment such as pumps and compressors need a large amount of electric power, which has to be provided from shore, platforms or floating vessels. The Tutorial will touch on the challenges for oil and gas production and transportation and provide background for the need of pumps and compressors and the required electric power to meet the flow and process needs. Different Electric Power Transmission and Distribution Systems will be presented and discussed related to the application and physical limitations. Critical components such as transformers, VSD's, Switchgears, cables and Connections will be presented including challenges and limitations seen from a subsea perspective. Electrification of seabed electric consumers is challenging, not only because of all components being submerged in seawater at water depths down to 10000 feet/3000m, but also the required accessibility to repair/exchange the components by regular maintenance and /or in a "fault situation". This shall be

taken into account in the modularization and the subsea lay-out in order to achieve the required availability of typical 98%. Consequently all electric components has to undergo severe qualification testing prior to being installed subsea following agreed test schedules to meet required TRL (Technical Readiness Level). The TRL levels and requirements will be displayed and an example from electrical wet mate connector qualification will be briefly presented. As subsea electrification is a relatively new technology and application area, Subsea Standards are not very well developed. However, several Oil Companies are cooperating in developing common standards, with the intention to transfer these to IEEE/IEC standards. The first Standard following this path is on Connections, with more to come. The tutorial will inform briefly of the ongoing work. Finally the Tutorial will look at future challenges and potential solutions for transmission on long distances, (DC) and taking components down to very deep waters (Pressure Tolerant solutions).

Sunday, September 14

1:00 pm – 5:00 pm

### Afternoon Sessions

## T2-1 Feedback-loop Design Issues of DC-DC Converters in High-power Energy Harvesting Applications

Room: 323

Instructor: Dr. Antonio Lazaro, Dr. Andrés Barrado, *Carlos III University of Madrid*

Exploiting the energy of sea waves, or recuperating the kinetic or potential energy of mechanical systems (electric vehicles, cranes and elevators, etc.) can be considered highpower energy harvesting. It is a common characteristic of such systems that the input power shows relatively rapid fluctuations, necessitating the need for short-term energy storage and bidirectional energy processing. The power converters used to control the power flow between the various building blocks of the system (electric generators, storage devices, motors, utility interface) must maintain stability and be able to handle the fluctuations under widely varying operating conditions.

## T2-2 Design for Reliability of Power Electronic Systems

Room: 324

Instructors: Frede Blaabjerg, *Center of Reliable Power Electronics (CORPE), Aalborg University, Denmark*, Huai Wang, *Center of Reliable Power Electronics (CORPE), Aalborg University, Denmark*, Ke Ma, *Center of Reliable Power Electronics (CORPE), Aalborg University, Denmark*, Marco Liserre, *Christian-Albrechts-University of Kiel, Germany*

In recent years, the automotive and aerospace industries have brought stringent reliability constraints on power electronic systems because of safety requirements. Today customers of many power electronic products expect up to 20 years of lifetime and they also want to have a "failure free period" and all with focus at the financials. The industrial and energy sectors are also following the same trend, and more and more efforts are being devoted to improving power electronic systems to account for reliability with cost-effective and sustainable solutions. The emphasis of this tutorial is to give a framework on the design for reliability of power electronic systems and the recent research activities and paradigm shifts in this research area. It will cover the reliability requirements in different industry sectors, reliability and lifetime of IGBT modules and capacitors used in power electronic converters, and the specific design for reliability procedure for power electronic systems. Study cases on mission profile based design of photovoltaic inverters and wind power converters, and active thermal control and condition monitoring of power converters are also discussed. The approaches presented in the tutorial are also the common interest for the companies involved in the



Center of Reliable Power Electronics (CORPE) at Aalborg University (<http://www.corpe.et.aau.dk/>). The tutorial will also present the views of the instructors on the future research opportunities in the area of reliability of power electronics.

## T2-3 Impedance-based Modeling and Analysis of 3-phase Grid-connected Converters

Room: 325

Instructor: Dr. Jian Sun, *Rensselaer Polytechnic Institute*

Operation and control performance of grid connected converters are strongly influenced by the grid. A wind or solar inverter, for example, may become unstable when connected to a weak grid that has high impedance. A converter may also form resonance with the grid impedance, producing high harmonics that deteriorate grid power quality, trig converter and grid protection functions, and cause physical damages to the converter and other devices in the grid. Impedance-based methods have been used extensively to study stability and dynamic performance of dc power systems. However, the time-varying (sinusoidal) operation trajectory of a converter with ac power system makes it mathematically difficult to develop its impedance models by conventional small-signal analysis. Additionally, the method cannot be directly applied to three-phase converters due to the mutual coupling among three phases (when there is no neutral connection, as is usually the case). This tutorial introduces impedance-based modeling and analysis methods for converters connected to the ac power grid, with a focus on three-phase PWM inverters and rectifiers. A new method combining harmonic linearization with symmetrical component analysis is presented for three-phase converters. In this approach, a three-phase converter is modeled by positive-sequence and negative-sequence impedances, and converter-grid interactions are studied using a positive-sequence and a negative-sequence equivalent circuit that are uncoupled from each other, such that the conventional Nyquist criterion can be applied. Applications of the method in such practical problems as converter control instability under weak grid conditions and harmonic resonance between the converter and the grid will be presented. Practical methods to measure three-phase converter and grid impedances are also presented, and the possibility to develop adaptive control for solar and wind inverters based on real-time measurement of the grid impedance is discussed.

## T2-4 GaN Transistors for Efficient Power Conversion

Room: 326

Instructors: Dr. Alex Lidow, Dr. David Reusch, *Efficient Power Conversion Corporation (EPC)*

Gallium Nitride (GaN) is now accepted in many power conversion and RF applications. The technology is rapidly developing and product experience in the field is expanding. This tutorial will begin with a discussion of the state-of-the-art in GaN technology, including an overview of GaN technology, GaN transistor structures and the latest electrical performance. The tutorial will continue with application examples including new developments in high efficiency DC-DC conversion and emerging applications enabled by GaN transistors, such as high frequency Envelope Tracking (ET), and Wireless Power Transfer (WiPo). Following these examples, drivers, layout, paralleling, dead-time management, and thermal considerations will be examined. The tutorial concludes with a look into future of this relatively young technology and its potential to improve performance in existing applications and enable new applications not possible with aging silicon MOSFETs. Beyond the discrete transistor, the extension of GaN technology to fully integrated circuits will be discussed, furthering the potential of GaN to raise the bar in power conversion performance.

## T2-5 The Rediscovery of Synchronous Reluctance and Ferrite PM Motors as Valid Competitors to Induction and Rare-earth PM Motors

Room: 327

Instructors: Dr. Gianmario Pellegrino, *Politecnico di Torino, Turin, Italy*, Dr. Thomas Jahns, *University of Wisconsin-Madison, USA*, Dr. Nicola Bianchi, *University of Padova, Italy*, Dr. Wen Soong, *The University of Adelaide, Australia*, Dr. Francesco Cupertino, *Politecnico di Bari, Italy*

The considerable recent variability in the price of rare-earth permanent magnets (PM) has caused a resurgence of interest in alternative machine topologies including synchronous reluctance and ferrite PM machines. This tutorial covers the analysis and design of synchronous motors for variable-speed applications, including permanent magnet and synchronous reluctance machines. It does not focus on a specific application, but aims to provide a broad perspective on electrical motors that are becoming a valid alternative to those currently used in variable-speed drives, such as induction motors and rare-earth PM synchronous machines. Among others, synchronous reluctance machines and PM machines without rare-earth materials will be considered and compared with state-of-the-art solutions.

## T2-6 Soft Crystalline Magnetic Materials

Room: 328

Instructor: Sigrid Jacobs, *ArcelorMittal Belgium*

Ferromagnetic materials play a key role in electrical machines: their presence in the cores of these machines can greatly influence the torque / power developed, as well as their efficiency. This works via the mechanism of flux concentration: if a current carrying conductor coil is placed around a ferromagnetic material, much more magnetic flux can be generated for a given current; and this flux is important for the torque developed by a motor or the energy transferred in a transformer. The tutorial starts with the principles of ferromagnetism and develops further into what happens during magnetisation processes, within the structure of typical ferromagnetic materials such as FeSi (electrical steels), FeCo and FeNi. Phenomena such as hysteresis, eddy currents, magnetic domains, Curie temperature, soft versus hard materials, are explained. The parameters that influence the level of flux concentration, as well as the level of energy losses within the ferromagnetic material are shown. The target of the tutorial is to clarify what are the differences between magnetic materials on the market, to show their key advantages and weaknesses. The different classes of magnetic materials will be explained: soft vs. hard, crystalline vs. amorphous, ferrites vs. composites vs. laminations, non-oriented vs. oriented, fully processed vs. semi-processed. The most suitable magnetic material for different types of electric applications will be explained, with examples on their influence of machine performance. The aim is to assist in a cost/performance choice when going into machine design and having a ferromagnetic material choice to make. This will be done in most detail for soft crystalline magnetic materials.

Monday, September 15

10:20 am – 12:00 pm

## S1 MPPT for Solar PV Systems

Room: 323

Chair: Ahmed Elasser

### 10:20 am > Distributed Control of PV Strings with Module Integrated Converters in Presence of a Central MPPT

Dezso Sera, Laszlo Mathe, Frede Blaabjerg, Aalborg University, Denmark

### 10:45 am > Maximum Power Point Tracking for Multiple Photovoltaic Modules using Root-finding Methods

Joonhyun Kim, Alexis Kwasinski, University of Texas at Austin, United States

### 11:10 am > PV Generation Enhancement with a Virtual Inertia Emulator to Provide Inertial Response to the Grid

Xiaoyu Wang, Meng Yue, Eduard Muljadi, Brookhaven National Laboratory, United States; National Renewable Energy Laboratory, United States

### 11:35 am > Using MPPT in Multi-pulse Converters for Photovoltaic Cogeneration

Lucas Lapolli Brighenti, Rubens Tadeu Hock Jr., Luis Gustavo Kremer, Alessandro Luiz Batschauer, Marcello Mezaroba, Santa Catarina State University, Brazil

## S2 Power Converters for Photovoltaic Applications

Room: 324

Chairs: M. Amirabadi, T. Shimizu

### 10:20 am > Low-voltage Ride through Capability of 3-phase Grid-connected Photovoltaic Inverters with Slim Film Capacitors

Baburaj Karanayil, Josep Pou, Mitra Mirhosseini, Vassilios G. Agelidis, University of New South Wales, Australia; Technical University of Catalonia, Spain

### 10:45 am > Modular Photovoltaic Inverter with High-frequency DC-DC Stage based on Low-voltage FETs

F. Giuliani, D. Barater, C. Concari, P. Cova, N. Delmonte, R. Menozzi, G. Buticchi, L. Tarisciotti, University of Parma, Italy; University of Kiel, Germany; University of Nottingham, United Kingdom

### 11:10 am > Control Approach to Achieve Burst Mode Operation with DC-link Voltage Protection in Single-phase Two-stage PV Inverters

Yang Du, Weidong Xiao, Yihua Hu, Dylan Dah-Chuan Lu, Masdar Institute of Science and Technology, United Arab Emirates; University of Strathclyde, United Kingdom; University of Sydney, Australia

### 11:35 am > Optimized Control of Isolated Residential Power Router for Photovoltaic Applications

Yuzhi Zhang, Janviere Umuhoza, Yusi Liu, Chris Farnell, H. Alan Mantooth, Roger Dougal, University of Arkansas, United States; University of South Carolina, United States

## S3 Microgrid Control I

Room: 325

Chairs: Sandeep Bala, Dragan Maksimović

### 10:20 am > Dual Sequence Current Controller without Current Sequence Decomposition Implemented on DSRF for Unbalanced Grid Voltage Conditions

Sizhan Zhou, Jinjun Liu, Linyuan Zhou, Hongwei She, Xi'an Jiaotong University, China

### 10:45 am > Voltage-frequency Control of an Islanded Microgrid using the Intrinsic Droop Characteristics of Resonant Current Regulators

B. Shoeiby, R. Davoodnezhad, D.G. Holmes, B.P. McGrath, RMIT University, Australia

### 11:10 am > Plug and Play Nonlinear Droop Construction Scheme to Optimize Microgrid Operations

Fatih Cingoz, Ali Elrayah, Yilmaz Sozer, University of Akron, United States

### 11:35 am > Transient Droop for Improved Transient Load Sharing in Microgrids

Andrew Paquette, Deepak Divan, Georgia Institute of Technology, United States

## S4 Widebandgap Devices I

Room: 326

Chairs: Filippo Chimento, Jerry Hudgins

### 10:20 am > Modeling and Characterization of a 300 V GaN based Boost Converter with 96% Efficiency at 1 MHz

Raghav Khanna, Brian Hughes, William Stanchina, Rongming Chu, Karim Boutros, Gregory Reed, University of Pittsburgh, United States; HRL Laboratories LLC, United States

### 10:45 am > Analytical Loss Model of Low Voltage Enhancement Mode GaN HEMTs

Wang Kangping, Yang Xu, Zeng Xiangjun, Yu Xiaoling, Li Hongchang, Guo Yixuan, Gao Bing, Ma Huan, Xi'an Jiaotong University, China

### 11:10 am > Avoiding Si MOSFET Avalanche and Achieving True Zero-voltage-switching for Cascode Device

Xiucheng Huang, Weijing Du, Zhengyang Liu, Fred C. Lee, Qiang Li, Virginia Polytechnic Institute and State University, United States

### 11:35 am > Characterization and Modeling of a Gallium Nitride Power HEMT

Kang Peng, Enrico Santi, University of South Carolina, United States

## S5 Reliability and Diagnostics in Grid Converters

Room: 327

Chair: Antonio M. Cardoso

### 10:20 am > Detection of Capacitor Degradation in LC Filters for AC Drives

Rangarajan M. Tallam, Russel J. Kerkman, Richard A. Lukaszewski, Rockwell Automation, United States

### 10:45 am > Improved Reliability of Single-phase PV Inverters by Limiting the Maximum Feed-in Power

Yongheng Yang, Huai Wang, Frede Blaabjerg, Aalborg University, Denmark

### 11:10 am > Improved Dual Second-order Generalized Integrator PLL for Grid Synchronization under Non-ideal Grid Voltages including DC Offset

Jie Li, Jing Zhao, Jia Wu, Ping-ping Xu, Xi'an University of Technology, China

### 11:35 am > Single Phase Synchronous Reference Frame Power Control of Grid Connected Multi Level Inverter

Bhanu Naga V Angirekula, Olorunfemi Ojo, Tennessee Technological University, United States

## S6 Telecom Power Supplies

Room: 328

Chair: Xiao-Bo Yang

### 10:20 am > Hyper-efficient (98%) and Super-compact (3.3kW/dm<sup>3</sup>) Isolated AC-DC Telecom Power Supply Module based on Multi-cell Converter Approach

Matthias Kasper, Dominik Bortis, Johann W. Kolar, Gerald Deboy, ETH Zurich, Switzerland; Infineon Technologies Austria, AG, Austria

### 10:45 am > Adaptive Implementation Strategy of Virtual Impedance for Paralleled Inverters UPS

Hongtao Shi, Fang Zhuo, Dong Zhang, Zhiqing Geng, Feng Wang, Xi'an Jiaotong University, China

### 11:10 am > Modeling the Output Impedance of 3-phase Uninterruptible Power Supply in D-Q Frame

Bo Wen, Dushan Boroyevich, Rolando Burgos, Paolo Mattavelli, Virginia Polytechnic Institute and State University, United States; University of Padova, Italy

### 11:35 am > A Series-stacked Architecture for Highly-efficiency Data Center Power Delivery

Josiah McClurg, Robert C.N. Pilawa-Podgurski, Pradeep S. Shenoy, University of Illinois at Urbana-Champaign, United States; Texas Instruments Inc., United States

## S7 Modulation for Power Converters

Room: 329

Chair: Donald Holmes

### 10:20 am > Decoupled Modulation Techniques for a Four-level 5-phase Open-end Winding Drive

Martin Jones, Milan Darijevic, Emil Levi, Liverpool John Moores University, United Kingdom

### 10:45 am > Common-mode Voltage Reduction of Three Level Four Leg PWM Converter

Seung-Jun Chee, Hyeon-Sik Kim, Seung-Ki Sul, Sanggi Ko, Seoul National University, Korea; Samsung Heavy Industries, Korea

### 11:10 am > A Dead-time Compensation Method for Parabolic Current Control with Improved Current Tracking Precision

Lanhua Zhang, Bin Gu, Jason Dominic, Jih-Sheng Lai, Virginia Polytechnic Institute and State University, United States

### 11:35 am > Investigation into the Control Methods to Reduce the DC-link Capacitor Ripple Current in a Back-to-back Converter

Zian Qin, Huai Wang, Frede Blaabjerg, Poh Chiang Loh, Aalborg University, Denmark

## S8 Control and Modulation of Multilevel Converters I

Room: 330

Chairs: Pericle Zanchetta, Stefano Bifaretti

### 10:20 am > A Generalised Natural Balance Model and Balance Booster Filter Design for Three Level Neutral Point Clamped Converters

Z. Mohzani, B.P. McGrath, D.G. Holmes, Robert Bosch Pty. Ltd., Singapore; RMIT University, Australia

### 10:45 am > A Reduced Switching Loss PWM Strategy to Eliminate Common Mode Voltage In Multilevel Inverters

Nho-Van Nguyen, Tam Tu Nguyen Khanh, Hai Thanh Quach, Hong-Hee Lee, Hochiminh City University of Technology, Viet Nam; University of Ulsan, Korea

### 11:10 am > Capacitor Voltage Balancing of a Five-level Diode-clamped Converter using Minimum Loss SVPWM Algorithm for Wide Range Modulation Indices

Aparna Saha, Yilmaz Sozer, Ali Elrayyah, University of Akron, United States

### 11:35 am > A New Control Scheme of Five-level Active NPC Converters for Common Mode Voltage Mitigation in Medium Voltage Drives

Jun Li, Zach Pan, Rolando Burgos, ABB US Corporate Research Center, United States; Virginia Polytechnic Institute and State University, United States

## S9 Assorted Issues in Electric Drives I

Room: 333

Chairs: Uday Deshpande, Akshay Rathore

### 10:20 am > Self-commissioning of Inverter Dead-time Compensation by Multiple Linear Regression based on a Physical Model

Nicola Bedetti, Sandro Calligaro, Roberto Petrella, Gefran s.p.a., Italy; DIEG-University of Udine, Italy

### 10:45 am > Current Reconstruction Method with Single DC-link Current Sensor based on the PWM Inverter and AC Motor

Kwang-Sik Kim, Han-Beom Yeom, Hyun-Keun Ku, Jang-Mok Kim, Won-Sang Im, Pusan National University, Korea; Lehigh University, United States

### 11:10 am > Dynamic Effects of Mismatched Time Constants in DC-DC Converters with Inductor DCR Current Sensing

Giorgio Spiazzi, Simone Buso, Luca Corradini, University of Padova, Italy

### 11:35 am > Insulated Signal Transmission System using Planar Resonant Coupling Technology for High Voltage IGBT Gate Driver

Hiroshi Shinoda, Takahide Terada, Hitachi, Ltd., Japan

## S10 Induction Machines

Room: 334

Chairs: Aldo Boglietti, Andy Knight

### 10:20 am > Modeling and Performance of Novel Scheme Dual Winding Cage Rotor Variable Speed Induction Generator with DC Link Power Delivery

Lucian Nicolae Tutelea, Ion Boldea, Nicolae Muntean, Sorin Ioan Deaconu, Politehnica University of Timisoara, Romania

### 10:45 am > A Differential Evolution Algorithm for Designing Inverter-driven Induction Motors

Alejandro J. Piña, Longya Xu, Ohio State University, United States

### 11:10 am > A 5-phase Induction Machine Model using Multiple DQ Planes Considering the Effect of Magnetic Saturation

Ayman S. Abdel-Khalik, Shehab Ahmed, Ahmed Massoud, Alexandria University, Egypt; Texas A&M University at Qatar, Qatar; Qatar University, Qatar

### 11:35 am > Analysis of Non-intrusive Efficiency Estimation of Induction Machines Compared to the IEEE 112B and IEC 34-2-1 Standards

C.S. Gajjar, M.A. Khan, P. Barendse, University of Cape Town, South Africa

## S11 Flux-switching Machines

Room: 335

Chairs: Ed Lovelace, Peng Zhang

### 10:20 am > Analysis of Flux Switching Permanent Magnet Machine Design for High-speed Applications

Yingjie Li, Silong Li, Yida Yang, Bulent Sarlioglu, WEMPEC, University of Wisconsin-Madison, United States

### 10:45 am > Analysis of the Torque Production Mechanism for Flux-switching Permanent Magnet Machines

James D. McFarland, T.M. Jahns, Ayman M. El-Refaie, University of Wisconsin-Madison, United States; GE Global Research Center, United States

**11:10 am > Reduced Rare-earth Flux Switching Machines for Traction Applications**

*Tsarafidy Raminosoa, Ayman El-Refaie, Di Pan, Kum-Kang Huh, James Alexander, Kevin Grace, Stefan Grubic, Steven Galioto, Patel Reddy, Xiaochun Shen, GE Global Research, United States; Ensco PLC, United States*

**11:35 am > Investigation of On-loaded Performances of Hybrid-excitation Flux-switching Brushless Machines for HEV/EV Applications**

*Gan Zhang, Wei Hua, Ming Cheng, Jinguo Liao, Jianzhong Zhang, Wei Jiang, Southeast University, China*

**Monday, September 15**

**1:30 pm – 3:35 pm**

**S12 Power Converters for Transportation Applications I**

*Room: 323*

*Chairs: S. Williamson, Giovanna Oriti*

**1:30 pm > Comparison of Multi-port Converter Topologies with Bidirectional Energy Flow for Automotive Energy Net Applications**

*Michael Mürken, Markus Simon, Christian Augustin, Johannes Pforr, Technische Hochschule Ingolstadt, Germany*

**1:55 pm > An Asymmetrical  $\Gamma$ Z-source Hybrid Power Converter with Space Vector Pulse-width Modulation**

*Jun Cai, Qing-Chang Zhong, University of Sheffield, United Kingdom*

**2:20 pm > Design of a Solid-state DC Circuit Breaker for Light Rail Transit Power Supply Network**

*David Lawes, Li Ran, Zhenyu Xu, London Underground Ltd., United Kingdom; University of Warwick, United Kingdom; Beijing Sifang Automation Ltd., China*

**2:45 pm > Design of Coupled Inductor for Minimum Inductor Current Ripple in Rapid Traction Battery Charger Systems**

*Taewon Kang, Beomseok Chae, Tahyun Kang, Yongsug Suh, Chonbuk National University, Korea*

**3:10 pm > Asymmetric Interleaving in Low-voltage CMOS Power Management with Multiple Supply Rails**

*Aaron D. Ho, Marcel Schuck, Robert C.N. Pilawa-Podgurski, University of Illinois at Urbana-Champaign, United States*

**S13 Control of Power Converters in Renewable Energy**

*Room: 324*

*Chairs: Jul-Ki Seok, Mahshid Amirabadi*

**1:30 pm > Analysis and Design of Grid-current-feedback Active Damping for LCL Resonance in Grid-connected Voltage Source Converters**

*Xiongfei Wang, Frede Blaabjerg, Poh Chiang Loh, Aalborg University, Denmark*

**1:55 pm > Investigation on Series Active Filter Compensated High Power Grid-connected Voltage Source Inverters with LCL Filter**

*S. Nadir Usluer, Ahmet M. Hava, Aselsan Inc., Turkey; Middle East Technical University, Turkey*

**2:20 pm > Input Current Ripple Cancellation of Current-fed Switched Inverter**

*Soumya Shubhra Nag, Arun Sankar, Santanu Mishra, Avinash Joshi, Indian Institute of Technology Kanpur, India*

**2:45 pm > Advanced Techniques for Integration of Energy Storage and Photovoltaic Generator in Renewable Energy Systems**

*Suman Dwari, Luis Arnedo, Vladimir Blasko, United Technologies Research Center, United States*

**3:10 pm > Analysis and PWM Control of 3-phase Boost-derived Hybrid Converter**

*Olive Ray, Vimala Dharmarajan, Santanu Mishra, Ravindranath Adda, Prasad Enjeti, Indian Institute of Technology Kanpur, India; Indian Institute of Technology Guwahati, India; Texas A&M University, United States*

**S14 Utility-scale Battery Systems**

*Room: 325*

*Chair: Adel Nasiri*

**1:30 pm > Centralized Control of Large Capacity Parallel Connected Power Conditioning System for Battery Energy Storage System in Microgrid**

*Jiuqing Cai, Changsong Chen, Shanxu Duan, Dongdong Yang, Huazhong University of Science and Technology, China*

**1:55 pm > Performance Analysis of LiFePO<sub>4</sub> Battery Energy Storage for Utility-scale PV System**

*Ye Yang, Hui Li, Florida State University, United States*

**2:20 pm > Optimization of Power Dispatch to Minimize Battery Storage Capacity in Wind Farm**

*Cong-Long Nguyen, Hong-Hee Lee, University of Ulsan, South Korea*

**2:45 pm > Residential Usage Profile Optimization and Experimental Implementation of the Retired HEV Battery with a Hybrid Microgrid Testbed**

*Feng Guo, He Li, Chengcheng Yao, Mohammed Alsolami, Andong Lang, Xintong Lu, Jin Wang, Ohio State University, United States*

**3:10 pm > A Hybrid Wind-solar-storage Energy Generation System Configuration and Control**

*Dan Shen, Afshin Izadian, Ping Liao, Purdue School of Engineering and Technology, United States; Nantong University, China*

**S15 Widebandgap Devices II**

*Room: 326*

*Chairs: Jelena Popovic, Enrico Santi*

**1:30 pm > Investigating the Reliability of SiC MOSFET Body Diodes using Fourier Series Modelling**

*R. Bonyadi, O. Alatise, S. Jahdi, J. Hu, L. Evans, P.A. Mawby, University of Warwick, United Kingdom*

**1:55 pm > 10 kV > 15 kV Silicon Carbide Power MOSFETs for Next-generation Energy Conversion and Transmission Systems**

*Vipindas Pala, Edward V. Brunt, Lin Cheng, Michael O'Loughlin, Jim Richmond, Albert Burk, Scott T. Allen, David Grider, John W. Palmour, Charles J. Scozzie, Cree, Inc., United States; US Army Research Laboratory, United States*

**2:20 pm > 15-kV 100-A Single-bias All-optical SiC Emitter Turn-off Thyristor**

*A. Mojab, S.K. Mazumder, University of Illinois at Chicago, United States*

**2:45 pm > Physics-based Electro-thermal Saber Model and Parameter Extraction for High-voltage SiC Buffer IGBTs**

*T.H. Duong, A.R. Hefner, J.M. Ortiz-Rodríguez, S.-H. Ryu, Edward Van Brunt, Lin Cheng, Scott Allen, John W. Palmour, National Institute of Standards and Technology, United States; Cree, Inc., United States*

**3:10 pm > High-efficiency 3-phase Inverter with SiC MOSFET Power Modules for Motor-drive Applications**

*Juan Colmenares, Dimosthenis Pefitsis, Georg Tolstoy, Diane Sadik, Hans-Peter Nee, Jacek Rabkowski, KTH Royal Institute Technology, Sweden; Warsaw University of Technology, Poland*

## S16 Modular Multilevel Converters for HVDC

Room: 327

Chairs: Madhav Manjrekar, Qin Lei

### 1:30 pm > Control of Hybrid HVDC Transmission System with LCC and FB-MMC

Younggi Lee, Shenghui Cui, Sungmin Kim, Seung-Ki Sul, Seoul National University, Korea

### 1:55 pm > A Switching Frequency Reduction and a Mitigation of Voltage Fluctuation of Modular Multilevel Converter for HVDC

Hak-Jun Lee, Jae-Jung Jung, Seung-Ki Sul, LSIS Co., Ltd., Korea; Seoul National University, Korea

### 2:20 pm > Maximum Modulation Index for Modular Multilevel Converter with Circulating Current Control

Yalong Li, Xiaojie Shi, Bo Liu, Fred Wang, Wanjun Lei, University of Tennessee, United States; Xi'an Jiaotong University, China

### 2:45 pm > Modulation and Control of MMC based Multiterminal HVDC

Xiu Yao, Luis Herrera, Jin Wang, Ohio State University, United States

### 3:10 pm > A Peak Current Limit Control Technique in Low-voltage Ride through Operation of the Star-connected Cascaded H-bridges Converter

Chia-Tse Lee, Hsin-Chih Chen, Ching-Wei Wang, Ping-Heng Wu, Ching-Hsiang Yang, Po-Tai Cheng, National Tsing Hua University, Taiwan

## S17 Control of 3-phase Converters

Room: 328

Chairs: Luca Zari, J. Pou

### 1:30 pm > Power Converter Control Framework for Agile Research and Development

Torben N. Matzen, Kim B. Larsen, Anders L. Jørgensen, Morten Weje, PowerCon A/S, Denmark; PowerCon Embedded A/S, Denmark

### 1:55 pm > Grid Frequency Tracking Control Strategy without PLL for 3-phase Inverter

Xinxin Zheng, Lan Xiao, Huizhen Wang, Shuo Liu, Nanjing University of Aeronautics and Astronautics, China

### 2:20 pm > An Improved Direct Power Control of PWM Rectifier with Active Power Ripple Minimization

Yongchang Zhang, Changqi Qu, Zhengxi Li, Wei Xu, North China University of Technology, China; Huazhong University of Science and Technology, China

### 2:45 pm > Capacitor Voltage Balancing Control of a Fully Integrated Three-level Isolated AC-DC PFC Converter for Reliable Operations

Xiong Li, Serkan Dusmez, Bilal Akin, Kaushik Rajashekara, University of Texas at Dallas, United States

### 3:10 pm > Discrete Time Modeling, Implementation and Design of Current Controllers

Christoph H. van der Broeck, Rik W. De Doncker, Sebastian A. Richter, Jochen von Bloh, RWTH Aachen University, Germany; AixControl GmbH, Germany

## S18 AC-AC Converters

Room: 329

Chairs: Patrick Wheeler, Pericle Zanchetta

### 1:30 pm > Single-phase AC-AC Double-star Chopper-cells (DSCC) Converter without Common DC-link Capacitor

Italo Roger F.M.P. Da Silva, Alexandre C. Oliveira, Cursino B. Jacobina, Federal University of Campina Grande, Brazil

### 1:55 pm > A Novel Single-phase Cascaded Multilevel AC-AC Converter without Commutation Problem

Sanghoon Kim, Heung-Geun Kim, Honnyong Cha, Kyungpook National University, Korea

### 2:20 pm > Evaluation of a Maximum Power Density Design Method for Matrix Converter using SiC-MOSFET

Kazuhiro Koiwa, Jun-ichi Itoh, Nagaoka University of Technology, Japan

### 2:45 pm > Several-hundred-kHz Single-phase to Commercial Frequency 3-phase Matrix Converter using Delta-sigma Modulation with Space Vector

Yuki Nakata, Koji Orikawa, Jun-ichi Itoh, Nagaoka University of Technology, Japan

### 3:10 pm > The Impact of Switching Frequency on Input Filter Design for High Power Density Matrix Converter

Saeed Safari, Alberto Castellazzi, Pat Wheeler, University of Nottingham, United Kingdom

## S19 Single-phase PFC Converters

Room: 330

Chairs: Paolo Mattavelli, Pericle Zanchetta

### 1:30 pm > A Single-stage Three-level Isolated PFC Converter

Serkan Dusmez, Xiong Li, Bilal Akin, University of Texas at Dallas, United States

### 1:55 pm > A Ripple-free Input Current PFC using Power Semiconductor Filter

Kuen-faat Yuen, Wing-to Fan, Henry Shu-hung Chung, City University of Hong Kong, Hong Kong

### 2:20 pm > A Family of Single-phase Hybrid Step-down PFC Converters

Siyang Zhao, Junming Zhang, Hulong Zeng, Xinke Wu, Zhejiang University, China

### 2:45 pm > A Bridgeless Hybrid-resonant PWM Zero Voltage Switching Boost AC-DC Power Factor Corrected Converter

Muntasir Alam, Wilson Eberle, Chris Botting, Murray Edington, University of British Columbia, Canada; Delta-Q Technologies Corp., Canada

### 3:10 pm > Design and Evaluation of GaN-based Dual-phase Interleaved MHz Critical Mode PFC Converter

Zhengyang Liu, Xiucheng Huang, Mingkai Mu, Yuchen Yang, Fred C. Lee, Qiang Li, Virginia Polytechnic Institute and State University, United States

## S20 Ernesto Weidenbrug Memorial Session: Diagnostics of Electric Machines

Room: 333

Chairs: Sang Bin Lee, Peter Wung

### 1:30 pm > Advanced Rotor Assessment of Motors Operating under Variable Load Conditions in Mining Facilities

José A. Antonino-Daviu, V. Climente-Alarcón, J. Pons-Llinares, E. Wiedenbrug, Universitat Politècnica de València, Spain; eta Scientific Inc, United States

### 1:55 pm > PM Synchronous Machine Drive Response to Asymmetrical Short-circuit Faults

Gilsu Choi, T.M. Jahns, University of Wisconsin-Madison, United States

### 2:20 pm > Online Broadband Insulation Spectroscopy of Induction Machines using Signal Injection

Prabhakar Neti, Stefan Grubic, General Electric Global Research, United States

### 2:45 pm > Evaluation of the Influence of Rotor Magnetic Anisotropy on Condition Monitoring of 2 Pole Induction Motors

Sungsik Shin, Jongwan Kim, Sang Bin Lee, Chaewoong Lim, Ernesto J. Wiedenbrug, Korea University, Korea; Hansung Electric Industrial Company, Korea

### 3:10 pm > Electrical Discharge and its Impact on Drivetrains of Wind Turbines

Pinjia Zhang, GE Global Research, United States

## S21 Inductive Power Transfer I

Room: 335

Chair: Burak Ozpineci

### 1:30 pm > A Dual-side Controlled Inductive Power Transfer System Optimized for Large Coupling Factor Variations

Tobias Diekhans, Rik W. De Doncker, Robert Bosch GmbH, Germany; RWTH Aachen University, Germany

### 1:55 pm > Magnetic Integration of LCC Compensated Resonant Converter for Inductive Power Transfer Applications

Junjun Deng, Junjun Deng, Weihan Li, Siqi Li, Chris Mi, Northwestern Polytechnical University, China; University of Michigan-Dearborn, United States

### 2:20 pm > A 3.5kW Wireless Charger for Electric Vehicles with Ultra High Efficiency

Raffael Haldi, Kurt Schenk, University of Applied Sciences NTB, Switzerland

### 2:45 pm > Loosely Coupled Inductive Wireless Power Transfer Systems with Class-E Transmitter and Multiple Receivers

Hiroo Sekiya, Kazuhide Inoue, Tomoharu Nagashima, Tadashi Suetsugu, Shotaro Kuga, Xiuqin Wei, Kenichi Shirota, Hironobu Hatamoto, Satoru Shimizu, Chiba University, Japan; Fukuoka University, Japan; Oki Electric Industry Co., Ltd., Japan

### 3:10 pm > Transformer Coupled Asymmetrical Half Bridges for Voltage Balancing of Floating Capacitor Converters

R. Ul Haque, S. Leng, N. Perera, J. Salmon, University of Alberta, Canada

## SS1 US Government Power Electronics and Electric Motors Research for Electric Motors

Room: 334

Chairs: Burak Ozpineci

### 1:30 pm > Advanced Power Electronics and Electric Motors Overview

Burak Ozpineci, Oak Ridge National Laboratory, United States

### 1:55 pm > WBG Power Electronics for Electric Vehicles

Madhu Chinthavali, Oak Ridge National Laboratory, United States

### 2:20 pm > Thermal Management for Electric Vehicles

Sreekant Narumanchi, National Renewable Energy Laboratory, United States

### 2:45 pm > Electric Motors for Electric Vehicles

Tim Burress, Oak Ridge National Laboratory, United States

### 3:10 pm > CMI/Rare Earth Magnets

Iver Anderson, the Ames Laboratory, United States

Tuesday, September 16

8:00 am – 9:40 am

## S22 Wind Energy: Control and Operation I

Room: 323

Chair: Bulent Sarlioglu

### 8:00 am > Reduced Cost of Reactive Power in Doubly Fed Induction Generator Wind Turbine System with Optimized Grid Filter

Dao Zhou, Frede Blaabjerg, Toke Franke, Michael Tonnes, Mogens Lau, Aalborg University, Denmark; Danfoss Silicon Power GmbH, Germany; Siemens Wind Power A/S, Denmark

### 8:25 am > Direct Power Control for DFIG under Unbalanced and Harmonically Distorted Grid Voltage in Stationary Frame

Yipeng Song, Heng Nian, Zhejiang University, China

### 8:50 am > Impacts of Providing Inertial Response on Dynamic Loads of Wind Turbine Drivetrains

Irving P. Girsang, Jaspreet S. Dhupia, Mohit Singh, Vahan Gevorgian, Eduard Muljadi, Jason Jonkman, Nanyang Technological University, Singapore; National Renewable Energy Laboratory, United States

### 9:15 am > A Flux Vector-based Discrete-time Direct Torque Control for Salient-pole Permanent-magnet Synchronous Generators

Zhe Zhang, Yue Zhao, Jianwu Zeng, Wei Qiao, University of Nebraska-Lincoln, United States

## S23 Power Converters for Smart Grid and Utility Applications

Room: 324

Chairs: Madhav Manirekar, Milijana Odavic

### 8:00 am > Development of the Active Capacitor Converter for PFC Converters

Shen-Yang Lee, Yang-Lin Chen, Yaow-Ming Chen, Kwang H. Liu, National Taiwan University, Taiwan; National Taiwan University of Science and Technology, Taiwan

### 8:25 am > An Improved DPWM Method for Reduction of Resonant Problem in the Inverter

Jin-Hyuk Park, Hae-Gwang Jeong, Kyo-Beum Lee, Ajou University, Korea; LG Electronics, Korea

### 8:50 am > Extremely Sparse Parallel AC-link Universal Power Converters

Mahshid Amirabadi, University of Illinois at Chicago, United States

### 9:15 am > Low Frequency Signal Injection for Grid Impedance Estimation in Three Phase Systems

Pablo García, Juan M. Guerrero, Jorge García, Ángel Navarro-Rodríguez, Mark Sumner, University of Oviedo, Spain; University of Nottingham, United Kingdom

## S24 Grid Stability

Room: 325

Chairs: Dragan Maksimović, Khurram Afridi

### 8:00 am > Sub-synchronous Resonance Analysis in DFIG-based Wind Farms: Mitigation Methods — TCSC, GCSC, and DFIG Controllers — Part II

Hossein Ali Mohammadpour, Enrico Santi, University of South Carolina, United States

### 8:25 am > Impedance Matching based Stability Criteria for AC Microgrids

Patricio A. Mendoza-Araya, Giri Venkataramanan, University of Chile, Chile; University of Wisconsin-Madison, United States

### 8:50 am > A Review of Low Voltage Ride-through Techniques for Photovoltaic Generation Systems

Hao Tian, Feng Gao, Cong Ma, Guoqing He, Li Guanghui, Shandong University, China; China Electric Power Research Institute, China

### 9:15 am > Frequency Stability of Hierarchically Controlled Hybrid Photovoltaic-battery-hydropower Microgrids

Yajuan Guan, Juan C. Vasquez, Josep M. Guerrero, Dan Wu, Wei Feng, Yibo Wang, Aalborg University, Denmark; Chinese Academy of Sciences, China

## S25 Widebandgap Devices III

Room: 326

Chairs: John Siefken, Craig Winterhalter

### 8:00 am > SiC MOSFETs based Split Output Half Bridge Inverter: Current Commutation Mechanism and Efficiency Analysis

Helong Li, Stig Munk-Nielsen, Szymon Beczkowski, Xiongfei Wang, Aalborg University, Denmark

**8:25 am > Dynamic Behavior Analysis and Characterization of a Cascade Rectifier based on a Normally-on SiC JFET**

A. Vazquez, A. Rodriguez, J. Sebastian, E. Maset, A. Ferreres, E. Sanchis, University of Oviedo, Spain; University of Valencia, Spain

**8:50 am > Evaluation of Switching Performance of SiC Devices in PWM Inverter Fed Induction Motor Drives**

Zheyu Zhang, Fred Wang, Leon M. Tolbert, Benjamin J. Blalock, Daniel Costinett, University of Tennessee, United States

**9:15 am > Exploration of a Switching Loop Snubber for Parasitic Ringing Suppression**

Zheng Chen, Yiyang Yao, Dushan Boroyevich, Khai Ngo, Paolo Mattavelli, Virginia Polytechnic Institute and State University, United States

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## S26 Modular Multilevel Converters I

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Room: 328

Chairs: Marcello Pucci, Pericle Zanchetta

**8:00 am > Branch Energy Control for the Modular Multilevel Direct Converter Hexverter**

Dennis Karwatzki, Lennart Baruschka, Malte von Hofen, Axel Mertens, Leibniz Universität Hannover, Germany; Protolar GmbH, Germany

**8:25 am > Realization of a Conceptual Approach for Power VLSI using Integrated Full-bridge Cells in Modular Multilevel Converters**

Hao Jiang, Zhenqiang Ma, Giri Venkataramanan, University of Wisconsin-Madison, United States

**8:50 am > A Low-speed, High-torque Motor Drive using the Modular Multilevel Cascade Converter based on Triple-star Bridge Cells (MMCC-TSBC)**

Wataru Kawamura, Kuan-Liang Chen, Makoto Hagiwara, Hirofumi Akagi, Tokyo Institute of Technology, Japan

**9:15 am > Capacitor Voltage Balancing based on Fundamental Frequency Sorting Algorithm for Modular Multilevel Converter**

Hao Peng, Ying Wang, Zibo Lv, Yan Deng, Xiangning He, Rongxiang Zhao, Zhejiang University, China

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## S27 Resonant Control in Power Converters

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Room: 329

Chair: Pericle Zanchetta

**8:00 am > Selective Harmonic Control for Power Converters**

Keliang Zhou, Yongheng Yang, Frede Blaabjerg, Wenzhou Lu, Danwei Wang, University of Canterbury, New Zealand; Aalborg University, Denmark; Southeast University, China; Nanyang Technological University, Singapore

**8:25 am > Reduced Order Generalized Integrators based Selective Harmonic Compensation Current Controller for Shunt Active Power Filters**

Zheng Zeng, Jiaqiang Yang, Shilan Chen, Jin Huang, Zhejiang University, China

**8:50 am > Flexible Grid Connection Technique of Voltage Source Inverter under Unbalanced Grid Conditions based on Direct Power Control**

Yongbo Shen, Heng Nian, Zhejiang University, China

**9:15 am > Resonant Controllers with Three-degree of Freedom for AC Power Electronic Converters**

A. Lidozzi, L. Solero, F. Crescimbin, M. Di Benedetto, S. Bifaretti, Roma Tre University, Italy; University of Roma Tor Vergata, Italy

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## S28 Switched-capacitor Converters

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Room: 330

Chairs: Gui-Jia Su, Qiang Li

**8:00 am > A High Step-up Converter based on Switched-capacitor Voltage Accumulator**

Shiyang Hou, Jianfei Chen, Chongqing University, China

**8:25 am > Analysis of Coupled Microinductors for Power-supply-on-chip Applications**

Ciaran Feeney, Maeve Duffy, Ningning Wang, Santosh Kulkarni, Cian O'Mathuna, National University of Ireland, Ireland; University College Cork, Ireland

**8:50 am > Current Source Converter with Switched-inductor DC Link Circuit for Reduced Converter Losses**

Yichao Zhang, T.M. Jahns, University of Wisconsin-Madison, United States

**9:15 am > Analysis and Design of a 1-kW 3X Interleaved Switched-capacitor DC-DC Converter**

Shouxiang Li, Bin Wu, Keyue Smedley, Sigmond Singer, University of California, Irvine, United States; Tel Aviv University, Israel

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## S29 Voltage Control Issues in Electric Drives

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Room: 333

Chairs: Vladimir Blasko, Sanjib Kumar Panda

**8:00 am > An Optimal Solution for Operating a 3-phase Variable Frequency Drive from a Single-phase AC Source**

Mahesh M. Swamy, Joshua Collins, Anupama Balakrishnan, Yaskawa America, Inc., United States; Missouri University of Science and Technology, United States

**8:25 am > Hexagon Voltage Manipulating Control (HVMC) for AC Motor Drives Operating at Voltage Limits**

Jul-Ki Seok, SeHwan Kim, Yeungnam University, Korea

**8:50 am > Interleaved PWM Control for Neutral Point Balancing in Dual 3-level Traction Drives**

Subhadeep Bhattacharya, Diego Mascarella, Benoit Boulet, Geza Joos, McGill University, Canada

**9:15 am > Identification of the Magnetic Model of Permanent Magnet Synchronous Machines using DC-biased Low Frequency AC Signal Injection**

S.A. Odhano, R. Bojoi, S.G. Rosu, A. Tenconi, Politecnico di Torino, Italy; University "Politehnica" of Bucharest, Romania

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## S30 Prof. D. Howe Memorial Session: Synchronous Machines

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Room: 334

Chairs: Z.Q. Zhu, Thomas Jahns

**8:00 am > PMSM Magnetization State Estimation based on Stator-reflected PM Resistance using High Frequency Signal Injection**

David Reigosa, Daniel Fernandez, Zi-Qiang Zhu, Fernando Briz, University of Oviedo, Spain; University of Sheffield, United Kingdom

**8:25 am > Comparison of Different Methods for Incipient Fault Diagnosis in PMSMs with Coaxial Insulated Windings**

Davide Barater, Jesus Arellano-Padilla, Chris Gerada, University of Parma, Italy; University of Nottingham, United Kingdom

**8:50 am > Analysis of FSCW SPM Servo Motor with Static, Dynamic and Mixed Eccentricity in Aspects of Radial Force and Vibration**

Shaofeng Jia, Ronghai Qu, Jian Li, Zansong Fu, Hong Chen, Leilei Wu, Huazhong University of Science and Technology, China

**9:15 am > The Structure Optimization of Novel Harmonic Current Excited Brushless Synchronous Machines based on Open Winding Pattern**

*Quntao An, Xiaolong Gao, Fei Yao, Lizhi Sun, Thomas Lipo, Harbin Institute of Technology, China; University of Wisconsin-Madison, United States*

**S31 Inductive Power Transfer II**

Room: 335

Chairs: Burak Ozpineci, Fabio Giulii Capponi

**8:00 am > Methods for Reducing Leakage Electric Field of a Wireless Power Transfer System for Electric Vehicles**

*Masaki Jo, Yukiya Sato, Yasuyoshi Kaneko, Shigeru Abe, Saitama University, Japan*

**8:25 am > Reducing Leakage Flux in IPT Systems by Modifying Pad Ferrite Structures**

*Fei Yang Lin, Adeel Zaheer, Mickel Budhia, Grant A. Covic, University of Auckland, New Zealand; Qualcomm NZ Ltd, New Zealand*

**8:50 am > Design Methodology of a Series-series Inductive Power Transfer System for Electric Vehicle Battery Charger Application**

*Zhicong Huang, Siu-Chung Wong, Chi K. Tse, Hong Kong Polytechnic University, Hong Kong*

**9:15 am > Analysis of Co-planar Intermediate Coil Structures in Inductive Power Transfer Systems**

*Abhilash Kamineni, Grant A. Covic, John T. Boys, University of Auckland, New Zealand*

**S32 Losses in Electrical Machines**

Room: 336

Chairs: Rafal Wrobel, Emmanuel Agamloh

**8:00 am > Combined Experimental and Numerical Method for Loss Separation in Permanent Magnet Brushless Machines**

*Greg Heins, Dan M. Ionel, Dean Patterson, Steve Stretz, Regal Beloit Corporation, United States*

**8:25 am > Vibration Reduction of One-axis Actively Position Regulated Single-drive Bearingless Motor with Repulsive Passive Magnetic Bearings**

*Hiroya Sugimoto, Seiyu Tanaka, Akira Chiba, Tokyo Institute of Technology, Japan*

**8:50 am > Winding Design for Minimum Power Loss and Low-cost Manufacture in Application to Fixed-speed PM Generator**

*Rafal Wrobel, Dave Staton, Richard Lock, Julian Booker, David Drury, University of Bristol, United Kingdom; Motor Design Ltd., United Kingdom*

**9:15 am > Cylindrical Rotor Design for Acoustic Noise and Windage Loss Reduction in Switched Reluctance Motor for HEV Applications**

*Kyohei Kiyota, Takeo Kakishima, Akira Chiba, Tokyo Institute of Technology, Japan*

**SS2 Wide Band Gap (WBG) Power Switch Modules — Requirements and Challenges**

Room: 327

Chair: Krishna Shenai

**8:00 am > Single-chip Data Sheets and Circuit Models — Do We Have Them Right for WBG Devices?**

*Krishna Shenai, Argonne National Laboratory, United States*

**8:25 am > WBG Usage in Automotive: Do Challenges Outweigh Advantages?**

*Andrew F Pinkos, Propulsion Systems, United States*

**8:50 am > Package and Assembly Requirements for SiC-based Power Modules in Industrial Applications**

*Thomas Grasshoff, Kevork Haddad, SEMIKRON International GmbH, United States*

**9:15 am > Reducing Cost in High-performance SiC Power Modules**

*Chad B. O'Neal, Arkansas Power Electronics International, Inc., United States*

**Wednesday, September 17**

**8:00 am – 9:40 am**

**S33 Solar PV Technologies**

Room: 323

Chair: Dezso Sera

**8:00 am > Power Electronic Components and System Installation for Plug-and-play Residential Solar PV**

*Md Tanvir Arafat Khan, Iqbal Husain, David Lubkeman, North Carolina State University, United States*

**8:25 am > High-density Power Converters for Sub-module Photovoltaic Power Management**

*Rahul Sangwan, Kapil Kesarwani, Jason T. Stauth, Dartmouth College, United States*

**8:50 am > Cost-effective Photovoltaic Water Pumping System for Remote Regions Communities**

*Flavio Palmiro, João Onofre Pereira Pinto, Lucio Henrique Pereira, Ruben Barros Godoy, Federal University of Mato Grosso do Sul, Brazil*

**9:15 am > PV Arc-fault Detection using Spread Spectrum Time Domain Reflectometry (SSTR)**

*Mohammed Khorshed Alam, Faisal H. Khan, Jay Johnson, Jack Flicker, University of Utah, United States; Sandia National Laboratories, United States*

**S34 Energy Management in Residential Applications**

Room: 324

Chairs: Mahesh Illindala, Feng Guo

**8:00 am > Modeling the Energy Features of a Vehicle-to-home System to Provide User-specific Technical Requirements**

*Fabrizio Fattori, Norma Anglani, University of Pavia, Italy*

**8:25 am > Performance Characteristics of a Hybrid CERTS Microgrid Electric Vehicle Charging Station**

*Philip J. Hart, T.M. Jahns, R.H. Lasseter, University of Wisconsin-Madison, United States*

**8:50 am > Energy Management System Control and Experiment for Future Home**

*Wei Zhang, Fred C. Lee, Pin-Yu Huang, Virginia Polytechnic Institute and State University, United States; National Taiwan University of Science and Techno, Taiwan*

**9:15 am > A Review of Faults and Fault Diagnosis in Micro-grids Electrical Energy Infrastructure**

*James Hare, Xiaofang Shi, Shalabh Gupta, Ali Bazzi, University of Connecticut, United States*

**S35 DC-DC Boost Converters**

Room: 326

Chairs: Hui Li, Paolo Mattavelli

**8:00 am > A High-efficiency High Step-up DC-DC Converter with Passive Clamped Coupled-inductor and Voltage Double Cells**

*Jian Fu, Bo Zhang, Dongyuan Qiu, South China University of Technology, China*



**8:25 am > High Power Step-up Modular Resonant DC-DC Converter for Offshore Wind Energy Systems**

Amir Parastar, Jul-Ki Seok, Yeungnam University, Korea

**8:50 am > A New Hybrid Boosting Converter**

Bin Wu, Shouxiang Li, Smedley Keyue, University of California-Irvine, United States

**9:15 am > Identification and Robust Control of a Quadratic DC-DC Boost Converter by Hammerstein Model**

F. Alonge, R. Rabbeni, M. Pucci, G. Vitale, Università degli Studi di Palermo, Italy; ISSIA-CNR, Italy

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**S36 Stability and Quality I**

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Room: 327

Chairs: Robert Pilawa, Hui Li

**8:00 am > Dynamic Phasor Models for AC Microgrids Stability Studies**

Patricio A. Mendoza-Araya, Giri Venkataramanan, University of Chile, Chile; University of Wisconsin-Madison, United States

**8:25 am > Modeling and Resonant Characteristics Analysis of Multiple Paralleled Grid-connected Inverters with LCL Filter**

Wei Hu, Jianjun Sun, Qian Ma, Chenxu Yin, Fei Liu, Xiaoming Zha, Wuhan University, China

**8:50 am > Strategies for the Connection of Distributed Power Generation Units to Distorted Networks**

Cristian Blanco, David Diaz Reigosa, Fernando Briz, Juan M. Guerrero, University of Oviedo, Spain

**9:15 am > Analysis of Sinusoidal Current Reference Generation with Flat Instantaneous Active Power for Unbalanced Grids**

Salvador Revelo, Marcelo A. Perez, Universidad Tecnica Federico Santa Maria, Chile

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**S37 Modular Multilevel Converters II**

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Room: 328

Chairs: Stefano Bifaretti, Alan Watson

**8:00 am > Design Considerations on the DC Capacitor of Each Chopper Cell in a Modular Multilevel Cascade Inverters (MMCI-DSCC) for Medium-voltage Motor Drives**

Yuhei Okazaki, Hitoshi Matsui, Makoto Hagiwara, Hirofumi Akagi, Tokyo Institute of Technology, Japan

**8:25 am > Study of Overcurrent Protection for Modular Multilevel Converter**

R. Grinberg, E. Bjornstad, P. Steimer, A. Korn, M. Winkelkemper, D. Gerardi, O. Senturk, O. Apeldoorn, J. Li, ABB Switzerland Ltd., Switzerland; ABB PAOG, Norway; ABB Corporate Research, United States

**8:50 am > Independent Control of Input Current, Load and Capacitor Voltage Balancing for a Modular Matrix Converter**

Toshiki Nakamori, Mahmoud A. Sayed, Yuma Hayashi, Takaharu Takeshita, Shizunori Hamada, Kuniaki Hirao, Nagoya Institute of Technology, Japan; South Valley University, Egypt; Meidensha Corporation, Japan

**9:15 am > Analysis of the 5-cell Single Phase MMC Natural Balancing Mechanism**

Wim van der Merwe, Peter Hokayem, Lidia Stepanova, ABB Corporate Research, Switzerland; École Polytechnique Fédérale de Lausanne, Switzerland

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**S38 Control of DC-DC Converters**

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Room: 329

Chairs: Giovanna Oriti, S. Williamson

**8:00 am > An Adaptive Ramp Compensation Scheme to Improve Stability for DC-DC Converters with Ripple-based Constant On-time Control**

Ting Qian, Brad Lehman, Tongji University, China; Northeastern University, United States

**8:25 am > Resonant Augmentation Circuits for a Buck Converter Achieving Minimum-time Voltage Recovery from Load Transients**

Zhenyu Shan, Siew-Chong Tan, Chi K. Tse, Juri Jatskevich, University of British Columbia, Canada; University of Hong Kong, Hong Kong; Hong Kong Polytechnic University, Hong Kong

**8:50 am > Digital Control of a High-voltage (2.5 kV) Bidirectional DC-DC Converter for Driving a Dielectric Electro Active Polymer (DEAP) based Capacitive Actuator**

Prasanth Thummala, Zhe Zhang, Michael A.E. Andersen, Dragan Maksimović, Technical University of Denmark, Denmark; University of Colorado-Boulder, United States

**9:15 am > Variable Frequency Multiplier Technique for High Efficiency Conversion over a Wide Operating Range**

Wardah Inam, David J. Perreault, Khurram K. Afridi, Massachusetts Institute of Technology, United States

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**S39 Active Power Filters and Power Quality**

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Room: 330

Chairs: Milijana Odavic, David D Reigosa

**8:00 am > Selected Harmonic Resistance Control based Series Active Power Filter**

Xiaoqing Song, Xijun Ni, Alex Q. Huang, North Carolina State University, United States

**8:25 am > Waveform Control Method for Mitigating Harmonics of Inverter Systems with Nonlinear Load**

Hao-Ran Wang, Guo-Rong Zhu, Xiao-Bin Fu, Siew-Chong Tan, Wuhan University of Technology, China; University of Hong Kong, Hong Kong

**8:50 am > Shunt Active Power Filter based on the Interconnection of Single-phase and 3-phase Converters for 3-phase Four-wire Systems**

A. de M. Maciel, C.B. Jacobina, E.C. dos Santos Jr., V.M.B. Melo, Federal University of Paraiba, Brazil; Federal University of Campina Grande, Brazil; Purdue School of Engineering and Technology, United States

**9:15 am > Adaptive Resonant Current-control for Active Power Filtering within a Microgrid**

Diarmaid J. Hogan, Fran Gonzalez-Espin, John G. Hayes, Gordon Lightbody, Michael G. Egan, University College Cork, Ireland; United Technologies Research Center, Ireland

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**S40 Fault Diagnostics in Power Converters**

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Room: 333

Chair: Lixiang Wei

**8:00 am > A Novel Online ESR and C Identification Method for Output Capacitor of Buck Converter**

Kai Yao, Wenbin Hu, Weijie Tang, Jianguo Lyu, Jingcheng Cao, Nanjing University of Science and Technology, China

**8:25 am > A New Fault-tolerant Realization of the Active Three-level NPC Converter**

Anderson V. Rocha, Sidelmo M. Silva, Igor A. Pires, Alysson A.P. Machado, Fernando V. Amaral, Victor N. Ferreira, Helder de Paula, Braz J. Cardoso Filho, Universidade Federal de Minas Gerais, Brazil; Centro Federal de Educação Tecnológica de Minas Gerais, Brazil

**8:50 am > Detection and Isolation of Multiple Faults in a Modular Multilevel Converter based on a Sliding Mode Observer**

Shuai Shao, Jon C. Clare, Alan J. Watson, Patrick W. Wheeler, University of Nottingham, United Kingdom

**9:15 am > Short-circuit Current Control Strategy for Full-bridge LLC Converter**

Shuo Liu, Ren Ren, Wuji Meng, Xinxin Zheng, Fanghua Zhang, Lan Xiao, Nanjing University of Aeronautics and Astronautics, China

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**S41 Control Issues in Electric Drives II**

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Room: 334

Chairs: Bimal Bose, Elena Lomonova

**8:00 am > Near Time-optimal Model Predictive Control using an L1-norm based Cost Functional**

Alexander Döttinger, Ralph M. Kennel, Technische Universität München, Germany

**8:25 am > Reformulation of the Long-horizon Direct Model Predictive Control Problem to Reduce the Computational Effort**

Petros Karamanakos, Tobias Geyer, Ralph Kennel, Technical University of Munich, Germany; ABB Switzerland Ltd., Switzerland

**8:50 am > On the Benefit of Long-horizon Direct Model Predictive Control for Drives with LC Filters**

Tobias Geyer, Petros Karamanakos, Ralph Kennel, ABB Switzerland Ltd., Switzerland; Technical University of Munich, Germany

**9:15 am > Discrete-time Control of High Speed Salient Machines**

Antonio Altomare, Alessandra Guagnano, Francesco Cupertino, David Naso, Politecnico di Bari, Italy

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**S42 IPM Machine Design**

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Room: 335

Chairs: Greg Heins, Jonathan Bird

**8:00 am > Design of High Torque Density Variable Flux Permanent Magnet Machine using Alnico Magnets**

Maged Ibrahim, Pragasen Pillay, Concordia University, Canada

**8:25 am > Saliency Ratio and Power Factor of IPM Motors Optimally Designed for High Efficiency and Low Cost Objectives**

Peng Zhang, Dan M. Ionel, Nabeel A.O. Demerdash, General Motors, United States; Regal Beloit Corp., United States; University of Wisconsin-Milwaukee, United States; Marquette University, United States

**8:50 am > Design Methodology for Variable Leakage Flux IPM for Automobile Traction Drives**

Takashi Kato, Hiroki Hijikata, Masanao Minowa, Kan Akatsu, Robert D. Lorenz, Nissan Motor Co., Ltd., Japan; Shibaura Institute of Technology, Japan; University of Wisconsin-Madison, United States

**9:15 am > Design of a Spoke Type IPM Synchronous Motor with Segmented Rotor for Low DC Voltage Applications**

Y. Demir, M. Aydin, MDS Motor Design Ltd., Turkey; Kocaeli University, Turkey

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**S43 Induction Motor Drives I**

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Room: 336

Chairs: Zach Pan, Mahesh Swamy

**8:00 am > Input-output Feedback Linearization Control of Linear Induction Motors Including the Dynamic End-effects**

F. Alonge, M. Cirrincione, M. Pucci, A. Sferlazza, University of Palermo, Italy; University of the South Pacific, Fiji; ISSIA-CNR, Italy

**8:25 am > Generalized Two-vectors-based Model Predictive Torque Control of Induction Motor Drives**

Yongchang Zhang, Haitao Yang, North China University of Technology, China

**8:50 am > Induction Motor Speed Estimation based on Rotor Slot Effects**

Lihang Zhao, Jin Huang, Zhaowen Hou, He Liu, Zhejiang University, China

**9:15 am > Induction Motor Control with Small DC-link Capacitor Inverters-fed by 3-phase Diode Front-end Rectifiers**

SeHwan Kim, GwangRok Kim, Anno Yoo, Jul-Ki Seok, Yeungnam University, Korea; LSIS Co., Ltd, Korea

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**SS3A Harmonic Resonance in Renewable Energy Systems**

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Room: 325

Chairs: Frede Blaabjerg, Pedro Rodriguez

**8:00 am > Harmonic Stability in Renewable Energy Systems: an Overview**

Frede Blaabjerg, Xiongfei Wang, Aalborg University, Denmark

**8:25 am > Modeling and Analysis of Supersynchronous Resonance by Sequence Impedances**

Jian Sun, Rensselaer Polytechnic Institute, United States

**8:50 am > Influence of Harmonic Grid Resonance on the Operation of Grid-connected Converters**

Axel Mertens, Felix Fuchs, Leibniz University, Germany

**9:15 am > Risk of DC-side Instabilities in VSC-based HVDC Systems**

Gustavo Pinarens, Massimo Bongiorno, Chalmers University of Technology, Sweden

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**Wednesday, September 17**

**10:00 am – 11:40 am**

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**S44 LED Drivers I**

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Room: 323

Chair: Bilal Akin

**10:00 am > Harmonics Compensation and Power Factor Improvement using LED Driver**

Saeed Anwar, Ali Elrayah, Yilmaz Sozer, University of Akron, United States

**10:25 am > Multi-channel LED Driver with CLL Resonant Converter**

Xuebing Chen, Daocheng Huang, Qiang Li, Fred C. Lee, Virginia Polytechnic Institute and State University, United States

**10:50 am > Design Consideration of a Current-source-output Inductive Power Transfer LED Lighting System**

Xiaohui Qu, Siu-Chung Wong, Chi Kong Tse, Guobao Zhang, Southeast University, China; Hong Kong Polytechnic University, Hong Kong

**11:15 am > Electrolytic-capacitor-less High-power LED Driver**

Yajie Qiu, Hongliang Wang, Zhiyuan Hu, Laili Wang, Yan-Fei Liu, P.C. Sen, Queen's University, Canada

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**S45 LCL Filters for Grid Converters**

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Room: 324

Chairs: Qin Lei, Alessandro Lidozzi

**10:00 am > New Optimal Design Method for Trap Damping Sections in Grid-connected LCL Filters**

Remus Narcis Beres, Xiongfei Wang, Frede Blaabjerg, Claus Leth Bak, Marco Liserre, Aalborg University, Denmark; University of Kiel, Germany

**10:25 am > Active Damping for Grid-connected LCL Filter based on Optimum Controller Design using Injected Grid Current Feedback Only**

Mahmoud A. Gaafar, Masahito Shoyama, Kyushu University, Japan

**10:50 am > Comparison of PR Controller and Damped PR Controller for Grid Current Control of LCL Filter based Grid-tied Inverter under Frequency Variation and Grid Distortion**

Ritwik Chattopadhyay, Ankan De, Subhashish Bhattacharya, North Carolina State University, United States

**11:15 am > Rectifier Stage Operation and Controller Design for a Medium Voltage Solid State Transformer with LCL Filter**

Fei Wang, Gangyao Wang, Alex Huang, Wensong Yu, Xijun Ni, North Carolina State University, United States

**S46 DC-DC Buck Converters**

Room: 326

Chairs: Baoming Ge, Gui-Jia Su

**10:00 am > A Series-capacitor Tapped Buck (Sc-Tab) Converter for Regulated High Voltage Conversion Ratio DC-DC Applications**

Minjie Chen, Pradeep S. Shenoy, Jeffrey Morroni, Massachusetts Institute of Technology, United States; Texas Instruments Inc., United States

**10:25 am > A Cost-effective Circuit for Three-level Flying-capacitor Buck Converter Combining the Soft-start, Flying Capacitor Pre-charging and Snubber Functions**

Zhihao Zhong, Yu Chen, Pengcheng Zhang, Yong Kang, Huazhong University of Science and Technology, China

**10:50 am > 100 MHz, 20 V, 90% Efficient Synchronous Buck Converter with Integrated Gate Driver**

Yuanzhe Zhang, Miguel Rodríguez, Dragan Maksimović, University of Colorado-Boulder, United States

**11:15 am > Modeling and Control of a Tapped-inductor Buck Converter with Pulse Frequency Modulation**

Luca Bessegato, Tomas Modeer, Staffan Norrga, KTH Royal Institute of Technology, Sweden

**S47 Stability and Quality II**

Room: 327

Chairs: Robert Pilawa, Feng Guo

**10:00 am > A Real-time Selective Harmonic Elimination based on a Transient-free, Inner Closed-loop Control for Cascaded Multilevel Inverters**

Hui Zhao, Tian Jin, Shuo Wang, Deliang Wu, Liang Sun, University of Texas at San Antonio, United States

**10:25 am > A Voltage Regulator using Multi-parallel-connected Series-voltage Compensator**

Victor Sui-pung Cheung, Henry Shu-hung Chung, Alan Wai-lun Lo, City University of Hong Kong, Hong Kong; Chu Hai College of Higher Education, Hong Kong

**10:50 am > A Voltage Regulator based in a Voltage-controlled DSTATCOM with Minimum Power Point Tracker**

Rubens Tadeu Hock Jr., Yales Rômulo De Novaes, Alessandro Luiz Batschauer, Santa Catarina State University, Brazil

**11:15 am > Stability Analysis of the High Voltage DC Link between the FEC and DC-DC Stage of a Transformer-less Intelligent Power Substation**

Sachin Madhusoodhanan, Awneesh Tripathi, Dhaval Patel, Krishna Mainali, Subhashish Bhattacharya, North Carolina State University, United States

**S48 Control and Modulation of Multilevel Converters II**

Room: 328

Chairs: Stefano Bifaretti, Rolando Burgos

**10:00 am > PWM for Active Thermal Protection in Three Level Neutral Point Clamped Inverters**

The-Minh Phan, Nikolaos Oikonomou, Gernot J. Riedel, Mario Pacas, University of Siegen, Germany; ABB Corporate Research, Switzerland

**10:25 am > Control Strategy of a Multilevel Converter with Multi-winding MFT/HFT Isolation**

Chunyang Gu, Zedong Zheng, Yongdong Li, Tsinghua University, China

**10:50 am > Carrier Interleaved PWM Techniques in Modular Multilevel Converters: A Comparison based on Same Voltage Level Waveforms**

Rosheila Darus, Georgios Konstantinou, Josep Pou, Salvador Ceballos, Vassilios G. Agelidis, University of New South Wales, Australia; Universiti Teknologi Mara, Malaysia; TECNALIA, Spain

**11:15 am > A State Machine Decoder for Phase Disposition Pulse Width Modulation of 3-phase Coupled-inductor Semi-bridge Converters**

C.A. Teixeira, B.P. McGrath, D.G. Holmes, RMIT University, Australia

**S49 Modeling and Control of DC-DC Converters**

Room: 329

Chairs: Sudip Mazumder, Sung Yeul Park

**10:00 am > A Detection Method of DC Magnetization Utilizing Local Inhomogeneity of Flux Distribution in Power Transformer Core**

Kazuhiro Umetani, Yuki Itoh, Masayoshi Yamamoto, Denso Corporation, Japan; Shimane University, Japan

**10:25 am > Equivalent Circuit Model of Constant On-time Current Mode Control with External Ramp Compensation**

Shuilin Tian, Fred C. Lee, Jian Li, Qiang Li, Pei-hsin Liu, Virginia Polytechnic Institute and State University, United States; Linear Technology, United States

**10:50 am > Dynamic Analysis of Hysteresis Control Strategy based on Ripple Characteristics**

Jianfeng Dai, Jinbin Zhao, Keqing Qu, Fen Li, Wei Cao, Shanghai University of Electric Power, China

**11:15 am > A Generic and Accurate Frequency-domain Model for Buck, Boost and Buck-boost Converters**

Xin Li, Xinbo Ruan, Nanjing University of Aeronautics and Astronautics, China

**S50 Power Converters for Transportation Applications II**

Room: 330

Chairs: Babak Fahimi, Fabio Giulii Capponi

**10:00 am > Reduced Switching Loss based DC-bus Voltage Balancing Algorithm for Three-level Neutral Point Clamped (NPC) Inverter for Electric Vehicle Application**

Abhijit Choudhury, Pragasen Pillay, M. Amar, Sheldon S. Williamson, Concordia University, Canada; TM4 Inc., Canada

**10:25 am > An Electrical-magnetic Hybrid Power Quality Compensation System and its Control Strategy for V/V Traction Power Supply System**

Baichao Chen, Chenmeng Zhang, Wenjun Zeng, Cuihua Tian, Jiixin Yuan, Wuhan University, China

**10:50 am > High Frequency Active-clamp Buck Converter for Low Power Automotive Applications**

Chenhao Nan, Raja Ayyanar, Youhao Xi, Arizona State University, United States; Texas Instruments Inc., United States

**11:15 am > Analysis, Modeling and Control of Half-bridge Current-source Converter for Supercapacitor Applications**

Jorge Garcia, Pablo Garcia, Fabio Giulii Capponi, Gabriele Borocci, Giulio De Donato, University of Oviedo, Spain; University of Rome-Sapienza, Italy

**S51 Performance and Reliability Issues in Electric Drives**

Room: 334

Chairs: Peter Liu, Radu Bojoi

**10:00 am > Improving Position Sensor Accuracy through Spatial Harmonic Decoupling, and Sensor Scaling, Offset, and Orthogonality Correction using Self-commissioning MRAS-methods**

Caleb W. Secrest, Jon S. Pointer, Michael R. Buehner, Robert D. Lorenz, University of Wisconsin-Madison, United States; Woodward, Inc., United States

**10:25 am > Current Sharing Strategies for Fault Tolerant AC Multi-drives**  
G. Scelba, G. Scarcella, M. Pulvirenti, M. Cacciato, A. Testa, S. De Caro, T. Scimone, University of Catania, Italy; University of Messina, Italy

**10:50 am > Performance Evaluation of a Bearingless Flux-switching Slice Motor**  
Karlo Radman, Neven Bulić, Wolfgang Gruber, University of Rijeka, Croatia; Johannes Kepler University, Austria

**11:15 am > Novel Discontinuous PWM Control Method to Improve IGBT Reliability at Low Speed**  
Lixiang Wei, Jeffrey McGuire, Jiangang Hu, Rockwell Automation, United States

## S52 Switched-reluctance Machines

Room: 335  
Chairs: Rajeev Vyas, Akira Chiba

**10:00 am > A Continuous Toroidal Winding SRM with 6 or 12 Switch DC Converter**  
R. Marlow, N. Schofield, A. Emadi, McMaster University, Canada

**10:25 am > Digital PWM Control-based Active Vibration Cancellation for Switched Reluctance Motors**  
H. Makino, T. Kosaka, N. Matsui, Nagoya Institute of Technology, Japan

**10:50 am > Practical Considerations for the Design and Construction of a High Speed SRM with a Flux-bridge Rotor**  
Jie Dang, J. Rhet Mayor, S. Andrew Semidey, Ronald Harley, Thomas Habetler, Jose Restrepo, Georgia Institute of Technology, United States; Universidad Simon Bolivar, Venezuela

**11:15 am > Design of a Switched Reluctance Machine for Off-road Vehicle Applications based on Torque Speed-curve Optimization**  
Md Wasi Uddin, Tausif Husain, Yilmaz Sozer, Iqbal Husain, University of Akron, United States; North Carolina State University, United States

## S53 Induction Motor Drives II

Room: 336  
Chairs: A.J. Marques Cardoso, Tobias Geyer

**10:00 am > Current Ripple Analysis of PWM Methods for Open-end Winding Induction Motor**  
Hajime Kubo, Yasuhiro Yamamoto, Takeshi Kondo, Kaushik Rajashekara, Bohang Zhu, Meidensha Corporation, Japan; University of Texas at Dallas, United States

**10:25 am > New Optimal Pulsewidth Modulation for Single DC-link Dual Inverter fed Open-end Stator Winding Induction Motor Drives**  
Amarendra Edpuganti, Akshay K. Rathore, Joachim Holtz, National University of Singapore, Singapore; University of Wuppertal, Germany

**10:50 am > Hybrid Open-end and NPC AC Six-phase Machine Drive Systems**  
Victor F.M.B. Melo, Cursino B. Jacobina, Nady Rocha, Federal University of Campina Grande, Brazil; Federal University of Paraiba, Brazil

**11:15 am > A Time-varying Observer for the Flux Magnitude of the Induction Motor using the Synchronous Reference Frame Model**  
Trey Mock, Randi Bimeal, Stephen Ling, Mihai Comanescu, Penn State Altoona, United States

## SS3B Harmonic Regulation and Mitigation

Room: 325  
Chairs: Pedro Rodriguez, Frede Blaaergjerg

**10:00 am > Harmonic Issues in Distribution Networks: Past and Future**  
Firuz Zare, Danfoss Power Electronics Company, Denmark

**10:25 am > Active Filtering Techniques for Harmonic Damping**  
Po-Tai Cheng, National Tsing Hua University, Taiwan

**10:50 am > Harmonic Interaction in High Populations of Distributed Power Resources**  
Johan Enslin, UNC Charlotte, United States

**11:15 am > LCL+Trap Grid Harmonics Mitigation and Potential Resonance Identification in Large Scale Distributed Power Plants**  
Pedro Rodriguez, Antoni Mir Cantarellas, Abengoa Research, Spain

## SS4 Optimization of Electric Motors and Multi-physics Analysis

Room: 333  
Chair: Mircea Popescu

**10:00 am > High Fidelity and Efficient Computation of Losses in Brushless Permanent Magnet Machines**  
Phil Mellor, University of Sheffield, United Kingdom

**10:25 am > Modern Design Optimisation of PM and Reluctance Synchronous Machines**  
Maarten Kamper, Stellenbosch University, South Africa

**10:50 am > Design for Manufacturing Employing Automated Optimization and Multi-physics Analysis — an Academic and Industrial Point of View**  
Dan Ionel, Regal Beloit Corp and University of Wisconsin M, United States

**11:15 am > Multiphysics Analysis of Electric Machines for Traction Applications Considering Complex Duty Cycles**  
David A. Staton, Motor Design Ltd, United Kingdom

Wednesday, September 17

1:30 pm – 3:10 pm

## S54 Wave and Wind Generation Systems

Room: 323  
Chair: David Dorrell

**1:30 pm > Hybrid Generator for Wind Generation Systems**  
Omid Beik, Nigel Schofield, McMaster University, Canada

**1:55 pm > A GA-SVM Hybrid Classifier for Multiclass Fault Identification of Drivetrain Gearboxes**  
Dingguo Lu, Wei Qiao, University of Nebraska-Lincoln, United States

**2:20 pm > Marine Current Turbine Generator System with Induction Machine Growing Neural Gas (GNG) MPPT based on Sensorless Sea Speed Estimation**  
L. Greco, C. Testa, M. Cirrincione, M. Pucci, G. Vitale, INSEAN-CNR, Italy; University of the South Pacific, Fiji

**2:45 pm > Pole-modulated PM Direct-drive Generator for Wave Energy Conversion**  
Wen Ouyang, Steven Englebretson, V.R. Ramanan, Giti Karimi-Moghaddam, ABB Corporate Research, United States

## S55 Power Converters for Smart Grid and Utility Applications II

Room: 324  
Chairs: Subhashish Bhattacharya, Luca Zarri

**1:30 pm > Novel, Simple Reactive Power Control Strategy with DC Capacitor Voltage Control for Active Load Balancer in 3-phase Four-wire Distribution Systems**  
Tint Soe Win, Yoshihido Hisada, Toshihiko Tanaka, Eiji Hiraki, Masayuki Okamoto, Seong Ryong Lee, Yamaguchi University, Japan; Okayama University, Japan; Ube National College of Technology, Japan; Kunsan National University, Korea

**1:55 pm > A Flexible DC Voltage Balancing Control based on the Power Flow Management for Star-connected Cascaded H-bridge Converter**

Chia-Tse Lee, Hsin-Chih Chen, Ching-Wei Wang, Ping-Heng Wu, Ching-Hsiang Yang, Po-Tai Cheng, National Tsing Hua University, Taiwan

**2:20 pm > Multilevel, Multiport, Switched-capacitor based Inverter for Utility Applications**

Mark J. Scott, Rachid Darbali Zamora, Andong Lang, Cong Li, Fanbo Zhang, Jin Wang, Ohio State University, United States

**2:45 pm > Black Start Operation for the Solid State Transformer Created Micro-grid under Islanding with Storage**

Sumit Dutta, Vivek Ramachandran, Subhashish Bhattacharya, North Carolina State University, United States

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**S56 Microgrid Control II**

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Room: 325

Chairs: Alessandro Lidozzi, Yongsug Suh

**1:30 pm > Application of Intelligent Agent Systems for Real-time Coordination of Power Converters (RCPC) in Microgrids**

Maryam Nasri, Herbert L. Ginn, Mehrdad Moallem, University of South Carolina, United States; Simon Fraser University, Canada

**1:55 pm > Investigation of Extra Power Loss Sharing among Photovoltaic Inverters Caused by Reactive Power Management in Distribution Networks**

Erhan Demirok, Dezso Sera, Remus Teodorescu, University of Manchester, United Kingdom; Aalborg University, Denmark

**2:20 pm > DC-bus Voltage Regulation Strategy for 3-phase Back-to-back Active Power Conditioners**

Cheng-Yu Tang, Yen-Fu Chen, Yu-Cai Hsu, Yaow-Ming Chen, Yih-Der Lee, National Taiwan University, Taiwan; Atomic Energy Council, Taiwan

**2:45 pm > An Effective Smooth Transition Control Strategy using Droop Based Synchronization for Parallel Inverters**

Nayeem Arafat, Ali Elrayah, Yilmaz Sozer, University of Akron, United States; Qatar Environment and Energy Research Institute, Qatar

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**S57 Battery Models**

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Room: 326

Chairs: Henry Chung, John Miller

**1:30 pm > A Transient Reduced Order Model for Battery Thermal Management based on Singular Value Decomposition**

Xiao Hu, Saeed Asgari, Ibrahim Yavuz, Scott Stanton, Chih-Cheng Hsu, Zhongying Shi, Bao Wang, Hao-Kun Chu, ANSYS Inc., United States; General Motor Company, United States

**1:55 pm > Near-real-time Parameter Estimation of an Electrical Battery Model with Multiple Time Constants and SOC-dependent Capacitance**

Wenguan Wang, Henry Shu-hung Chung, Jun Zhang, Sun Yat-sen University, China; City University of Hong Kong, Hong Kong

**2:20 pm > An Enhanced Circuit-based Battery Model with Considerations of Temperature Effect**

Ni Lin, Song Ci, Hongjia Li, University of Nebraska-Lincoln, United States; Chinese Academy of Sciences, China

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**S58 Grid Emulation**

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Room: 327

Chairs: Rolando Burgos, Omer Onar

**1:30 pm > Development of Converter based Reconfigurable Power Grid Emulator**

Liu Yang, Yiwei Ma, Jingxin Wang, Jing Wang, Xiaohu Zhang, Leon M. Tolbert, Fred Wang, Kevin Tomsovic, University of Tennessee, United States

**1:55 pm > A Power-HIL Microgrid Testbed: Smart Energy Integration Lab (SEIL)**

F. Huerta, J.K. Gruber, M. Prodanovic, P. Matatagui, Institute IMDEA Energy, Spain

**2:20 pm > Power Hardware-in-the-loop Simulation of Integrated Voltage Regulation and Islanding Detection for Distributed PV Systems on GRU Model**

Ran Mo, Ye Yang, Hui Li, Florida State University, United States

**2:45 pm > Static and Dynamic Power System Load Emulation in Converter-based Reconfigurable Power Grid Emulator**

Jing Wang, Liu Yang, Yiwei Ma, Jingxin Wang, Leon M. Tolbert, Fred Wang, Kevin Tomsovic, University of Tennessee, United States

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**S59 Device Temperature Estimation**

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Room: 328

Chairs: Adam Skorek, Bram Ferreira

**1:30 pm > Online Junction Temperature Extraction with Turn-off Delay Time for High Power IGBTs**

Pengfei Sun, Haoze Luo, Yufei Dong, Wuhua Li, Xiangning He, Guodong Chen, Enxing Yang, Zuyi Dong, Zhejiang University, China; Shanghai Electric Power Transmission & Distribution Group, China

**1:55 pm > P-i-N Diode Chip Temperature Extraction Method by Investigation into Maximum Recovery Current Rate di/dt**

Haoze Luo, Pengfei Sun, Yufei Dong, Wuhua Li, Xiangning He, Guodong Chen, Enxing Yang, Zuyi Dong, Zhejiang University, China; Shanghai Electric Power Transmission & Distribution Group, China

**2:20 pm > Evaluation of Thermo-sensitive Electrical Parameters based on the Forward Voltage for On-line Chip Temperature Measurements of IGBT Devices**

Laurent Dupont, Yvan Avenas, IFSTTAR, France; Universite de Grenoble, France

**2:45 pm > Frequency-domain Transient Temperature Estimation and Aging Analysis for Weak Points of IGBT Modules**

Ze Wang, Wei Qiao, Liyan Qu, University of Nebraska-Lincoln, United States

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**S60 Resonant DC-DC Converters I**

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Room: 329

Chairs: Wei Qiao, Shuo Wang

**1:30 pm > A ZCS-PWM Bidirectional DC-DC Converter with a Two-terminal Resonant Tank-based Auxiliary Switching Cell**

Tomokazu Mishima, Shinya Masuda, Mutsuo Nakaoka, Kobe University, Japan; University of Malaya, Malaysia; Kyungnam University, Korea

**1:55 pm > Single-inductor Resonant Switched Capacitor Voltage Multiplier with Safe Commutation**

Julio C. Rosas-Caro, Jonathan C. Mayo-Maldonado, Fernando Mancilla-David, Antonio Valderabano-Gonzalez, Francisco Beltran Carbajal, Victor M. Sanchez, Universidad Panamericana Campus Guadalajara, Mexico; University of Southampton, United Kingdom; University of Colorado-Denver, United States; Universidad Autonoma Metropolitana Azcapotzalco, Mexico; Universidad de Quintana Roo, Mexico

**2:20 pm > Analysis, Design and Implementation of Quadrupler based High Voltage Full Bridge Series Resonant DC-DC Converter**

Amit K. Singh, Pritam Das, S.K. Panda, National University of Singapore, Singapore

**2:45 pm > A Transformerless Step-up Resonant Converter for Grid-connected Renewable Energy Sources**

Xiaogang Wu, Wu Chen, Renjie Hu, Yong Ke, Southeast University, China; WuHu Profession and Technology College, China

## S61 AC-DC Multi-phase Converters

Room: 330

Chairs: Maurizio Cirrincione, Norma Anglani

### 1:30 pm > DC Voltage Balancing of Flying Converter Cell Active Rectifier

M. Makoschitz, M. Hartmann, H. Ertl, R. Fehring, Vienna University of Technology, Austria; Schneider Electric Power Drives, Austria

### 1:55 pm > Multilevel Multichannel Interleaved AC-DC Converter for High Current Applications

Eddy Aeloiza, Yu Du, ABB Inc., United States

### 2:20 pm > Voltage Sequence Control based High-current Rectifier System

Jitendra Solanki, Norbert Fröhleke, Joachim Böcker, Gregor Düppe, Andreas Averbeg, Peter Wallmeier, University of Paderborn, Germany; AEG Power Solutions GmbH, Germany

### 2:45 pm > Modulation Scheme for Delta-type Current Source Rectifier to Reduce Input Current Distortion

Ben Guo, Fred Wang, Eddy Aeloiza, University of Tennessee, United States; ABB Corporate Research, United States

## S62 Control of Power Converters I

Room: 333

Chairs: Vladimir Blasko, Sudip Mazumder

### 1:30 pm > A Dual Voltage Control Strategy for Single-phase PWM Converters with Power Decoupling Function

Yi Tang, Zian Qin, Frede Blaabjerg, Poh Chiang Loh, Aalborg University, Denmark

### 1:55 pm > Hybrid Interleaving with Adaptive PLL Loop for Adaptive On-time Controlled Switching Converters

Pei-hsin Liu, Fred C. Lee, Qiang Li, Virginia Polytechnic Institute and State University, United States

### 2:20 pm > Dynamic Physical Limits of Boost Converters: A Benchmarking Tool for Transient Performance

Ignacio Galiano Zurbriggen, Matias Anun, Martin Ordonez, University of British Columbia, Canada

### 2:45 pm > On-chip Frequency Compensation Control Scheme with Independently Parameters Tuning and Green Native Adaptive Voltage Position (GNAVP) for Voltage Regulators

Ching-Jan Chen, Shao-Hung Lu, Sheng-Fu Hsiao, Yung-Jen Chen, Jian-Rong Huang, RichTek Technology Corporation, Taiwan; National Taiwan University, Taiwan

## S63 Sensorless Control: HF Injection

Room: 334

Chairs: David Diaz-Reigosa, Jul-Ki Seok

### 1:30 pm > Analysis of Carrier Signal Injection based Sensorless Control of PMSM Drives under Limited Inverter Switching Frequency Condition

P.L. Xu, Z.Q. Zhu, University of Sheffield, United Kingdom

### 1:55 pm > Position Sensorless Control Method at Zero Speed Region for Permanent Magnet Synchronous Motors using the Neutral Point Voltage of Stator Windings

Yoshitaka Iwaji, Ryoichi Takahata, Takahiro Suzuki, Shigehisa Aoyagi, Hitachi Ltd., Japan

### 2:20 pm > High Frequency D-Q Modeling of Synchronous Machines for Sensorless Control

Luigi Alberti, Nicola Bianchi, Silverio Bolognani, Free University of Bozen, Italy; University of Padova, Italy

### 2:45 pm > Carrier Signal Injection Method in Three Shunt Sensing Inverter for Sensorless AC Machine Drive

Sungho Jung, Jung-Ik Ha, Seoul National University, Korea

## S64 Prof. B. Chalmers Memorial Session: IPM Analysis

Room: 335

Chairs: Dan Ionel, Thomas Jahns

### 1:30 pm > Analysis of Torque versus Current Capability of Reluctance and Interior PM Machines under Limited Current and Flux-linkage Operation

Emanuele Fornasiero, Nicola Bianchi, Wen L. Soong, University of Padova, Italy; University of Adelaide, Australia

### 1:55 pm > Analysis of Iron Loss in Interior PM Machines with Distributed Windings under Deep Field-weakening

Chun Tang, Wen L. Soong, Nesimi Ertugrul, Thomas M. Jahns, University of Adelaide, Australia; University of Wisconsin-Madison, United States

### 2:20 pm > Permanent Magnet Volume Minimization of Spoke Type Fractional Slot Synchronous Motors

Enrico Carraro, Nicola Bianchi, Sunny Zhang, Matthias Koch, University of Padova, Italy; Brose Fahrzeugteile GmbH and Co. KG, Germany

### 2:45 pm > Impact of the Field Weakening on the Iron Losses in the Stator of an Internal Permanent Magnet Synchronous Machine

S. Küttler, K. El Kadri Benkara, G. Friedrich, F. Vangraefschèpe, A. Abdelli, University of Technology of Compiègne, France; IFP New Energies, France

## S65 Magnetic Materials

Room: 336

Chairs: Thomas Wu, Galina Mirzaeva

### 1:30 pm > Characterization of Electrical Steels for High Speed Induction Motor Applications: Going Beyond the Standards

André S.L. Costa, Rodrigo R. Bastos, Sebastião C. Paolinelli, Sebastião L. Nau, Ramón M. Valle, Braz J. Cardoso Filho, Universidade Federal de Minas Gerais, Brazil; Aperam South America, Brazil; WEG Motors, Brazil

### 1:55 pm > Design Considerations of 2-D Magnetizers for High Flux Density Measurements

J.G. Wanjiku, P. Pillay, Concordia University, Canada

### 2:20 pm > A Simple Method to Minimize Effects of Temperature Variation on IPMSM Control in Real-time Manner

Sang Min Kim, Taesuk Kwon, Hyundai Mobis, Korea

### 2:45 pm > Effect of Magnet Properties on Power Density and Flux-weakening Performance of High-speed Interior Permanent Magnet Synchronous Machines

James D. McFarland, T.M. Jahns, Ayman M. El-Refai, Patel B. Reddy, University of Wisconsin-Madison, United States; GE Global Research Center, United States

Wednesday, September 17

3:30 pm – 5:10 pm

## S66 Utility Interactive Solar PV System

Room: 323

Chair: Pedro Rodriguez

### 3:30 pm > Comprehensive Modeling of Single-phase Quasi-Z-source Photovoltaic Inverter to Investigate Low-frequency Voltage and Current Ripples

Yushan Liu, Haitham Abu-Rub, Baoming Ge, Dongsun Sun, Hao Zhang, Daqiang Bi, Fang Z. Peng, Beijing Jiaotong University, China; Texas A&M University at Qatar, Qatar; Texas A&M University, United States; University of Texas at San Antonio, United States; Tsinghua University, China; Michigan State University, United States

**3:55 pm > A High-efficiency Single-phase Inverter for Transformerless Photovoltaic Grid-connection**

Senjun Hu, Wenfeng Cui, Wuhua Li, Xiangning He, Fengwen Cao, Zhejiang University, China; Suzhou Vocational University, China

**4:20 pm > Multiphase Parallel Interleaved and Primary-parallel Secondary-series Forward Micro-inverter Comparison**

D. Meneses, O. García, P. Alou, J.A. Oliver, J.A. Cobos, Universidad Politécnica de Madrid, Spain

**4:45 pm > A High Efficiency PV Micro-inverter with Grid Support Functions**

M. Harfman-Todorovic, F. Tao, M. Agamy, D. Dong, X. Liu, L. Garces, R. Zhou, E. Delgado, D. Marabell, C. Stephens, R. Steigerwald, General Electric Global Research Center, United States

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**S67 Power Converters for Renewable Energy Applications**

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Room: 324

Chair: V. Angelidis

**3:30 pm > A Single-switch High Step-up DC-DC Converter with Coupled Inductor**

Liping Zhou, Dongyuan Qiu, Wenxun Xiao, Bo Zhang, South China University of Technology, China

**3:55 pm > High Gain Single-stage Boosting Inverter**

Ben Zhao, Alexander Abramovitz, Keyue Smedley, Northwestern Polytechnical University, China; University of California, Irvine, United States

**4:20 pm > PV Power Conditioning System with LLC Resonant Converter in DCM**

Giovanna Oriti, Alexander L. Julian, Troy D. Bailey, Naval Postgraduate School, United States

**4:45 pm > High Efficiency Multilevel Flying-capacitor DC-DC Converter for Distributed Generation Applications**

MingGuo Jin, Amir Parastar, Jul-Ki Seok, Yeungnam University, Korea

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**S68 Microgrid Control III**

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Room: 325

Chairs: Hui Li, Mahesh Illindala

**3:30 pm > Control Design of Coordinated Droop Control for Hybrid AC-DC Microgrid Considering Distributed Generation Characteristics**

Woojin Choi, Jong-Bok Baek, Bo-Hyung Cho, Seoul National University, Korea

**3:55 pm > Power-based Control of Low-voltage Microgrids**

Tommaso Caldognetto, Paolo Tenti, Danilo Iglesias Brandao, University of Padova, Italy; State University of Campinas, Brazil

**4:20 pm > Secondary Coordinated Control of Islanded Microgrids based on Consensus Algorithms**

Dan Wu, Tomislav Dragicevic, Juan C. Vasquez, Josep M. Guerrero, Yajuan Guan, Aalborg University, Denmark

**4:45 pm > A Controller for the Smooth Transition from Grid-connected to Autonomous Operation Mode**

Stefano Lissandron, Paolo Mattavelli, University of Padova, Italy

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**S69 Battery Energy Management**

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Room: 326

Chairs: Chris Mi, Bulent Sarlioglu

**3:30 pm > Loss Minimization-based Charging Strategy for Lithium-ion Battery**

Zheng Chen, Bing Xia, Chunting Chris Mi, Rui Xiong, University of Michigan-Dearborn, United States

**3:55 pm > Enhanced Coulomb Counting Method with Adaptive SOC Reset Time for Estimating OCV**

Yong-Min Jeong, Yong-Ki Cho, Jung-Hoon Ahn, Seung-Hee Ryu, Byoung-Kuk Lee, Sungkyunkwan University, Korea

**4:20 pm > Equalization System for Serially-connected Battery Cells based on the Wave-trap Concept**

M. Arias, D. Bretón, M.M. Hernando, U. Viscarret, Iñigo Gil, University of Oviedo, Spain; Ikerlan-Ik4, Spain; Orona, Spain

**4:45 pm > Modular Approach for Continuous Cell-level Balancing to Improve Performance of Large Battery Packs**

M. Muneeb Ur Rehman, Michael Evzelman, Kelly Hathaway, Regan Zane, Gregory L. Plett, Kandler Smith, Eric Wood, Dragan Maksimović, Utah State University, United States; University of Colorado-Colorado Springs, United States; National Renewable Energy Lab, United States; University of Colorado-Boulder, United States

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**S70 Other Power Electronics Topics for Grid Applications**

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Room: 327

Chairs: Peng Zhang, Dan Ionel

**3:30 pm > New Power Electronic Interface Combining DC Transmission, a Medium-frequency Bus and an AC-AC Converter to Integrate Deep-sea Facilities with the AC Grid**

Andres Escobar-Mejia, Yusi Liu, Juan Carlos Balda, Kenny George, University of Arkansas, United States

**3:55 pm > Operational Study of a Modular Direct Current Power System for Subsea Power Delivery**

Dong Dong, Di Zhang, Rixin Lai, Song Chi, Maja H. Todorovic, General Electrical Global Research Center, United States

**4:20 pm > Investigation on Dynamic Voltage Restorer with Two DC-links and Series Converters for 3-phase Four-wire Systems**

Gregory A.A. Carlos, Cursino B. Jacobina, Euzeli C. dos Santos Jr., Federal Institute of Alagoas, Brazil; Federal University of Campina Grande, Brazil; Purdue School of Engineering Technology, United States

**4:45 pm > Locking Frequency Band Exposure Method for Islanding Detection and Prevention in Distributed Generation**

Iman Mazhari, Lotfi Beghou, Johan Enslin, Babak Parkhideh, Shibashis Bhowmik, University of North Carolina, United States; SineWatts Inc., United States

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**S71 Power Electronic Modules I (high T and SiC)**

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Room: 328

Chairs: Yvan Avenas, Puqi Ning

**3:30 pm > Novel IGBT Module Design, Material and Reliability Technology for 175°C Continuous Operation**

Takashi Saito, Yoshitaka Nishimura, Fumihiko Momose, Akira Morozumi, Yuta Tamai, Eiji Mochizuki, Yoshikazu Takahashi, Fuji Electric Co., Ltd., Japan

**3:55 pm > A High Temperature Silicon Carbide MOSFET Power Module with Integrated Silicon-on-insulator based Gate Drive**

Zhiqiang Wang, Xiaojie Shi, Leon M. Tolbert, Fred Wang, Zhenxian Liang, Daniel Costinett, Benjamin J. Blalock, University of Tennessee, United States; Oak Ridge National Laboratory, United States

**4:20 pm > Evaluation of Commercially Available SiC Devices and Packaging Materials for Operation Up to 350°C**

Dean Hamilton, Michael Jennings, Yogesh Sharma, Craig Fisher, Olayiwola Alatise, Philip Mawby, University of Warwick, United Kingdom

**4:45 pm > All-SiC Power Module for Delta-type Current Source Rectifier**

Ben Guo, Fred Wang, Eddy Aeloiza, Puqi Ning, Zhenxian Liang, University of Tennessee, United States; ABB Corporate Research, United States; Oak Ridge National Laboratory, United States

## S72 Multilevel DC-DC Converters

Room: 329

Chairs: Madhu Chinthavali, Jin Wang

### 3:30 pm > A Bidirectional Multiple-input Multiple-output Modular Multilevel DC-DC Converter

*Kia Filsoof, Peter W. Lehn, University of Toronto, Canada*

### 3:55 pm > A Family of the New Interleaved Multi-channel Three-level DC-DC Converters

*Yu Du, Eddy Aeloiza, ABB Corporate Research, United States*

### 4:20 pm > A ZVS Bidirectional Three-level DC-DC Converter with Direct Current Slew Rate Control of Leakage Inductance

*Lingyu Xu, Deshang Sha, Hongyu Chen, Beijing Institute of Technology, China*

### 4:45 pm > High Voltage Cell Power Supply for Modular Multilevel Converters

*Osman S. Senturk, Tobias Maerki, Peter Steimer, Steven McLaughlin, ABB Ltd., Switzerland*

## S73 DC-AC Converters

Room: 330

Chairs: Radu Bojoi, Luca Solero

### 3:30 pm > Generalized Active Power Decoupling Method for H-bridge with Minimum Voltage and Current Stress

*Runruo Chen, Sisheng Liang, Fang Z. Peng, Michigan State University, United States*

### 3:55 pm > Analysis and Design of Modified Half-bridge Series Resonant Inverter with DC-link Neutral Point Clamped Cell

*Seung-Hee Ryu, Dong-Gyun Woo, Jung-Hoon Ahn, Byoung-Kuk Lee, Sungkyunkwan University, Korea*

### 4:20 pm > Operation of Current Source Inverters in Discontinuous Conduction Mode

*Daniel Drews, Robert Cuzner, Giri Venkataramanan, DRS Power and Control Technologies, United States; University of Wisconsin-Madison, United States*

### 4:45 pm > A Hybrid Modulation Method for Single-phase Quasi-Z Source Inverter

*Hao Zhang, Baoming Ge, Yushan Liu, Haitham Abu-Rub, Dongsun Sun, Fang Zheng Peng, Beijing Jiaotong University, China; Texas A&M University, United States; Texas A&M University at Qatar, Qatar; University of Texas at San Antonio, United States; Michigan State University, United States*

## S74 Control of Power Converters II

Room: 333

Chairs: Tobias Geyer, Vladimir Blasko

### 3:30 pm > Utilization of Proportional Filter Capacitor Voltage Feedforward to Realize Active Damping for Digitally-controlled Grid-tied Inverter Operating under Wide Grid Impedance Variation

*Yuanbin He, Ke-wei Wang, Shu-hung Chung, City University of Hong Kong, Hong Kong*

### 3:55 pm > Observer-based State-space Current Controller for a Grid Converter Equipped with an LCL Filter: Analytical Method for Direct Discrete-time Design in Synchronous Coordinates

*Jarno Kukkola, Marko Hinkkanen, Kai Zenger, Aalto University, Finland*

### 4:20 pm > Gain-scheduled Control using Voltage Controlled Oscillator with Variable Gain for a LLC Resonant Converter

*Sang Woo Kang, Hye Jin Kim, Bo Hyung Cho, Seoul National University, Korea*

## S75 Sensorless Control II

Room: 334

Chairs: Giacomo Scelba, Fernando Briz

### 3:30 pm > An Integral Method Combining V/Hz and Vector Control of Permanent Magnet Motor

*Vladimir Blasko, Luis Arnedo, Dong Jiang, United Technologies Research Center, United States*

### 3:55 pm > High-speed Sensorless Control of a PMSM Operating under Periodic Magnetic Saturation Conditions

*Kwang-Woon Lee, Mokpo National Maritime University, Korea*

### 4:20 pm > Sensorless Control of 3-phase BLDC Motors using DC Current Model

*Won-Sang Im, Wenxin Liu, Jang-Mok Kim, Lehigh University, United States; Pusan National University, Korea*

### 4:45 pm > Sensorless Control of Linear Permanent Magnet Synchronous Motor using a Combined Sliding Mode Adaptive Observer

*M.A.M. Cheema, John Edward Fletcher, Dan Xiao, Faz Rahman, University of New South Wales, Australia*

## S76 IPM Machines for Automotive Applications

Room: 335

Chairs: Bulent Sarlioglu, Rajeev Vyas

### 3:30 pm > Experimental Comparison of PM Assisted Synchronous Reluctance Motors

*Nicola Bianchi, Emanuele Fornasiero, Marco Ferrari, Mosè Castiello, University of Padova, Italy*

### 3:55 pm > Influence of Magnet Arrangement on the Performance of IPMSMs for Automotive Applications

*S. Yoshioka, S. Morimoto, M. Sanada, Y. Inoue, Osaka Prefecture University, Japan*

### 4:20 pm > Effect of Magnet Types on Performance of High Speed Spoke Interior Permanent Magnet Machines Designed for Traction Applications

*Steven J. Galioto, Patel B. Reddy, Ayman M. El-Refaie, GE Global Research Center, United States*

### 4:45 pm > Variable Leakage Flux (VLF) IPMSMs for Reduced Losses over a Driving Cycle while Maintaining the Feasibility of High Frequency Injection-based Rotor Position Self-sensing

*Apoorva Athavale, Takashi Fukushige, Takashi Kato, Chen-Yen Yu, Robert D. Lorenz, University of Wisconsin-Madison, United States; Nissan Motor Co. Ltd., Japan*

## S77 Solid-state Transformers

Room: 336

Chairs: Yongsug Suh, Zhiguo Pan

### 3:30 pm > Resonant Power Electronic Transformer for Power Grid

*Zhaohui Wang, Jiajia Ouyang, Junming Zhang, Kuang Sheng, Wenxi Yao, Zhejiang University, China*

### 3:55 pm > Multiple Objectives Tertiary Control Strategy for Solid State Transformer Interfaced DC Microgrid

*Xunwei Yu, Xijun Ni, Alex Huang, North Carolina State University, United States*

### 4:20 pm > Volume/Weight/Cost Comparison of a 1 MVA 10kV/400V Solid-state against a Conventional Low-frequency Distribution Transformer

*Jonas E. Huber, Johann W. Kolar, ETH Zurich, Switzerland*

### 4:45 pm > Design and Operation of a 3.6kV High Performance Solid State Transformer based on 13kV SiC MOSFET and JBS Diode

*Fei Wang, Gangyao Wang, Alex Huang, Wensong Yu, Xijun Ni, North Carolina State University, United States; Cree Inc., United States*



**S78 Energy Storage Systems**

Room: 323

Chair: Ion Exteberria

**8:00 am > Converter-fed Synchronous Machine for Pumped Hydro Storage Plants***Peter K. Steimer, Osman Senturk, Steve Aubert, Stefan Linder, ABB Ltd., Switzerland***8:25 am > Development of the Flywheel Energy Storage System with Multiple Parallel Drives***Jun-ichi Itoh, Tsuyoshi Nagano, Kenta Tanaka, Koji Orikawa, Noboru Yamada, Nagaoka University of Technology, Japan***8:50 am > Diagnosis of Lithium-ion Batteries State-of-health based on Electrochemical Impedance Spectroscopy Technique***Daniel I. Stroe, Maciej Swierczynski, Ana I. Stan, Vaclav Knap, R. Teodorescu, Søren J. Andreasen, Aalborg University, Denmark***9:15 am > Derivation of an Equivalent Electrical Circuit Model for Degradation Mechanisms in High Temperature PEM Fuel Cells in Performance Estimation***Chris de Beer, Paul Barendse, Pragasen Pillay, Raghunathan Rengaswamy, Brian Bullocks, University of Cape Town, South Africa; Texas Tech University, United States***S79 Power Converters for Wind Energy Applications**

Room: 324

Chairs: D. D. Reigosa, Brian Welchko

**8:00 am > Flyback-type di/dt Snubber for 10kV IGCT in MV Wind Turbines***Kihyun Lee, Yongsug Suh, Chonbuk National University, Korea***8:25 am > Nine-switch Converter-based DFIG Wind Power System and its Dynamic DC Voltage Assigned Approach for Low Voltage Riding through (LVRT)***Wen Gang, Chen Yu, Zhong Zhihao, Kang Yong, Huazhong University of Science and Technology, China***8:50 am > 13.8 kV Five Level ANPC Inverter for Wind Power***Mohammad Mohebbi, Michael L. McIntyre, John F. Naber, Robert Hickman, University of Louisville, United States; APIQ Semiconductor, United States***9:15 am > Single-stage 3-phase AC-DC Step-up Medium Voltage Resonant Converter for Offshore Wind Power Systems***John Lam, Praveen K. Jain, York University, Canada; Queen's University, Canada***S80 Microgrid Modeling**

Room: 325

Chairs: Sandeep Bala, Rolando Burgos

**8:00 am > High Resolution Output Power Estimation of Large-scale Distributed PV Systems***Tong Yao, Yingying Tang, Raja Ayyanar, Arizona State University, United States***8:25 am > Modeling, Analysis and Evaluation of Smart Load Functionality in the CERTS Microgrid***Abrez Mondal, David A. Klapp, Mahesh S. Illindala, Joseph H. Eto, Ohio State University, United States; American Electric Power, United States; Lawrence Berkeley National Lab, United States***8:50 am > Modeling, Analysis, and Measurement of Impedance for 3-phase AC Distributed Power System***Hongtao Shi, Fang Zhuo, Dong Zhang, Zhiqing Geng, Feng Wang, Xi'an Jiaotong University, China***9:15 am > Design of the Fort Sill Microgrid***Andrew Paquette, Ronald Harley, Vijay Bhavaraju, Slobodan Krstic, Peter Theisen, Georgia Institute of Technology, United States; Eaton Corporation, United States***S81 Cascaded Converters for Grid Applications**

Room: 326

Chairs: David Perreault, Navid Zargari

**8:00 am > Optimization of Fundamental Frequency Modulation for Cascaded Multilevel Inverter based Transformer-less UPFC***Shuitao Yang, Shao Zhang, Xiaorui Wang, Deepak Gunasekaran, Fang Z. Peng, Michigan State University, United States***8:25 am > One Dimensional Cell Inversion: A Modulation Strategy for Hybrid Cascaded Converters***Christopher D. Townsend, Daniel Tormo, Hector Zelaya De La Parra, ABB Corporate Research, Sweden***8:50 am > Efficiency Improved and Current Balanced 3-phase Modular Cascaded H-bridge Multilevel PV Inverter for Grid-connected Applications***Bailu Xiao, Leon M. Tolbert, University of Tennessee, United States***9:15 am > Zero-sequence Voltage Injection for DC Capacitor Voltage Balancing Control of the Star-connected Cascaded H-bridge PWM Converter under Unbalanced Grid***Chia-Tse Lee, Hsin-Chih Chen, Ching-Wei Wang, Ping-Heng Wu, Ching-Hsiang Yang, Po-Tai Cheng, National Tsing Hua University, Taiwan***S82 Power Electronic Modules II**

Room: 327

Chairs: Robert Pilawa, Jean Luc Schanen

**8:00 am > Substrate Layout Evaluation for T-type Three-level IGBT Modules***Nan Zhu, Min Chen, Xingyao Zhang, Jie Ma, Dehong Xu, Zhejiang University, China***8:25 am > A Compact Planar Rogowski Coil Current Sensor for Active Current Balancing of Parallel-connected Silicon Carbide MOSFETs***Yang Xue, Junjie Lu, Zhiqiang Wang, Leon M. Tolbert, Benjamin J. Blalock, Fred Wang, University of Tennessee, United States***8:50 am > Realization and Characterization of an IGBT Module based on the Power Chip-on-chip 3D Concept***Jean-Louis Marchesini, Pierre-Olivier Jeannin, Yvan Avenas, Leonardo Ruffeil de Oliveira, Cyril Buttay, Raphaël Riva, Université de Grenoble, France; Université de Lyon, France***9:15 am > Develop Parasitic Inductance Model for the Planar Busbar of an IGBT H Bridge in a Power Inverter***Ning Zhang, Shuo Wang, Hui Zhao, University of Texas at San Antonio, United States***S83 Multi-level Converters**

Room: 328

Chairs: Stefano Bifaretti, Alan Watson

**8:00 am > Multi-phase Multilevel LLC Resonant Converter with Low Voltage Stress on the Primary-side Switches***Feng Jin, Fuxin Liu, Xinbo Ruan, Xiaoli Meng, Nanjing University of Aeronautics and Astronautics, China***8:25 am > 3-phase Three-level LC-type Series Resonant DC-DC Converter with Variable Frequency Control***Yue Chen, Fuxin Liu, Xinbo Ruan, Xiaoling Meng, Nanjing University of Aeronautics and Astronautics, China*

**8:50 am > Five-level Unidirectional T-rectifier for High Speed Gen-set Applications**

Petar Grbovic, Alessandro Lidozzi, Luca Solero, Fabio Crescimbin, Huawei Technologies Dusseldorf GmbH, Germany; Roma Tre University, Italy

**9:15 am > Characterization of the Voltage and Electric Field Stresses in Multi-cell Solid-state Transformers**

Thomas Guillod, Jonas E. Huber, Gabriel Ortiz, Ankan De, Christian M. Franck, Johann W. Kolar, ETH Zurich, Switzerland; North Carolina State University, United States

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**S84 Resonant DC-DC Converters II**

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Room: 329

Chairs: Yogesh Patel, Hui Li

**8:00 am > Design and Implementation of a Half-bridge Dual LLC Converter with Symmetrical Autotransformer**

Ke-Ming Chen, Tsorng-Juu Liang, Shih-Ming Chen, Shih-Wen Tsai, National Cheng Kung University, Taiwan

**8:25 am > LLC Resonant DC Transformer (DCX) with Parallel PWM Tight Regulation**

Hui Chen, Xinke Wu, Zhejiang University, China

**8:50 am > A Bidirectional Resonant DC-DC Converter with Frequency Tracking Control**

Qicheng Huang, Keyan Shi, Xiaoyu Jia, Changsheng Hu, Dehong Xu, Zhejiang University, China

**9:15 am > Analysis on the Influence of Secondary Parasitic Capacitance to ZVS Transient in LLC Resonant Converter**

Hui Chen, Xinke Wu, Zhejiang University, China

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**S85 EMI and Power Converters**

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Room: 330

Chairs: Sung Yeul Park, Jiangang Hu

**8:00 am > Development of a Frequency-analysis Equipment Capable of Judging Propagation Direction of Conductive EMI**

Noriyuki Nosaka, Satoshi Ogasawara, Masatsugu Takemoto, Yoshitaka Iwaji, Kazutoshi Ogawa, Hokkaido University, Japan; Hitachi, Ltd., Japan

**8:25 am > DC-link Input EMI Filter Design in a Centralized Architecture PV Inverter: Impedance Approach**

Djilali Hamza, Khalifa Hasan Al Hosani, Petroleum Institute, United Arab Emirates

**8:50 am > Shielding-cancellation Technique for Suppressing Common Mode EMI in Isolated Power Converters**

Lihong Xie, Xinbo Ruan, Qing Ji, Zhihong Ye, Nanjing University of Aeronautics and Astronautics, China; Lite-On Technology, China

**9:15 am > Analysis and Filter Design of Differential Mode EMI Noise for GaN-based Interleaved MHz Critical Mode PFC Converter**

Yuchen Yang, Zhengyang Liu, Fred C. Lee, Qiang Li, Virginia Polytechnic Institute and State University, United States

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**S86 Electric Vehicle Technologies**

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Room: 333

Chairs: Yang Wang, Rahman Khwaja

**8:00 am > A New Integrated Onboard Charger and Accessory Power Converter for Plug-in Electric Vehicles**

Gui-Jia Su, Lixin Tang, Oak Ridge National Laboratory, United States

**8:25 am > Optimal Sizing of Propulsion Systems Applied to Fuel Cell based Vehicles**

C. Raga, A. Barrado, A. Lázaro, I. Quesada, H. Miniguano, P. Zumel, M. Sanz, Universidad Carlos III de Madrid, Spain

**8:50 am > Transverse Flux Permanent Magnet Motor with Double-C Stator Hoops and Flux-concentrated Rotor for In-wheel Drive Electric Vehicle**

Zhou Jia, Heyun Lin, Hui Yang, Zhou Jia, Chris Mi, Southeastern University, China; University of Michigan-Dearborn, United States

**9:15 am > Integrated Capacitor for Common-mode EMI Mitigation Applicable to High Frequency Planar Transformers used in Electric Vehicles DC-DC Converters**

Djilali Hamza, Majid Pahlevaninezhad, The Petroleum Institute, United Arab Emirates; Queen's University, Canada

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**S87 Asymmetry and Forces in Electric Machines**

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Room: 334

Chairs: Antonio Cardoso, Dave Dorrell

**8:00 am > Effects of Unbalanced Magnetic Pull in Large Permanent Magnet Machines**

M. Michon, K. Atallah, G. Johnstone, University of Sheffield, United Kingdom; Romax Technology Ltd., United Kingdom

**8:25 am > Experimental Verification of 6th Radial Force Control for IPMSMs based on Flux Linkage**

Masato Kanematsu, Hiroshi Fujimoto, Yoichi Hori, Toshio Enomoto, Masahiko Kondou, Hiroshi Komiya, Kantaro Yoshimoto, Takayuki Miyakawa, University of Tokyo, Japan; Nissan Motor Co., Ltd., Japan

**8:50 am > The Measurement and Indexing of Unbalanced Magnetic Pull in Electrical Machines**

David G. Dorrell, Jonathan K.H. Shek, Min-Fu Hsieh, University of Technology Sydney, Australia; University of Edinburgh, United Kingdom; National Cheng Kung University, Taiwan

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**S88 Permanent Magnet Machine Drives I**

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Room: 335

Chairs: Gianmario Pellegrino, Long Wu

**8:00 am > Plug-in, Direct Flux Vector Control of PM Synchronous Machine Drives**

Gianmario Pellegrino, Barbara Boazzo, Thomas M. Jahns, Politecnico di Torino, Italy; University of Wisconsin-Madison, United States

**8:25 am > Analysis and Control of Mono Inverter Dual Parallel SPMSM Drive System**

Yongjae Lee, Jung-Ik Ha, Seoul National University, Korea

**8:50 am > Mechanical Parameter Estimation of Permanent Magnet Synchronous Machines with Aiding from Estimation of Rotor PM Flux Linkage**

Kan Liu, Z.Q. Zhu, University of Sheffield, United Kingdom

**9:15 am > Flux Regulation Strategies for Hybrid Excitation Synchronous Machines**

F. Giulii Capponi, G. Borocci, G. De Donato, F. Caricchi, University of Roma "La Sapienza", Italy

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**S89 Non-conventional Electric Machines**

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Room: 336

Chairs: Elena Lomonova, Abraham Gebregergis

**8:00 am > Transient Analysis of a Line Start Hysteresis Interior Permanent Magnet Motor**

S.F. Rabbi, M.A. Rahman, Memorial University of Newfoundland, Canada

**8:25 am > Bearingless Transverse Flux Permanent Magnet Machine for Large Direct-drive**

Deok-je Bang, Seon-Hwan Hwang, Ji-Won Kim, Wook Hwang, Pii-Wan Han, Dae-Hyun Koo, Korea Electrotechnology Research Institute, Korea, Kyungnam University, Korea

**8:50 am > Hardware Integration for an Integrated Modular Motor Drive Including Distributed Control**

Adam Shea, T.M. Jahns, University of Wisconsin-Madison, United States

**9:15 am > Modeling of Dual Mechanical Port Machine with Squirrel-cage Outer Rotor for Hybrid Electric Vehicles**

Haiwei Cai, Longya Xu, Ohio State University, United States

Thursday, September 18

10:00 am – 11:40 am

**S90 Wind Energy: Control and Operation II**

Room: 323

Chair: Wei Qao

**10:00 am > Control of a Small Wind Turbine in the High Wind Speed Region**

Carlos Lumbreras, Juan M. Guerrero, Pablo García, Fernando Briz, David Díaz, University of Oviedo, Spain

**10:25 am > Sideband Torque Ripple in Direct Drive Permanent Magnet Wind Power Generator System**

W. Liang, W. Fei, P.C.K. Luk, Cranfield University, United Kingdom

**10:50 am > Intelligent Maximum Power Extraction Control for Wind Energy Conversion Systems based on Online Q-learning with Function Approximation**

Chun Wei, Zhe Zhang, Wei Qiao, Liyan Qu, University of Nebraska-Lincoln, United States

**11:15 am > Proportional Derivative based Stabilizing Control of Paralleled Grid Converters with Cables in Renewable Power Plants**

Xiongfei Wang, Frede Blaabjerg, Poh Chiang Loh, Aalborg University, Denmark

**S91 Voltage Control Issues in Renewable Energy Applications**

Room: 324

Chairs: Jiangang Hu, Jaedo Park

**10:00 am > Estimation of Synchronization Signal using Sinusoidal Amplitude Integrator in Synchronous Reference Frame**

Xiong Du, Yandong Liu, Guoning Wang, Pengju Sun, Luowei Zhou, Heng-Ming Tai, Chongqing University, China; University of Tulsa, United States

**10:25 am > High-dynamic Single-phase Hilbert-based PLL for Improved Phase-jump Ride-through in Grid-connected Inverters**

Buticchi Giampaolo, Davide Barater, Luca Tarisciotti, Pericle Zanchetta, University of Kiel, Germany; University of Parma, Italy; University of Nottingham, United Kingdom

**10:50 am > Output Voltage Control of 3- $\phi$  Switched Boost Inverter for Standalone Renewable Energy based Distribution Generation Systems**

Ravindranath Adda, Avinash Joshi, Santanu Mishra, Indian Institute of Technology Guwahati, India; Indian Institute of Technology Kanpur, India

**11:15 am > Decoupled Capacitor Voltage Control of Modular Multilevel Converters**

Marcelo A. Perez, Jose Rodriguez, Steffen Bernet, Universidad Tecnica Federico Santa Maria, Chile; Technical University of Dresden, Germany

**S92 Grid Devices**

Room: 325

Chairs: Hui Li, Khurram Afridi

**10:00 am > A Six-switch Solid State Variable Capacitor with Minimum DC Capacitance**

Sisheng Liang, Fang Z. Peng, Dong Cao, Michigan State University, United States; North Dakota State University, United States

**10:25 am > Verification by Current Control of Multi-phase Transformer-linked Type Boost Chopper Circuit using Current Sensorless Method**

Taichi Kawakami, Hiroataka Tanada, Masayoshi Yamamoto, Shimane University, Japan

**10:50 am > An Alternative Topology for Fault Current Limiting and Interrupting Devices**

R. Alaei, S.A. Khajehoddin, W. Xu, S.H. Fathi, University of Alberta, Canada; Amirkabir University of Technology, Iran

**11:15 am > A Silicon Carbide Fault Current Limiter for Distribution Systems**

Yusi Liu, Chris Farnell, Hao Zhang, Andrés Escobar-Mejía, H. Alan Mantooth, Juan Carlos Balda, Simon S. Ang, University of Arkansas, United States

**S93 Power Converters for Grid Applications**

Room: 326

Chairs: Luca Solero, Di Pan

**10:00 am > An Isolated Multiport Bidirectional DC-DC Converter for PV-battery-DC Microgrid Applications**

Jianwu Zeng, Wei Qiao, Liyan Qu, University of Nebraska-Lincoln, United States

**10:25 am > Bidirectional DC-AC Converter for Isolated Microgrids with Voltage Unbalance Reduction Capabilities**

Felipe S.F. e Silva, Luiz A. de S. Ribeiro, José Gomes de Matos, Federal University of Maranhao, Brazil

**10:50 am > A Multiport Power Sharing Converter Topology for Renewable-to-grid Interface**

J.T. Hawke, H.S. Krishnamoorthy, P.N. Enjeti, Texas A&M University, United States

**11:15 am > Y-connected Three-leg Converters Applied in Three or Four-wire Shunt Compensator**

Edgard L.L. Fabricio, Cursino B. Jacobina, Montiê A. Vitorino, Maurício B.R. Correa, Federal University of Campina Grande, Brazil; Federal University of Paraiba, Brazil

**S94 Control of Power Converters based on Physical and Virtual Models**

Room: 327

Chairs: Tobias Geyer, Tiefu Zhao

**10:00 am > Estimation of the Plant Time Constant of Current-controlled Voltage Source Converters**

Ana Vidal, Alejandro G. Yepes, Jano Malvar, Óscar López, Jesús Doval-Gandoy, Francisco D. Freijedo, University of Vigo, Spain; Aalborg University, Denmark

**10:25 am > Model Predictive Current Control for Modular Multilevel Converters**

Georgios Darivianakis, Tobias Geyer, Wim van der Merwe, ABB Corporate Research Center, Switzerland

**10:50 am > Virtual Impedance Current Sharing Control of Parallel Connected Converters for AC Motor Drives**

Bassim Jassim, Bashar Zahawi, David J. Atkinson, Baghdad University, Iraq; Khalifa University, United Arab Emirates; Newcastle University, United Kingdom

**11:15 am > Improving Power Quality with Multi-objective Modulated Model Predictive Control**

Luca Tarisciotti, Pericle Zanchetta, Alan Watson, Jon Clare, Stefano Bifaretti, University of Nottingham, United Kingdom; University of Rome "Tor Vergata", Italy

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## S95 DC-AC Multi-phase Converters

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Room: 328

Chairs: Radu Bojoi, Norma Anglani

### 10:00 am > A New Four-level $\pi$ -type Converter with Neutral Point Voltage Balancing Capability

Xibo Yuan, University of Bristol, United Kingdom

### 10:25 am > SVPWM-based D- $\Sigma$ Digital Control for 3 $\phi$ Grid-connected Inverter with Wide Inductance Variation

T.-F. Wu, C.-H. Chang, L.-C. Lin, National Tsing Hua University, Taiwan; National Chung Cheng University, Taiwan

### 10:50 am > Switched Coupled-inductor Z-source Inverters with Large Conversion Ratio and Soft-switching Condition

Xinping Ding, Chenghui Zhang, Qingdao Technological University, China; Shandong University, China

### 11:15 am > A Novel P-Q Variations Method using a Decoupled Injection of Reference Currents for a Precise Estimation of Grid Impedance

Je-Hee Cho, Ki-Young Choi, Yong-Wook Kim, Rae-Young Kim, Hanyang University, Korea

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## S96 Soft-switching Bridge DC-DC Converters

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Room: 329

Chairs: Jin Wang, Madhu Chinthavali

### 10:00 am > A Low-RMS-current Passive Auxiliary Circuit for ZVS Operation of Full Bridge Converters

Alireza Safaee, Praveen Jain, Alireza Bakhshai, Bombardier Transportation Inc., Canada; Queen's University, Canada

### 10:25 am > The Cost-efficient, Full ZVS Range Hybrid Full-bridge/Half-bridge Family with Shared Lagging Leg: Topology Derivation, Optimization Design and Experimental Results

Yu Chen, Gang Wen, Li Peng, Yong Kang, Huazhong University of Science and Technology, China

### 10:50 am > 3-phase Current-fed Zero Current Switching Phase-shift PWM DC-DC Converter

Ali Mohammadpour, Tao Li, Leila Parsa, Rensselaer Polytechnic Institute, United States

### 11:15 am > A Novel High Efficiency High Power Density Three-port Converter based on Interleaved Half-bridge Converter for Renewable Energy Applications

Lili Zhu, Hongfei Wu, Peng Xu, Haibing Hu, Hongjuan Ge, Nanjing University of Aeronautics and Astronautics, China

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## S97 Flux and Direct Torque Control

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Room: 330

Chairs: Mario Pacas, Robert Cuzner

### 10:00 am > A Novel Stator Flux Oriented V/f Control Method in Sensorless Induction Motor Drives for Accuracy Improvement and Oscillation Suppression

Bin Chen, Wenxi Yao, Zhengyu Lu, Kevin Lee, Zhejiang University, China; Eaton Corporation, United States

### 10:25 am > Loss Manipulation Capabilities of Deadbeat-direct Torque and Flux Control Induction Machine Drives

Yukai Wang, Takumi Ito, Robert D. Lorenz, University of Wisconsin-Madison, United States; Toshiba Mitsubishi-Electric Industrial Systems Corporation, Japan

### 10:50 am > A Novel Method of Maximum Torque per Ampere Control for a Direct Torque-controlled PMSM in a Stator Flux-linkage Synchronous Frame

Tatsuki Inoue, Yukinori Inoue, Shigeo Morimoto, Masayuki Sanada, Osaka Prefecture University, Japan

### 11:15 am > Super-twisting Sliding Mode Direct Torque Control of Induction Machine Drives

Cristian Lascu, Frede Blaabjerg, University Politehnica of Timisoara, Romania; Aalborg University, Denmark

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## S98 Synchronous Reluctance Machines

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Room: 333

Chairs: Francesco Cupertino, Thomas Wu

### 10:00 am > FE-aided Analytical Method to Predict the Capabilities of Line-start Synchronous Motors

Damiano Mingardi, Nicola Bianchi, University of Padova, Italy

### 10:25 am > A Mechanically Robust Rotor with Transverse-laminations for a Synchronous Reluctance Machine for Traction Applications

Seyedmorteza Taghavi, Pragasen Pillay, Concordia University, Canada

### 10:50 am > Design of a 50,000 rpm Synchronous Reluctance Machine for an Aeronautic Diesel Engine Compressor

M. Palmieri, M. Perta, F. Cupertino, Politecnico di Bari, Italy

### 11:15 am > On the Feasibility of Integer and Fractional Number of Slots per Pole Distributed Winding Designs for Synchronous Reluctance Motors

Mircea Popescu, James E. Goss, David A. Staton, Yi Wang, Dan M. Ionel, Motor Design Ltd., United Kingdom; University of Wisconsin-Milwaukee, United States

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## S99 Modeling of Electric Machines

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Room: 334

Chairs: Jagadeesh Tangudu, Ronghai Qu

### 10:00 am > Ultrafast Steady-state Multi-physics Model for PM and Synchronous Reluctance Machines

Yi Wang, Dan M. Ionel, David Staton, University of Wisconsin-Milwaukee, United States; Regal Beloit Corp., United States; Motor Design, Ltd., United Kingdom

### 10:25 am > Coupled Electromagnetic/Thermal Machine Design Optimization based on Finite Element Analysis with Application of Artificial Neural Network

Wenyang Jiang, T.M. Jahns, University of Wisconsin-Madison, United States

### 10:50 am > A Multi-physics Design Methodology Applied to a High-force-density Short-duty Linear Actuator

N. Simpson, R. Wrobel, P.H. Mellor, University of Bristol, United Kingdom

### 11:15 am > A Methodology for Predicting the Thermal Behaviour of Modular-wound Electrical Machines

J.L. Baker, R. Wrobel, D. Drury, P.H. Mellor, University of Bristol, United Kingdom

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## S100 Permanent Magnet Machine Drives II

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Room: 335

Chairs: Thomas Jahns, Gui-Jia Su

### 10:00 am > Low Switching Frequency Stator Flux Linkage Observer for Interior Permanent Magnet Synchronous Machines

Wei Xu, Robert D. Lorenz, University of Wisconsin-Madison, United States

### 10:25 am > Using D-Q Transformation to Variable Switching Frequency PWM Control for Interior Permanent Magnet Synchronous Motor Drives

Fei Yang, Allan Taylor, Hua Bai, Bing Cheng, Arshan Khan, Young Joo Lee, Zhong Nie, Kettering University, United States; Chrysler Group LLC, United States

**10:50 am > Permanent Magnet Temperature Estimation in PMSMs using Pulsating High Frequency Current Injection**

David Reigosa, Daniel Fernandez, Hideo Yoshida, Takashi Kato, Fernando Briz, University of Oviedo, Spain; Nissan Motor Co., Ltd., Japan

**11:15 am > Operating within Dynamic Voltage Limits during Magnetization State Increases in Variable Flux PM Synchronous Machines**

Brent Gagas, Takashi Fukushige, Takashi Kato, Robert D. Lorenz, University of Wisconsin-Madison, United States; Nissan Motor Co., Ltd., Japan

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**S101 Magnetic Materials and Design**

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Room: 336

Chairs: Juan Rivas, Charles Sullivan

**10:00 am > A New Core Loss Model for Rectangular AC Voltages**

Mingkai Mu, Fred C. Lee, Virginia Polytechnic Institute and State University, United States

**10:25 am > Allowable Power Analysis for High Power Density DC-DC Converters using Integrated Magnetic Components**

Shota Kimura, Shogo Aoto, Jun Imaoka, Masayoshi Yamamoto, Shimane University, Japan

**10:50 am > Design and Evaluation of the Constant-flux Inductor with Enclosed-winding**

Han Cui, Khai D.T. Ngo, Jim Moss, Michele Lim, Ernesto Rey, Virginia Polytechnic Institute and State University, United States; Texas Instruments Inc., United States

**11:15 am > Gap Design for Nonlinear Ferrite Cores to Maximize Inductance**

Ting Ge, Khai Ngo, Jim Moss, Michele Lim, Virginia Polytechnic Institute and State University, United States; Texas Instruments Inc., United States

**Thursday, September 18**

**1:30 pm – 3:10 pm**

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**S102 LED Drivers II**

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Room: 323

Chair: Yilmaz Sozer

**1:30 pm > An Input-adaptive Self-oscillating Synchronous Boost Converter for LED Driving with Ultra-low Wide-range Voltage Input**

Yi Chen, Yurong Nan, Siheng Zhong, Qinggang Kong, Zhejiang University of Technology, China; Dalian Shinergy Science & Technology Development Co., Ltd., China

**1:55 pm > A Parallel LED String Driver using Capacitors for Source and String Ground Separation**

Ruihong Zhang, Henry Shu-Hung Chung, City University of Hong Kong, Hong Kong

**2:20 pm > Control Scheme for Decoupling Auxiliary Power Supply in Dimmable LED Drivers**

Liang Jia, David Fang, Yan-Fei Liu, Philips Electronics North America, United States; Queen's University, Canada

**2:45 pm > Inductive Power Transfer System for Driving Multiple OLED Lighting Panels**

Rui Zhou, Ruihong Zhang, Henry Shu-hung Chung, City University of Hong Kong, Hong Kong

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**S103 DC-DC Converters for Renewable Energy Applications**

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Room: 324

Chairs: Subhashish Bhattacharya, Tiefu Zhao

**1:30 pm > Frequency-based Control of a Micro-grid with Multiple Renewable Energy Sources**

Giampaolo Buticchi, Marco Liserre, Davide Barater, Carlo Concari, Alessandro Soldati, Giovanni Franceschini, University of Kiel, Germany; University of Parma, Italy

**1:55 pm > A Family of Dual-input DC-DC Converters based on Quasi-switched-capacitor Circuit**

Feng Guo, Lixing Fu, Xuan Zhang, Chengcheng Yao, He Li, Jin Wang, Ohio State University, United States

**2:20 pm > Multi-input Transformer Coupled DC-DC Converter for PV-wind based Stand-alone Single-phase Power Generating System**

B. Mangu, B.G. Fernandes, Indian Institute of Technology Bombay, India

**2:45 pm > Inductive-boost Switched-capacitor DC-DC Converter for Maximum Power Point Tracking Photovoltaic Systems**

Ali Gandomkar, Jul-Ki Seok, Yeungnam University, Korea

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**S104 Smart Grid Technologies I**

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Room: 325

Chairs: David Perreault, Zhiguo Pan

**1:30 pm > Medium Voltage AC Collection Grid for Large Scale Photovoltaic Plants based on Medium Frequency Transformers**

Bahaa Hafez, Harish S. Krishnamoorthy, Prasad Enjeti, Uffe Borup, Shehab Ahmed, Texas A&M University, United States; Danfoss Solar Inverters, United States; Texas A&M University at Qatar, Qatar

**1:55 pm > Towards Fully Controllable Multi-terminal DC Grids using Flexible DC Transmission Systems**

Kumars Rouzbehi, Arash Miranian, Alvaro Luna, Pedro Rodriguez, Technical University of Catalonia, Spain; Ferdowsi University of Mashhad, Iran; Abengoa Research, Spain

**2:20 pm > Standalone ESS Modeling and Dual-loop Control using Zn-Br Redox Flow Battery**

Jung-Muk Choe, Younghoon Cho, Gyu-Ha Choe, Konkuk University, Korea

**2:45 pm > Storage System Requirements for Grid Supporting PV-power Plants**

Catalin Gavriluta, Ignacio Candela, Joan Rocabert, Ion Etxeberria-Otadui, Pedro Rodriguez, Technical University of Catalonia, Spain; IKERLAN-IK4 Technological Research Centre, Spain; Abengoa Research, Spain

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**S105 HVDC Systems**

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Room: 326

Chairs: Amel Lachichi, Luca Solero

**1:30 pm > A DC-DC Circuit Suitable for HVDC Applications with Large Step-ratios**

T. Lüth, M. Merlin, T. Green, Imperial College London, United Kingdom

**1:55 pm > DC Impedance Modelling of a MMC-HVDC System for DC Voltage Ripple Prediction under a Single-line-to-ground Fault**

Xiaojie Shi, Zhiqiang Wang, Bo Liu, Yalong Li, Leon M. Tolbert, Fred Wang, University of Tennessee, United States

**2:20 pm > Optimization of Limiting Reactors Design for DC Fault Protection of Multi-terminal HVDC Networks**

E. Kontos, S. Rodrigues, R. Teixeira Pinto, P. Bauer, Delft University of Technology, Netherlands

**2:45 pm > Implementation and Testing of High-power IGCT-based Cascaded-converter Cells**

*Tomas Modeer, Staffan Norrga, Hans-Peter Nee, KTH Royal Institute of Technology, Sweden*

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**S106 Dual Active Bridge DC-DC Converters**

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Room: 327

Chairs: Shuo Wang, Wei Qiao

**1:30 pm > Dual-input High Gain DC-DC Converter based on the Cockcroft-Walton Multiplier**

*Lukas Müller, Jonathan W. Kimball, Missouri University of Science and Technology, United States*

**1:55 pm > Novel Multiobjective Optimization of MF Transformers for Soft-switching Converters using a Genetic Algorithm**

*Asier Garcia-Bediaga, Irma Villar, Luis Mir, Ion Etxebarria-Otadui, Alfred Rufer, IK4-IKERLAN Technological Research Centre, Spain; École Polytechnique Fédérale de Lausanne, Switzerland*

**2:20 pm > An Isolated Hybrid Switched C-L DC-DC Circuit with High Step-up Ratio and Reduced Switch Voltage Stress**

*Cong Li, Rachid Darbali Zamora, Chengcheng Yao, Lixing Fu, He Li, Xuan Zhang, Feng Guo, Jin Wang, Ohio State University, United States*

**2:45 pm > A Series Compensation Enabled ZVS Range Enhancement of a Dual Active Bridge Converter for Wide Range Load Conditions**

*Awneesh Tripathi, Krishna Mainali, Subhashish Bhattacharya, North Carolina State University, United States*

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**S107 Multi-level Converter Topologies I**

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Room: 328

Chairs: Luca Zarri, Patrick Wheeler

**1:30 pm > A Non-regenerative Five-level Rectifier**

*Xibo Yuan, University of Bristol, United Kingdom*

**1:55 pm > Optimised Operation Mode for the Hexverter Topology based on Adjacent Compensating Power**

*Dennis Karwatzki, Lennart Baruschka, Malte von Hofen, Axel Mertens, Leibniz Universität Hannover, Germany; Protolar GmbH, Germany*

**2:20 pm > Low-speed Drive Operation of the Modular Multilevel Converter Hexverter Down to Zero Frequency**

*Lennart Baruschka, Dennis Karwatzki, Malte von Hofen, Axel Mertens, Leibniz Universität Hannover, Germany; Protolar GmbH, Germany*

**2:45 pm > A Cross Connected Submodule Topology for Hybrid Multilevel Converters**

*Ebin Cherian Mathew, Anshuman Shukla, Mahendra Ghat, Indian Institute of Technology Bombay, India*

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**S108 Low-power Resonant Converters**

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Room: 329

Chair: Henry Chung

**1:30 pm > On-line DC-link Voltage Control of LLC Resonant Converter for Server Power Applications**

*Zih-Jie Su, Yen-Shin Lai, National Taipei University of Technology, Taiwan*

**1:55 pm > Modeling and Experimentation of Misalignment-tolerable Loosely-coupled Coil Structure**

*Jeff Po Wa Chow, Nan Chen, Henry Shu Hung Chung, Leanne Lai Hang Chan, City University of Hong Kong, Hong Kong; ABB Corporate Research Center, Sweden*

**2:20 pm > Comparison of Two High Frequency Converters for Capacitive Power Transfer**

*Liang Huang, Aiguo Patrick Hu, Akshya Swain, Xin Dai, University of Auckland, New Zealand; Chongqing University, China*

**2:45 pm > Optimal Operation and Burst-mode Control for Improving the Efficiency of the Quasi-switched-capacitor Resonant Converter**

*Xuan Zhang, Chengcheng Yao, Feng Guo, Jin Wang, Ohio State University, United States*

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**S109 Modulation for Power Converters II**

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Room: 330

Chairs: J. Pou, Madhav Manirekar

**1:30 pm > Critical Modulation Method based on PWAM in Back-to-back 3-phase System**

*Hojoon Shin, Jung-Ik Ha, Seoul National University, Korea*

**1:55 pm > A Comparative Investigation of Various Advanced Bus Clamped Space Vector Pulse Width Modulation (SVPWM) Techniques**

*Meenu D. Nair, Gopinath Vivek, Anjana Kolathiparambil, Mukti Barai, NIT Calicut, India*

**2:20 pm > A Control Mechanism to Compensate Nonlinearity of Discontinuous Modulation based Grid-connected Differential-mode Ćuk Inverter**

*Siamak Mehrnami, Sudip K. Mazumder, University of Illinois at Chicago, United States*

**2:45 pm > A New Space Vector Modulation Technique for Common-mode Voltage Reduction in both Magnitude and Third-order Component**

*Kai Tian, Jiacheng Wang, Bin Wu, Dewei Xu, Zhongyuan Cheng, Navid Reza Zargari, Ryerson University, Canada; Simon Fraser University, Canada; Rockwell Automation Canada, Canada*

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**S110 Power Electronics Reliability Assessment**

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Room: 333

Chairs: Yehui Han, Shashank Krishnamurthy

**1:30 pm > Mission Profile Translation to Capacitor Stresses in Grid-connected Photovoltaic Systems**

*Yongheng Yang, Ke Ma, Huai Wang, Frede Blaabjerg, Aalborg University, Denmark*

**1:55 pm > Reliability Assessment of Power MOSFETs Working in Avalanche Mode based on a Thermal Strain Direct Measurement Approach**

*S. Russo, A. Testa, S. De Caro, S. Panarello, S. Patané, T. Scimone, G. Scelba, G. Scarcella, STMicroelectronics, Italy; University of Messina, Italy; University of Catania, Italy*

**2:20 pm > Transient Modelling of Loss and Thermal Dynamics in Power Semiconductor Devices**

*Ke Ma, Yongheng Yang, Frede Blaabjerg, Aalborg University, Denmark*

**2:45 pm > An Icepak-PSpice Co-simulation Method to Study the Impact of Bond Wires Fatigue on the Current and Temperature Distribution of IGBT Modules under Short-circuit**

*Rui Wu, Francesco Iannuzzo, Huai Wang, Frede Blaabjerg, Aalborg University, Denmark*

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**S111 High Power Drives**

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Room: 334

Chairs: Lei Hao, Qin Lei

**1:30 pm > Improved Selective Harmonics Elimination (SHE) Scheme with Online Harmonic Compensation for High-power PWM Converters**

*Ye Zhang, Yun Wei Li, Navid R. Zargari, Zhongyuan Cheng, University of Alberta, Canada; Rockwell Automation, Canada*

**1:55 pm > Model Predictive Pulse Pattern Control with Very Fast Transient Responses**

*Tobias Geyer, Nikolaos Oikonomou, ABB Corporate Research, Switzerland*

**2:20 pm > A Voltage Controlled Current Source Gate Drive Method for IGBT Devices**

*Lu Shu, Junming Zhang, Fangzheng Peng, Zhiqian Chen, Zhejiang University, China; Michigan State University, United States; IMRA Europe S.A.S, United Kingdom*

**2:45 pm > Modulation Schemes for a 30 MVA IGCT Converter using NPC H-bridges**

*Jie Shen, Stefan Schröder, Bo Qu, Yingqi Zhang, Kunlun Chen, Fan Zhang, Richard Zhang, GE Global Research, Germany; GE Global Research, China; GE Power Conversion, China*

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**S112 High Speed Electric Machines**

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Room: 335

Chairs: Fabio Capponi, Radu Bojoi

**1:30 pm > High Speed Operation of Electrical Machines, a Review on Technology, Benefits and Challenges**

*Reza Rajabi Moghaddam, ABB Corporate Research, Sweden*

**1:55 pm > High Frequency AC Machines Winding Model-parameters Estimation**

*I. Rasoanarivo, A. Baddi, N. Haje Obeid, T. Boileau, B. Nahid-Mobarakkeh, N. Takorabet, F. Meibody-Tabar, Université de Lorraine, France*

**2:20 pm > Minimization of Proximity Losses in Electrical Machines with Tooth-wound Coils**

*Mario Vetusch, Francesco Cupertino, Politecnico di Bari, Italy*

**2:45 pm > AC Losses in High Frequency Electrical Machine Windings formed from Large Section Conductors**

*Phil Mellor, Rafal Wrobel, Nick Simpson, University of Bristol, United Kingdom*

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**S113 Manufacturing Issues of Electric Machines**

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Room: 336

Chairs: Marcello Pucci, Peter Wung

**1:30 pm > Roll Up Stator Development for 56 Frame PM Synchronous Motor**

*Jason J. Kreidler, Wes K. Anderson, Sree Venkateswararao, Bill J. Conway, Harold D. Willis, Peter Y.P. Wung, Regal Beloit America Inc., United States; Regal Beloit Inc., India*

**1:55 pm > Reduction of Cogging Torque due to Production Tolerances of Rotor by using Partially Placed Dummy Slots in Axial Direction**

*Masatsugu Nakano, Yusuke Morita, Toshihiro Matsunaga, Mitsubishi Electric Corporation, Japan*

**2:20 pm > Performance and Core Loss of Concentrated Winding IPMSM with Different Core Treatment**

*Shah Asifur Rahman, Andrew M. Knight, University of Alberta, Canada; University of Calgary, Canada*

**2:45 pm > Manufacturing Influence on the Magnetic Properties and Iron Losses in Cobalt-iron Stator Cores for Electrical Machines**

*Andreas Krings, Marco Cossale, Juliette Souldard, Aldo Boglietti, Andrea Cavagnino, KTH Royal Institute of Technology, Sweden; Politecnico di Torino, Italy*

Thursday, September 18

3:30 pm – 5:10 pm

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**S114 Converters for Solar PV Systems**

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Room: 323

Chair: Amir Mehdi Pasdar

**3:30 pm > Analysis and Experimental Verification of Series-connected Micro-converter Photovoltaic System**

*Wang Chen, Min Chen, Zhe Zhang, Chen Jiang, Zhejiang University, China*

**3:55 pm > Photovoltaic Power Conversion Circuit using a Symmetric Boost Converter for Low-voltage Distribution Systems**

*Hideaki Fujita, Ryosuke Amma, Tokyo Institute of Technology, Japan*

**4:20 pm > New Control Strategy for DCM-232 3-phase PV Inverter with Constant Common Mode Voltage and Anti-islanding Capability**

*Xiaoqiang Guo, David Xu, Bin Wu, Yanshan University, China*

**4:45 pm > Single-switch Single-magnetic PWM Converter Integrating Voltage Equalizer for Series-connected Photovoltaic Modules under Partial Shading**

*Masatoshi Uno, Akio Kukita, Japan Aerospace Exploration Agency, Japan*

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**S115 Stability Analysis and Power Quality**

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Room: 324

Chairs: T. Shimizu, D. G. Holmes

**3:30 pm > Stability Analysis of Single-phase Grid-connected Inverter with L-filter**

*Ruiliang Xie, Xiang Hao, Xu Yang, Lang Huang, Chao Wang, Yuehong Yang, Xi'an Jiaotong University, China*

**3:55 pm > Comparison of Modulation Techniques for Active Split DC-bus 3-phase Four-leg Inverters**

*Stefano Bifaretti, Alessandro Lidozzi, Luca Solero, Fabio Crescimbeni, University of Roma Tor Vergata, Italy; Roma Tre University, Italy*

**4:20 pm > Shunt Active Power Filter based on Source Current Detection with a Fast Transient Response**

*Tomoyuki Mannen, Hideaki Fujita, Tokyo Institute of Technology, Japan*

**4:45 pm > An Inrush Limited, Surge Tolerant Hybrid Resonant Bridgeless PWM AC-DC PFC Converter**

*Muntasir Alam, Wilson Eberle, Nicholas Dohmeier, University of British Columbia, Canada; Delta-Q Technologies Corp., Canada*

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**S116 Smart Grid Technologies II**

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Room: 325

Chairs: Navid Zargari, Norma Anglani

**3:30 pm > Evaluation and Control Design of Virtual-synchronous-machine-based STATCOM for Grids with High Penetration of Renewable Energy**

*Chi Li, Rolando Burgos, Igor Cvetkovic, Dushan Boroyevich, Lamine Mili, Pedro Rodriguez, Virginia Polytechnic Institute and State University, United States; Abengoa Research, Spain*

**3:55 pm > Islanding Detection in 3-phase and Single-phase Systems using Pulsating High Frequency Signal Injection**

*David Reigosa, Fernando Briz, Cristian Blanco, Juan Manuel Guerrero, University of Oviedo, Spain*

**4:20 pm > Analysis of  $\Delta P - \Delta Q$  Area of Uncontrolled Islanding in Low Voltage Grids with PV Generators**

*Riccardo Sgarbossa, Stefano Lissandron, Paolo Mattavelli, Roberto Turri, Alberto Cerretti, University of Padova, Italy; ENEL SpA, Italy*

**4:45 pm > Design, Simulation and Testing of Semiconductor Assisted OLTC for Grid Voltage Regulator**

*Thiwanka Wijekoon, Eva-Maria Baerthlein, Ara Panosyan, Balusamy Kullampalayam Parameswaran, Simon Schramm, Stefan Schroeder, GE Global Research-Europe, Germany*

**S117 DC Grids**

Room: 326

Chairs: Dong Jiang, Amel Lachichi

**3:30 pm > Stability Analysis of a DC Microgrid with Master-slave Control Structure**

*Li Guo, Yibin Feng, Xialin Li, Chengshan Wang, Yunwei Li, Tianjin University, China; University of Alberta, Canada*

**3:55 pm > Design Consideration for Contactless DC Connector in High Power Density Future 380 V DC Distribution System**

*Yusuke Hayashi, Hajime Toyoda, Toshifumi Ise, Akira Matsumoto, Osaka University, Japan; NTT Facilities, Japan*

**4:20 pm > DC Pole-to-pole Short-circuit Behavior Analysis of Modular Multilevel Converter**

*Guoju Zhang, Yao Chen, Chenyang Yue, Li Qi, Jiuping Pan, ABB Ltd., China; ABB Ltd., United States*

**4:45 pm > Control of Voltage Source Converter based Multi-terminal DC Grid under DC Fault Operating Condition**

*Nima Yousefpoor, Sungmin Kim, Subhashish Bhattacharya, Quanta Technology, United States; Seoul National University, Korea; North Carolina State University, United States*

**S118 Gate Drive Techniques**

Room: 327

Chairs: David Cotini, Jelena Popovic

**3:30 pm > Thermal Analysis and Improvement of Cascode GaN HEMT in Stack-die Structure**

*Shuojie She, Wenli Zhang, Xiucheng Huang, Weijing Du, Zhengyang Liu, Fred C. Lee, Qiang Li, Beijing University of Technology, China; Virginia Polytechnic Institute and State University, United States*

**3:55 pm > Gate-driver for Safe Operation of Depletion-mode SiC JFETs**

*Simon Weber, Arvid Merkert, Axel Mertens, Leibniz Universität Hannover, Germany*

**4:20 pm > Transformer Isolated Gate Drive with Protection for SiC MOSFET in High Temperature Application**

*Feng Qi, Longya Xu, Guoliang Zhao, Jiangbo Wang, Ohio State University, United States*

**4:45 pm > Design and Experimental Validation of a High Frequency Gate Driver for Silicon Carbide Power Modules**

*Alejandro Rujas, Gabriel Garcia, Ion Etxeberria-Otadui, Uxue Larrañaga, Txomin Nieva, IK4-IKERLAN Technological Research Centre, Spain; CAF Power and Automation, Spain*

**S119 Multi-level Converter Topologies II**

Room: 328

Chairs: Rolando Burgos, Pierluigi Tenca

**3:30 pm > Partial 5/3 Level Topology for Solar Grid-tie Inverters**

*Antonio Ginart, Richard Liou, Andres Salazar, Carlos Restrepo, Michael Ernst, SolarMax, United States; Georgia Institute of Technology, United States*

**3:55 pm > Design and Implementation of a Novel Multilevel DC-AC Inverter**

*Cheng-Han Hsieh, Tsorng-Juu Liang, Shih-Wen Tsai, National Cheng Kung University, Taiwan*

**4:20 pm > A High Voltage Gain Multilevel Modular Switched-capacitor DC-DC Converter**

*Dong Cao, Wei Qian, Fang Z. Peng, North Dakota State University, United States; Michigan State University, United States*

**4:45 pm > Modification of Cascaded H-bridge Multilevel Inverter to Increase Output Voltage Level with a Single DC Voltage Source**

*Jin-sung Choi, Feel-soon Kang, Hanbat National University, Korea*

**S120 DC-DC Converter Applications**

Room: 329

Chairs: Qiang Li, Baoming Ge

**3:30 pm > Downsizing Effects of Integrated Magnetic Components in High Power Density DC-DC Converters for EV and HEV**

*Shota Kimura, Jun Imaoka, Masayoshi Yamamoto, Shimane University, Japan*

**3:55 pm > A Linear-assisted DC-DC Hybrid Power Converter for Envelope Tracking RF Power Amplifiers**

*Rajdeep Bondade, Yi Zhang, Dongsheng Ma, University of Texas at Dallas, United States; Texas Instruments Inc., United States*

**4:20 pm > A 98.7% Efficient Composite Converter Architecture with Application-tailored Efficiency Characteristic**

*Hua Chen, Kamal Sabi, Hyeokjin Kim, Tadakazu Harada, Robert Erickson, Dragan Maksimović, University of Colorado-Boulder, United States*

**4:45 pm > Discontinuous Conduction Mode Operation of the 2-phase Integrated-magnetic Boost Converter**

*Brendan C. Barry, John G. Hayes, Marek S. Rylko, Jerzy W. Masłoń, University College Cork, Ireland; dtw Sp. z o.o., Poland*

**S121 Control of Power Converters III**

Room: 330

Chair: Jaedo Park

**3:30 pm > Control and Experiment of High Frequency Isolated Modular Converter under Normal and AC Fault Operating Condition**

*Nima Yousefpoor, Babak Parkhideh, Ali Azidehak, Sungmin Kim, Subhashish Bhattacharya, Quanta Technology, United States; North Carolina State University, United States; Seoul National University, Korea*

**3:55 pm > Integrated Grid Inductance Estimation Technique for Finite Control Set Model Predictive Control in Grid Connected Converters**

*Bilal Arif, Luca Tarisciotti, Pericle Zanchetta, Jon Clare, Marco Degano, University of Nottingham, United Kingdom*

**4:20 pm > Finite State Model Predictive Control for 3x3 Matrix Converter based on Switching State Elimination**

*Ozan Gulbudak, Enrico Santi, Janosch Marquart, University of South Carolina, United States; University of Applied Sciences, Switzerland*

**4:45 pm > Control Strategy for 3-phase Converter under Unbalanced Grid Voltage Conditions Considering Line Loss**

*Kyung-Hwan Lee, Jung-Ik Ha, Seoul National University, Korea*



## S122 Energy-efficient Motor Drives

Room: 333

Chairs: Ali M. Bazzi, Stefan Schroeder

### 3:30 pm > Minimum Copper Loss Control of a Single-phase Grid-connected Wound Rotor Machine over Full Speed Range

*Kahyun Lee, Yongsu Han, Jung-Ik Ha, Seoul National University, Korea*

### 3:55 pm > Power Loss, System Efficiency, and Leakage Current Comparison between Si IGBT VFD and SiC FET VFD with Various Filtering Options

*Mahesh Swamy, Jun-Koo Kang, Kohei Shirabe, Yaskawa America, Inc., United States*

### 4:20 pm > Pulsating Torque Control with Voltage Suppression Period for Position-dependent Load Torque Applications

*Takahiro Suzuki, Yuichi Shimizu, Hitachi, Ltd., Japan; Hitachi Appliances, Inc., Japan*

## S123 Wound-field Machines

Room: 334

Chairs: Jiaqi Liang, Lei Hao

### 3:30 pm > Separately Excited Synchronous Motor with Rotary Transformer for Hybrid Vehicle Application

*Constantin Stancu, Terence Ward, Khwaja Rahman, Robert Dawsey, Peter Savagian, General Motors, United States*

### 3:55 pm > Investigation of an Improved Hybrid-excitation Flux Switching Brushless Machine for HEV/EV Applications

*Gan Zhang, Wei Hua, Ming Cheng, Jianzhong Zhang, Wei Jiang, Southeast University, China*

### 4:20 pm > Design of SPM and IPM Rotors in Novel One-axis Actively Positioned Single-drive Bearingless Motor

*Hiroya Sugimoto, Itsuki Shimura, Akira Chiba, Tokyo Institute of Technology, Japan*

### 4:45 pm > Design and Control Strategy of a 2-phase Brushless Exciter for Three-stage Starter/Generator

*Ningfei Jiao, Weiguo Liu, Jichang Peng, Shuai Mao, Hua Zhang, Northwestern Polytechnical University, China*

## S124 Axial-flux Machines

Room: 335

Chairs: Jessica Colton, Greg Heins

### 3:30 pm > Increase in Operating Range and Efficiency for Variable Gap Axial Flux Motors

*Greg Heins, Mark Thiele, Dean Patterson, Nicholas Lambert, Regal Beloit Corporation, Australia; Charles Darwin University, Australia*

### 3:55 pm > Closed-form Solution for Winding Types of Axial Flux Permanent Magnet Machines

*Ju Hyung Kim, Wooyung Choi, Bulent Sarioglu, WEMPEC, University of Wisconsin-Madison, United States*

### 4:20 pm > Examination for the Higher Efficiency in a Ferrite Permanent Magnet 10 kW In-wheel Axial-gap Motor with Coreless Rotor Structure

*Kodai Sone, Masatsugu Takemoto, Satoshi Ogasawara, Kenichi Takezaki, Wataru Hino, Hokkaido University, Japan; Dynax Corporation, Japan*

### 4:45 pm > Analysis and Development of an Axial Flux Magnetic Gear

*Matthew Johnson, Alireza Shapoury, Pedram Boghrat, Mike Post, Hamid A. Toliyat, Texas A&M University, United States; Physical Optics Corporation, United States*

## S125 Traction and Heavy-duty Vehicle Systems

Room: 336

Chairs: Ozpineci Burak, Drzen Dujju

### 3:30 pm > A Non-dissipative Controllable Charging Equalizer for Series Connected High-capacity Super-capacitors Urban Rail Transport System

*Jianfeng Liu, Cheng Luo, Haikuan Jiang, Zhiwu Huang, Central South University, China; Hunan Engineering Laboratory for Advanced Control and Intelligent Automation, China*

### 3:55 pm > Hybrid Railway Power Conditioner with Partial Compensation for Rating Optimization

*NingYi Dai, KengWeng Lao, ChiSeng Lam, University of Macau, Macau*

### 4:20 pm > DC Side Ripple Cancellation in a Cascaded Multilevel Topology for Automotive Applications

*Andrew Goodman, Alan Watson, Anubrata Dey, Jon Clare, Pat Wheeler, Yusuke Zushi, University of Nottingham, United Kingdom; Nissan Motor Co., Ltd, Japan*

### 4:45 pm > Experimental Evaluation of E-motor Engine Start in a Heavy-duty Hybrid Vehicle under Cold Soak Conditions

*J.G. Vining, Daimler Trucks North America, United States*

Monday, September 15

5:00 pm • 6:30 pm

## Poster Session: Control Aspects in Smart Grids

**E** Room: Exhibit Hall C – East  
Chairs: Qin Lei, Omer Onar

### P101 • Inverter Power Control to Support Distribution System Voltage Variability Mitigation

Xiao Liu, Aaron M. Cramer, University of Kentucky, United States

### P102 • A Unified Controller for a Microgrid based on Adaptive Virtual Impedance and Conductance

Meiqin Mao, Zheng Dong, Yong Ding, Liuchen Chang, Hefei University of Technology, China; University of New Brunswick, Canada

### P103 • Small Signal Impedance Measurement in Droop Controlled AC Microgrids

Malte John, Patricio A. Mendoza-Araya, Giri Venkataramanan, Leibniz Universität Hannover, Germany; University of Chile, Chile; University of Wisconsin-Madison, United States

### P104 • Series-connected HV-IGBTs using Active Voltage Control with Status Feedback Circuit

Shiqi Ji, Ting Lu, Zhengming Zhao, Hualong Yu, Liqiang Yuan, Tsinghua University, China

### P105 • Independent Damping Control of Multimode Low-frequency Oscillations using Shunt-connected FACTS Devices in Power System

Mebtu Beza, Massimo Bongiorno, Chalmers University of Technology, Sweden

### P106 • The Improved Sen Transformer — A New Effective Approach to Power Transmission Control

Jiaxin Yuan, Li Chen, Baichao Chen, Wuhan University, China

### P107 • Independent Real and Reactive Power Flow Control without Sensing Receiving End Voltage in Transformer-less Unified Power Flow Controller

Deepak Gunasekaran, Shao Zhang, Shuitao Yang, Fang Zheng Peng, Michigan State University, United States

### P108 • A Line Impedance Conditioner to Improve Zigzag Transformer based Hybrid AC-DC Transmission under Unbalanced Line Impedance Conditions

Bo Liu, Xiaojie Shi, Fred Wang, Yalong Li, University of Tennessee, Knoxville, United States

### P109 • Multi-terminal DC Grid Control under Loss of Terminal Station

Nima Yousefpoor, Sungmin Kim, Subhashish Bhattacharya, Quanta Technology, United States; Seoul National University, Korea; North Carolina State University, United States

### P110 • Control Concept Including Validation Strategy for an AC-DC Hybrid Link (Ultranet)

Volker Staudt, Andreas Steimel, Michael Kohlmann, Martin Kleine Jäger, Carsten Heising, Daniel Meyer, Klaus Vennemann, Eckhard Grebe, Klaus Kleinekorte, Ruhr-University Bochum, Germany; Avasition, Germany; Amprion, Germany

### P111 • Suppression Strategy for Short-circuit Current in Loop-type DC Microgrid

Xiaoming Zha, Han Ning, Xiaoli Lai, Ying Huang, Fei Liu, Wuhan University, China

### P112 • Cost-based Droop Scheme for DC Microgrid

Inam Ullah Nutkani, Wang Peng, Poh Chiang Loh, Frede Blaabjerg, Nanyang Technological University, Singapore; Aalborg University, Denmark

### P113 • Droop Voltage Range Design in DC Micro-grids Considering Cable Resistance

Fang Chen, Wei Zhang, Rolando Burgos, Dushan Boroyevich, Virginia Polytechnic Institute and State University, United States

### P114 • Flexible Power Flow Control for Next-generation Multi-terminal DC Power Network

Kenji Natori, Hidemine Obara, Kouhei Yoshikawa, Bao Cong Hiu, Yukihiro Sato, Chiba University, Japan

### P115 • Robust Control of a Single-phase VSI with LCL Filter for Grid-tie and Islanded Operation Modes Applied to PV Distributed Generation in Microgrids Environment

José C.U. Peña, Guilherme Melo, Carlos A. Canesin, Leonardo P. Sampaio, São Paulo State University, Brazil; Federal Technological University of Paraná, Brazil

### P116 • Average Modeling of a 3-phase Inverter for Integration in a Microgrid

Zeljko Jankovic, Bora Novakovic, Vijay Bhavaraju, Adel Nasiri, University of Wisconsin-Milwaukee, United States; Eaton Corporation, United States

### P117 • Optimization of the Maximum Power Point Tracking Method for Peak-current Controlled Flyback Micro-inverter

Zhe Zhang, Wang Chen, Min Chen, Zhejiang University, China

### P118 • Implementation of LVRT Techniques of Grid-connected PCS with the Adaptive Low Pass Notch PLL Method

Dong-sul Shin, Jong-Pil Lee, Kyung-Jun Lee, Tae-Jin Kim, Dong-Wook Yoo, Pusan National University, Korea; KERI, Korea

### P119 • Sub-synchronous Resonance Analysis in DFIG-based Wind Farms: Definitions and Problem Identification – Part I

Hossein Ali Mohammadpour, Enrico Santi, University of South Carolina, United States

### P120 • 8-shaped Trajectory Control for Rugged Rural PV Inverters

Juan M. Galvez, Martin Ordenez, University of British Columbia, Canada

### P121 • Management of the Wind Turbine Energy Delivered to the Grid based on the Flatness Control Method

Merzak Aimene, Alireza Payman, Brayima Dakyo, University of Le Havre, France

## Poster Session: Transportation

**E** Room: Exhibit Hall C – East  
Chairs: Jiaqi Liang, Burak Ozpineci

### P301 • Parameter Identification of Wireless Power Transfer Systems using Input Voltage and Current

Deyan Lin, Jian Yin, S.Y. Ron Hui, University of Hong Kong, Hong Kong

### P302 • Efficiency Improvement and Evaluation of Floating Capacitor Open-winding PM Motor Drive for EV Application

Di Pan, Kum-Kang Huh, Thomas A. Lipo, GE Global Research, United States; University of Wisconsin-Madison, United States

### P303 • Reducing the Impact of Source Internal Resistance by Source Coil in Resonant Wireless Power Transfer

Yiming Zhang, Ting Lu, Zhengming Zhao, Tsinghua University, China

### P304 • Analysis and Design of a Class D Rectifier for a Class E Driven Wireless Power Transfer System

Patrick C.K. Luk, Samer Aldhafer, Cranfield University, United Kingdom

### P305 • 7M-off-long-distance Extremely Loosely Coupled Inductive Power Transfer Systems using Dipole Coils

Bo H. Choi, Eun S. Lee, Ji H. Kim, Chun T. Rim, KAIST, Korea

**P306 • Evolutionary Multi-objective Optimization of H<sup>∞</sup> Controller for Inductive Power Transfer System**

Xin Dai, Yang Zou, Yue Sun, Zhihui Wang, Chunsen Tang, Aiguo Patrick Hu, Chongqing University, China; University of Auckland, New Zealand

**P307 • A Resonant Compensation Method for Improving the Performance of Capacitively Coupled Power Transfer System**

Liang Huang, Aiguo Patrick Hu, Akshya Swain, University of Auckland, New Zealand

**P308 • Optimization of Foil Conductor Layout in Inductive Power Transfer System Resonators**

Mohammad Etemadrezaei, Srdjan M. Lukic, North Carolina State University, United States

**P309 • Analysis, Design and Implementation of Phase-shifted Series Resonant High-voltage Capacitor Charging Power Supply and its Fuzzy Logic Controller**

Lei Lin, Heqing Zhong, Yu Deng, Yongfu Liao, Ao Li, Yu Chen, Li Peng, Huazhong University of Science and Technology, China

**P310 • Hundreds kW Charging Stations for e-Buses Operating under Regular Ultra-fast Charging**

Júlio C.G. Justino, Thiago M. Parreiras, Braz de J. Cardoso Filho, Federal University of Minas Gerais, Brazil

**P311 • Battery Management System with Cell Equalizer for Multi-cell Battery Packs**

Giovanna Oriti, Alexander L. Julian, Peter Norgaard, Naval Postgraduate School, United States; United States Navy, United States

**P312 • Cell Selection through Two-level Basis Pattern Recognition with Low/High Frequency Components Decomposed by DWT-based MRA**

Jonghoon Kim, Chosun University, Korea

**P313 • Tethered Aerial Robots using Contactless Power Systems for Extended Mission Time and Range**

Su Y. Choi, Bo H. Choi, Seog Y. Jung, Beom W. Gu, Seung J. Yoo, Chun T. Rim, KAIST, Korea

**P314 • Variable Frequency Generation System for Aircraft**

Denis Makarov, Sergey Kharitonov, Gennadiy Zinoviev, Dmitriy Korobkov, Andrey Sidorov, Novosibirsk State Technical University, Russian

**P315 • High Power Density SRC for Low Voltage Battery Charger in xEV with Third Harmonic Operation Technique**

Jung-Hoon Ahn, Dong-Hee Kim, Won-Yong Sung, Seung-Hee Ryu, Byoung-Kuk Lee, Sungkyunkwan University, Korea

**Poster Session: Non-isolated DC-DC Converters**

**N**

Room: Exhibit Hall C – North  
Chair: Gui-Jia Su

**P501 • Further Reduction of Switching Loss for the Lossless Snubber based Converters**

Beibei Wang, Trillion Q. Zheng, Jiepin Zhang, Beijing Jiaotong University, China

**P502 • Voltage Controlled Variable Capacitor based Snubber for the Reduction of IGBT's Turn-off Loss**

Beibei Wang, Trillion Q. Zheng, Jiepin Zhang, Beijing Jiaotong University, China

**P503 • A Quasi-Z-source DC-DC Converter**

LiQiang Yang, Dongyuan Qiu, Bo Zhang, GuiDong Zhang, Wenxun Xiao, South China University of Technology, China

**P504 • Power Semiconductor Filter: Use of Series-pass Device in Switching Converters for Input Filtering**

Wing-to Fan, Kuen-faat Yuen, Henry Shu-hung Chung, City University of Hong Kong, Hong Kong

**P505 • Master-slave Technique with Direct Variable Frequency Control for Interleaved Bidirectional Boost Converter**

A. Vazquez, M. Arias, A. Rodriguez, D.G. Lamar, S. Luri, University of Oviedo, Spain; IK4-IKERLAN, Spain

**P506 • Design of a 2 MW DC Supply using a 4-stage Interleaved DC-DC Converter**

Yusi Liu, Chris Farnell, Juan Carlos Balda, H. Alan Mantooth, University of Arkansas, United States

**P507 • 3D Printed Air Core Inductors for High Frequency Power Converters**

Wei Liang, Luke Raymond, Juan Rivas, Stanford University, United States

**P508 • Inductor Loss Analysis of Various Materials in Interleaved Boost Converters**

Yuki Itoh, Shota Kimura, Jun Imaoka, Masayoshi Yamamoto, Shimane University, Japan

**P509 • Voltage Balancing in an Interleaved High Gain Boost Converter**

Jesús E. Valdez-Reséndiz, Abraham Claudio-Sánchez, Gerardo V. Guerrero-Ramírez, Alejandro Tapia-Hernández, Aldo N. Higuera Juárez, Adolfo R. López Núñez, Centro Nacional de Investigación y Desarrollo Tecnológico, Mexico

**Poster Session: Multi-phase Converters**

**N**

Room: Exhibit Hall C – North  
Chair: Jiangang Hu

**P701 • Virtual-flux-based Power Predictive Control of 3-phase PWM Rectifiers using Space-vector Modulation**

Yongsoo Cho, Kyo-Beum Lee, Ajou University, Korea

**P702 • Zero Sequence Blocking Transformers for Multi-pulse Rectifier in Aerospace Applications**

Wenli Yao, Frede Blaabjerg, Xiaobin Zhang, Yongheng Yang, Zhaohui Gao, Northwest Polytechnical University, China; Aalborg University, Denmark

**P703 • A Novel 3-phase Current Source Rectifier with Delta-type Input Connection to Reduce Device Conduction Loss**

Ben Guo, Fred Wang, Eddy Aeloiza, University of Tennessee, United States; ABB Corporate Research, United States

**P704 • Active Front End Rectifier Design Trade-off between PWM and Direct Power Control Method**

Lixiang Wei, Yogesh Patel, Murthy Csn, Rockwell Automation, United States; L&T Technology, United States

**P705 • 3-phase Four-switch Partial Resonant Soft Switched Rectifier**

Ankan De, Subhashish Bhattacharya, North Carolina State University, United States

**P706 • Control Strategy of PV Inverter under Unbalanced Grid Voltage Sag**

Huang Hao, Xu Yonghai, North China Electric Power University, China

**P707 • Pulsed-width Modulation Technique for Family of (3N+3)-switch Converters**

Kennedy A. Aganah, Olorunfemi Ojo, Tuskegee University, United States; Tennessee Technological University, United States

**P708 • Modeling of Voltage Source Inverter having Active Split DC-bus for Supply of Four-wire Electrical Utility Systems**

Alessandro Lidozzi, Giovanni Lo Calzo, Sabino Pipolo, Luca Solero, Fabio Crescimbin, Roma Tre University, Italy

**P709 • High Reliability Capacitor Bank Design for Modular Multilevel Converter in MV Applications**

Vahid Najmi, Jun Wang, Rolando Burgos, Dushan Boroyevich, Virginia Polytechnic Institute and State University, United States

**P710 • Model Predictive Control of a Direct Three-to-seven Phase Matrix Converter**

Sk Moin Ahmed, Haitham Abu-Rub, Zainal Salam, Texas A&M University at Qatar, Qatar; University Technology Malaysia, Malaysia

**P711 • A New Space Vector Modulation Strategy to Reduce Common-mode Voltage for Quasi-Z-source Indirect Matrix Converter**

Xuyang You, Baoming Ge, Shuo Liu, Xinjian Jiang, Haitham Abu-Rub, Fang Z. Peng, Beijing Jiaotong University, China; Texas A&M University, United States; Tsinghua University, China; Texas A&M University at Qatar, Qatar; Michigan State University, United States

**P712 • A Novel Medium-frequency-transformer Isolated Matrix Converter for Wind Power Conversion Applications**

Chunyang Gu, Harish S. Krishnamoorthy, Prasad N. Enjeti, Yongdong Li, Tsinghua University, China; Texas A&M University, United States

**P713 • Novel Matrix Converter Topologies with Reduced Transistor Count**

S.M. Sajjad Hossain Rafin, Thomas A. Lipo, Byung-il Kwon, Hanyang University, Korea; University of Wisconsin-Madison, United States

**P714 • Control of AC-capacitor Clamped Three and Five Level Matrix Converter using Voltage and Current Modulation**

Lin Qiu, Lie Xu, Yongdong Li, Tsinghua University, China

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**Poster Session: DC-DC Converters**

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**S**

Room: Exhibit Hall C – South

Chairs: Lixiang Wei, Brian Welchko

**P901 • A Digital Predictive Current Mode Controller using Average Inductor Current**

Siyu He, John Y. Hung, Robert M. Nelms, Auburn University, United States

**P902 • Phase-shift Control of Isolated Bidirectional DC-DC Converters for Unidirectional Power Flow**

Junjie Ge, Zhengming Zhao, Junchao Ma, Fanbo He, Liqiang Yuan, Ting Lu, Tsinghua University, China

**P903 • Auto-tuning and Self-calibration Techniques for V2 Control with Capacitor Current Ramp Compensation using Lossless Capacitor Current Sensing**

Pei-hsin Liu, Yingyi Yan, Fred C. Lee, Qiang Li, Virginia Polytechnic Institute and State University, United States; Linear Technology, United States

**P904 • Band Separation in Linear-assisted Switching Power Amplifiers for Accurate Wide-bandwidth Envelope Tracking**

Dongxue Li, Yuanzhe Zhang, Miguel Rodríguez, Dragan Maksimović, University of Colorado-Boulder, United States

**P905 • Modeling and State-space Feedback Control of a DC-DC Converter for Photovoltaic Systems**

Darlan A. Fernandes, Márcia K. Vieira, Montê A. Vitorino, Fabiano Fragoso Costa, Pollyana C. Ribeiro, Federal University of Paraíba, Brazil; Federal University of Campina Grande, Brazil; Federal University of Bahia, Brazil

**P906 • Stability and Accuracy Considerations in the Design and Implementation of a Kilowatt-scale DC Power Hardware-in-the-loop Platform**

Jonathan Siegers, Herbert L. Ginn, Enrico Santi, University of South Carolina, United States

**P907 • A Method to Measure the DC bias in High Frequency Isolation Transformer of the Dual Active Bridge DC to DC Converter and its Removal using Current Injection and PWM Switching**

Sumit Dutta, Subhashish Bhattacharya, North Carolina State University, United States

**P908 • Fault Diagnosis in Unidirectional Non-isolated DC-DC Converters**

E. Ribeiro, A.J. Marques Cardoso, C. Boccaletti, University of Beira Interior, Portugal; Sapienza University of Rome, Italy

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**Poster Session: DC-AC and DC-AC Converters**

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**S**

Room: Exhibit Hall C – South

Chairs: Lixiang Wei, Brian Welchko

**P1101 • Parameter Design of the 3-phase Four-wire Testing Platform for New Energy Grid Connected Devices based on PRR Controller**

Shuang Zhao, Fei Liu, Zha Xiaoming, Sun Jianjun, Hu Wei, Wuhan University, China

**P1102 • Nonlinear Feedback Control of Compound Active-clamp Soft-switching 3-phase PFC Converter base on Load Observer**

Xin Guo, Hai-Peng Ren, Xi'an University of Technology, China

**P1103 • Second Harmonic Current Reduction and Dynamic Performance Improvement in the Two-stage Inverter: An Output Impedance Perspective**

Li Zhang, Xinbo Ruan, Xiaoyong Ren, Nanjing University of Aeronautics and Astronautics, China

**P1104 • Stationary Frame Control Strategy for Voltage Source Inverter under Unbalanced and Distorted Grid Voltage**

Yipeng Song, Heng Nian, Zhejiang University, China

**P1105 • Model Predictive Control of Nested Neutral Point Clamped (NNPC) Converter**

Mehdi Narimani, Venkata Yaramasu, Bin Wu, George Cheng, Navid Zargari, Ryerson University, Canada; Rockwell Automation, Canada

**P1106 • Power Loss Benchmark of Nine-switch Converters in 3-phase Online-UPS Application**

Zian Qin, Poh Chiang Loh, Frede Blaabjerg, Aalborg University, Denmark

**P1107 • A New Control Method for Minimizing the DC-link Capacitor Current of HEV Inverter Systems**

Christian Sommer, Arvid Merkert, Axel Mertens, Leibniz Universität Hannover, Germany

**P1108 • Resonant-inductor-voltage-feedback Active Damping based Control for Grid-connected Inverters with LLCL-filters**

Min Huang, Xiongfei Wang, Poh Chiang Loh, Frede Blaabjerg, Aalborg University, Denmark

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**Poster Session: Control of Power Converters**

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**S**

Room: Exhibit Hall C – South

Chairs: Lixiang Wei, Brian Welchko

**P1301 • Decentralized Voltage Sharing Control Strategy for Fully Modular Input-series Output-series High-voltage System**

Guangjiang Wang, Wu Chen, Yong Ke, Wei Jiang, Southeast University, China; WuHu Profession and Technology College, China

**P1302 • A Novel Input Voltage Sharing Control Strategy for Input-series Output-parallel System with High Reliability**

Wu Chen, Xu Zhu, Guangjiang Wang, Wei Jiang, Kai Yao, Southeast University, China; Nanjing University of Science and Technology, China

**P1303 • Implementation of H $\infty$  Controller for Active Voltage Quality Regulator under Distorted Grid**

Yong Lu, Guochun Xiao, Xuanlv Wu, Lifu Zheng, Jinjun Liu, Le Sun, Xi'an Jiaotong University, China

**P1304 • Active Damping for Model Predictive Pulse Pattern Control**

Peter Hokayem, Tobias Geyer, Nikolaos Oikonomou, ABB Corporate Research Center, Switzerland

**P1305 • High Efficiency and Total Harmonic Distortion Improvement by Zero Current Prediction Technique for Transformer-free Buck Power Factor Corrector**

Che-Hao Meng, Chih-Wei Chang, Chao-Chang Chiu, Ke-Horng Chen, Ying-Hsi Lin, Tsung-Yen Tsai, Chao-Cheng Lee, National Chiao Tung University, Taiwan; Realtek Semiconductor Corp., Taiwan

**P1306 • Variable-speed IGBT Gate Driver with Loss/Overshoot Balancing for Switching Loss Reduction**

Alexey Sokolov, Diego Mascarella, Geza Joos, McGill University, Canada

**P1307 • New Current Control Scheme for the Vienna Rectifier in Discontinuous Conduction Mode**

Michael Leibl, Johann W. Kolar, Josef Deuringer, ETH Zurich, Switzerland; Siemens AG Healthcare, Germany

**P1308 • Synchronous Frame and Resonant Adaptive Observers as Disturbance Estimators and their Applications in Power Electronics**

Vlatko Miskovic, Vladimir Blasko, Thomas M. Jahns, Robert D. Lorenz, Charles J. Romanesko, Haojiong Zhang, Danfoss Power Electronics, United States; University of Wisconsin-Madison, United States; United Technologies Research Center, United States

**P1309 • Sliding Mode Controlled Half Bridge Audio Amplifier using Single Power Supply**

Sridhar Joshi, Parthasarathi Sensarma, Indian Institute of Technology Kanpur, India

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### Poster Session: General Topics

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**S**

Room: Exhibit Hall C – South  
Chair: Peng Zhang

**P1501 • Reconsideration of Loop Gain Measurement of DC/DC Converters**

Chun Xiong, Xinbo Ruan, Peilin Chen, Xuehua Wang, Huazhong University of Science and Technology, China

**P1502 • Simplified Electric Vehicle Models for use in Undergraduate Teaching and Research**

John G. Hayes, University College Cork, Ireland

**P1503 • AC-DC Converters with Open-end Grid for AC Machine Conversion Systems**

João P.R.A. Mello, Cursino B. Jacobina, Gregory A.A. Carlos, Nady Rocha, Federal University of Campina Grande, Brazil; Federal Institute of Alagoas, Brazil; Federal University of Paraíba, Brazil

**P1504 • Energy Saving HVAC System Modeling and Closed Loop Control in Industrial and Commercial Adjustable Speed Drives**

Kevin Lee, Ravishankar Ruge, Kyle Zheng, Bing Yang, Eaton Corporation, United States

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### Poster Session: Induction Machines

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**W**

Room: Exhibit Hall C – West  
Chair: Galina Mirzaeva

**P1701 • Maximum Efficiency per Torque Direct Flux Vector Control of Induction Motor Drives**

S.A. Odhano, R. Bojoi, A. Boglietti, S.G. Rosu, G. Griva, Politecnico di Torino, Italy; University "Politehnica" of Bucharest, Romania

**P1702 • Electric Circuit Coupling of a Slotted Semi-analytical Model for Induction Motors based on Harmonic Modeling**

R.L.J. Sprangers, J.J.H. Paulides, B.L.J. Gysen, E.A. Lomonova, J. Waarma, Eindhoven University of Technology, Netherlands; Vostermans Ventilation B.V., Netherlands

**P1703 • Soft Start and Voltage Control of Grid Connected Induction Motors using Floating Capacitor H-bridge Converters**

S. Leng, R. Ul-Haque, N. Perera, A. Knight, J. Salmon, University of Alberta, Canada; University of Calgary, Canada

**P1704 • Modeling and Parameter Estimation of Split-single Phase Induction Motors**

Burak Tekgun, Yilmaz Sozer, Igor Tsukerman, University of Akron, United States

**P1705 • Thermal Design of High Power-density Additively-manufactured Induction Motor**

Ram Ranjan, Jagadeesh Tangudu, United Technologies Research Center, United States

**P1706 • Dynamics and Vector Control of Wound-rotor Brushless Doubly Fed Induction Machines**

Zhentao S. Du, Thomas A. Lipo, University of Wisconsin-Madison, United States

**P1707 • The Doubly-fed Induction Machine as an Aero Generator**

Tom Feehally, Judith Apsley, University of Manchester, United Kingdom

**P1708 • Start-up Problem with an Induction Machine and a Permanent Magnet Gear**

T.V. Frandsen, N.I. Berg, R.K. Holm, P.O. Rasmussen, Aalborg University, Denmark

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### Poster Session: Reluctance Machines

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**W**

Room: Exhibit Hall C – West  
Chair: Wen Ouyang

**P1901 • Power Converter Rating for Switched Reluctance Motors**

Howard C. Lovatt, CSIRO, Australia

**P1902 • Control of Switched Reluctance Generators in Continuous Conduction Mode**

W.U. Nuwantha Fernando, RMIT University, Australia

**P1903 • Torque Ripple Minimization of Switched Reluctance Motors through Speed Signal Processing**

Rakesh Mitra, Yilmaz Sozer, University of Akron, United States

**P1904 • Synchronous Reluctance Motors with Toroidal Windings**

Christopher Spargo, Barrie Mecrow, James Widmer, Newcastle University, United Kingdom

**P1905 • Vector Control for Switched Reluctance Motor Drives using an Improved Current Controller**

Noriya Nakao, Kan Akatsu, Shibaura Institute of Technology, Japan

**P1906 • Magnetic Design of 2-phase Switched Reluctance Motor with Bi-directional Startup Capability**

Lei Gu, Adam Clark, Wei Wang, Joseph Hearron, Babak Fahimi, University of Texas at Dallas, United States

**P1907 • Design of a Synchronous Reluctance Motor with Non-overlapping Fractional-slot Concentrated Windings**

Christopher Spargo, Barrie Mecrow, James Widmer, Newcastle University, United Kingdom

**P1908 • Two Converter based Operation of a Brushless Doubly Fed Reluctance Machine**

Ronald S. Rebeiro, Andrew M. Knight, University of Calgary, Canada

**P1909 • Design Considerations for Reduction of Acoustic Noise in Switched Reluctance Drives**

Chenjie Lin, Babak Fahimi, University of Texas at Dallas, United States

**P1910 • Static Modeling of the Ultra High Speed Machine Rotor**

B. Suttles, J. Mayor, A. Semidey, Georgia Institute of Technology, United States

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### Poster Session: Other Topics in Electrical Machines

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**W**

Room: Exhibit Hall C – West  
Chair: Dan Ionel

**P2101 • A Magnetic Gearbox with an Active Region Torque Density of 239Nm/L**

K.K. Uppalapati, J.Z. Bird, J. Wright, J. Pritchard, M. Calvin, W. Williams, University of North Carolina at Charlotte, United States

**P2102 • Harmonics in Rotating Transformer Exciting Systems for Turbine Generators**

Stefan Schmuelling, Christoph Schmuelling, Stefan Habel, TU Dortmund University, Germany

**P2103 • 3-D Modeling of Shielding of Magnetic Stray Fields based on Superposition of 2-D Models**

K.J.W. Pluk, J.W. Jansen, E.A. Lomonova, Eindhoven University of Technology, Netherlands

**P2104 • Influences of CO<sub>2</sub> and FKL-laser Cutting as well as Mechanical Cutting on the Magnetic Properties of Electric Steel Sheet S Determined by Epstein Frame and Stator Lamination Stack Measurements**

Madeleine Bali, Annette Muetze, Graz University of Technology, Austria

**P2105 • Numerical Magnetic Property Evaluation in Consideration of Power Semiconductor Property in Inverter with Play Model**

Shunya Odawara, Keisuke Fujisaki, Tetsuji Matsuo, Toyota Technological Institute, Japan; Kyoto University, Japan

**P2106 • Evaluation of Dielectric Fluids for Macro-scale Electrostatic Actuators and Machinery**

Baoyun Ge, Daniel C. Ludois, University of Wisconsin-Madison, United States

**P2107 • Parametric Design Optimization of a Novel Permanent Magnet Coupling using Finite Element Analysis**

Stig Högberg, Nenad Mijatovic, Joachim Holbøll, Bogi Bech Jensen, Flemming Buus Bendixen, Technical University of Denmark, Denmark; University of the Faroe Islands, Faroe Islands; Sintex a/s, Denmark

**P2108 • Analysis of Insulation Diagnosis and Failure in Stator Windings of Air-cooled Gas Turbine Generator**

Hee-Dong Kim, Tae-Sik Kong, Korea Electric Power Corporation (KEPCO), Korea

**P2109 • Green Mode Control Strategy of a PMSM with Front-end SEPIC PFC Converter**

Chiao-Chien Lin, Ying-Yu Tzou, National Chiao Tung University, Taiwan

**P2110 • Thermomagnetic Liquid Cooling: A Novel Electric Machine Thermal Management Solution**

Giti Karimi-Moghaddam, Darren D. Tremelling, Richard D. Gould, Subhashish Bhattacharya, North Carolina State University, United States; ABB Corporate Research, United States

**P2305 • Shorted-stator Mode Control of Doubly-fed Induction Generator Connected to a Weak Grid**

Adeola Balogun, Olorunfemi Ojo, Frank Okafor, University of Lagos, Nigeria; Tennessee Technological University, United States

**Poster Session: Wave and Wind Generation Systems**

**E**

Room: Exhibit Hall C – East

Chair: Seungdeog Choi

**P2501 • Oscillating Water Column Power Conversion: A Technology Review**

Nicola Delmonte, Davide Barater, Francesco Giuliani, Paolo Cova, Giampaolo Buticchi, University of Parma, Italy; University of Kiel, Germany

**P2502 • Dynamic Emulation of Oscillating Wave Energy Converter**

Samir Hazra, Ashish Sanjay Shrivastav, Akash Gujarati, Subhashish Bhattacharya, North Carolina State University, United States

**P2503 • Wave Lab Testing of a Two-body Autonomous Wave Energy Converter**

Timothy M. Lewis, Bret Bosma, Annette von Jouanne, Ted K.A. Brekken, Oregon State University, United States

**Poster Session: Converters for Solar PV Systems**

**E**

Room: Exhibit Hall C – East

Chair: Ahmed Elasser

**P2701 • Modeling and Digital Control of a High-power Full-bridge Isolated DC-DC Buck Converter Designed for a Two-stage Grid-tie PV Inverter**

Paulo Sergio Nascimento Filho, Leonardo Ruffeil de Oliveira, Tarcio André dos Santos Barros, Marcelo Gradella Villalva, Ernesto Ruppert Filho, University of Campinas, Brazil

**P2702 • A High Set-up Quasi-Z-source Inverter based on Voltage-lifting Unit**

Linlin Li, Yu Tang, Nanjing University of Aeronautics and Astronautics, China

**P2703 • A New DC-DC Buck-boost Modified Series Forward Converter for Photovoltaic Applications**

D. López del Moral, A. Barrado, M. Sanz, A. Lázaro, P. Zumel, Carlos III of Madrid University, Spain

**P2704 • Development of a Four Phase Floating Interleaved Boost Converter for Photovoltaic Systems**

Christopher D. Lute, Marcelo Simões, Danilo Iglesias Brandão, Ahmed Al Durra, S.M. Mueen, Colorado School of Mines, United States; The Petroleum Institute, United Arab Emirates

**Poster Session: Smart Grid Components**

**E**

Room: Exhibit Hall C – East

Chairs: Madhav Manjrekar, Luca Solero

**P2901 • Bridge-type Fault Current Limiter for Asymmetric Fault Ride-through Capacity Enhancement of Doubly Fed Induction Machine based Wind Generator**

Gilmanur Rashid, Mohd. Hasan Ali, University of Memphis, United States

**P2902 • LCL Filter Design and Inductor Ripple Analysis for 3-level NPC Grid Interface Converter**

Yang Jiao, Fred C. Lee, Virginia Polytechnic Institute and State University, United States

**P2903 • A Unified Access Conditioner for Microgrid with Renewable Energy Sources**

Chang Yuan, Xiangning Xiao, North China Electric Power University, China

Tuesday, September 16

10:00 am – 11:30 am

**Poster Session: DFIG based Wind Systems**

**E**

Room: Exhibit Hall C – East

Chair: Bilal Akin

**P2301 • A No-load Grid-connected Strategy based on One-cycle Control for Doubly-fed Wind Power System**

Yanxia Shen, Zhicheng Ji, Tinglong Pan, Dinghui Wu, Jiangnan University, China

**P2302 • Capability of DFIG WTS to Ride through Recurring Asymmetrical Grid Faults**

Wenjie Chen, Frede Blaabjerg, Min Chen, Dehong Xu, Zhejiang University, China; Aalborg University, Denmark

**P2303 • Model based methods for Rotor Position Detection of Doubly-fed Induction Generator**

Rongwu Zhu, Zhe Chen, Yunqian Zhang, Xiaojie Wu, Aalborg University, Denmark; University of Mining and Technology, China

**P2304 • Sizing of the Series Dynamic Breaking Resistor in a Doubly Fed Induction Generator Wind Turbine**

Hammam Soliman, Huai Wang, Dao Zhou, Frede Blaabjerg, Mostafa I. Marie, Aalborg University, Denmark; Ain Shams University, Egypt

### **P2904 • Alternate Arm Converter Operation of the Modular Multilevel Converter**

M.M.C. Merlin, P.D. Judge, T.C. Green, P.D. Mitcheson, F. Moreno, K. Dyke, Imperial College London, United Kingdom; Alstom Grid, United Kingdom

### **P2905 • Impact of Frequency Modulation Ratio on Capacitor Cells Balancing in Phase-shifted PWM based Chain-link Statcom**

Ehsan Behrouzian, Massimo Bongiorno, Remus Teodorescu, Chalmers University of Technology, Sweden; Chalmers University of Technology, Sweden; Aalborg University, Denmark

### **P2906 • A Full-bridge AC Power Flow Controller with Reduced Capacitance Operated with both FFS (Fundamental Frequency Switching) and PWM**

Takanori Isobe, University of Tsukuba, Japan

### **P2907 • Startup Strategy of VSC-HVDC System based on Modular Multilevel Converter**

Fanqiang Gao, Zixin Li, Fei Xu, Zunfang Chu, Ping Wang, Yaohua Li, Chinese Academy of Sciences, China

### **P2908 • A Module based Self-balanced Series Connection for IGBTs**

Lei Yang, Peng Fu, Xiu Yao, Jin Wang, Chinese Academy of Science, China; Ohio State University, United States

### **P2909 • Turn-off Voltage Sharing of Field Stop IGBTs in Series Connection**

Xueqiang Zhang, Xin Yang, Jin Zhang, Weiwei He, Patrick R. Palmer, University of Cambridge, United Kingdom

### **P2910 • Over-current Protection Scheme for SiC Power MOSFET DC Circuit Breaker**

Yuan Zhang, Yung C. Liang, National University of Singapore, Singapore

### **P2911 • A High Density Converter for Mid Feeder Voltage Regulation of Low Voltage Distribution Networks**

Richard Silversides, Tim Green, Michael M.C. Merlin, Imperial College London, United Kingdom

### **P2912 • Analysis on Practical Design of Virtual-air-gap Variable Reactors for Tieline Reclosing in Microgrid**

Yucheng Zhang, Praveen Devakota, Ruiyun Fu, South Dakota School of Mines and Technology, United States

### **P2913 • Wind Powered Smart Charging Facility for PHEVs**

Preeatham Goli, Wajih Shireen, University of Houston, United States

### **P2914 • Supercapacitor Assisted Surge Absorber (SCASA) Technique: Selection of Supercapacitor and Magnetic Components**

Jayathu Fernando, Nihal Kularatna, University of Waikato, New Zealand

### **P2915 • One and Two DC-links Universal Active Power Filter without Series Isolation Transformer**

P.L.S. Rodrigues, C.B. Jacobina, G.A. de A. Carlos, M.B.R. Correa, M.A. Vitorino, Federal University of Campina Grande, Brazil; Federal Institute of Alagoas, Brazil

## Poster Session: Power Supplies

**E**

Room: Exhibit Hall C – East

Chairs: Jean Luc Schanen, Shuo Wang

### **P3101 • Analyses of the Impact of Current Load Change on a Current-mode Constant On-time Buck Converter Regulator**

Ming-Chuan Yen, Dan Chen, Sheng-Fu Hsiao, Yung-Jen Chen, National Taiwan University, Taiwan; Richtek Technology Corporation, Taiwan

### **P3102 • High Efficiency Point-of-load and Bus Converter System using Built-in Converters**

Won-Yong Sung, Chang-Yeol Oh, Jung-Hoon Ahn, Byoung-Kuk Lee, Yun-Sung Kim, Sungkyunkwan University, Korea

## Poster Session: Isolated DC-DC Converters

**N**

Room: Exhibit Hall C – North

Chair: Wei Qiao

### **P3301 • A Line and Load Independent Constant-frequency Zero-voltage-switching Series Resonant Converter**

Alireza Safaei, Konrad Woronowicz, Praveen Jain, Alireza Bakhshai, Bombardier Transportation Inc., Canada; Queen's University, Canada

### **P3302 • An Improved Start-up Method for LLC Series Resonant Converter based on State-plane Analysis**

Dongdong Yang, Changsong Chen, Shanxu Duan, Jiuqing Cai, Huazhong University of Science and Technology, China

### **P3303 • Analysis of a Novel Interleaved CLL Resonant Converter for EV Battery Charger Applications**

Erdem Asa, Kerim Colak, Dariusz Czarkowski, New York University, United States

### **P3304 • High Power LLC Battery Charger: Wide Regulation using Phase-shift for Recovery Mode**

Navid Shafiei, Martin Ordonez, Marian Cracium, Murray Edington, Chris Botting, University of British Columbia, Canada; Delta-Q Technologies, Canada

### **P3305 • Modular Snubberless Bidirectional Soft-switching Current-fed Dual 6-pack (CFD6P) DC/DC Converter**

Satarupa Bal, Akshay K. Rathore, Dipti Srinivasan, National University of Singapore, Singapore

### **P3306 • A Novel Interleaved LLC Resonant Converter with Phase Shift Modulation**

Koji Murata, Fujio Kurokawa, Nagasaki University, Japan

### **P3307 • High Voltage Dual Active Bridge with Series Connected High Voltage Silicon Carbide (SiC) Devices**

Kasunaidu Vechalapu, Arun Kumar Kadavelugu, Subhashish Bhattacharya, North Carolina State University, United States

### **P3308 • Piecewise Linear Modeling of Snubberless Dual Active Bridge Commutation**

Babak Farhangi, Hamid A. Toliyat, Texas A&M University, United States

### **P3309 • Analysis and Comparison of Voltage-source and Current-source Asymmetric Dual-active Half-bridge Converters**

Shiladri Chakraborty, Souvik Chattopadhyay, Indian Institute of Technology, India

## Poster Session: Multilevel Converters

**N**

Room: Exhibit Hall C – North

Chair: Pericle Zanchetta

### **P3501 • Capacitor Selection for Modular Multilevel Converter**

Yuan Tang, Li Ran, Olayiwola Alatise, Philip Mawby, University of Warwick, United Kingdom

### **P3502 • An FPGA-based Real-time Simulator for HIL Testing of Modular Multilevel Converter Controller**

Wei Li, Luc-André Grégoire, Sisounthone Souvanlasy, Jean Bélanger, OPAL-RT Technologies, Canada

### **P3503 • A Carrier-based PWM Method for Neutral-point Ripple Reduction of a 3-level Inverter**

June-Seok Lee, Kyo-Beum Lee, Ajou University, Korea

### **P3504 • A Detection Method for an Open-switch Fault in Cascaded H-bridge Multilevel Inverters**

Hyun-Woo Sim, June-Seok Lee, Kyo-Beum Lee, Ajou University, Korea

**P3505 • AC-DC-AC 3-phase Converter based on Three Three-leg Cconverters Connected in Series**

Nustenil S.M.L. Marinus, Cursino B. Jacobina, Nady Rocha, Euzeli C. dos Santos Jr., Federal University of Campina Grande, Brazil; Federal University of Paraiba, Brazil; Federal Institute of the Ceará, Brazil; Indiana University-Purdue University Indianapolis, United States

**P3506 • An Adaptive Backstepping Observer for Modular Multilevel Converter**

Vahid Najmi, Hamed Nademi, Rolando Burgos, Virginia Polytechnic Institute and State University, United States; ABB Ltd., Norway

**P3507 • Condition Monitoring for Submodule Capacitors in Modular Multilevel Converters**

Yun-Jae Jo, Thanh Hai Nguyen, Dong-Choon Lee, Yeungnam University, Korea

**P3508 • A New Five-level Hybrid-clamped Converter with Reduced Number of Clamping Devices**

Kui Wang, Lie Xu, Zedong Zheng, Yongdong Li, Tsinghua University, China

**P3509 • A Simple Capacitor Voltage Balancing Method for Nested Neutral Point Clamped Inverter**

Kai Tian, Bin Wu, Mehdi Narimani, Dewei Xu, Zhongyuan Cheng, Navid Reza Zargari, Ryerson University, Canada; Rockwell Automation Canada, Canada

**P3510 • A High Cell Count Cascade Full Bridge Converter for Wide Bandwidth Ultrasonic Transducer Excitation**

Geoffrey R. Walker, Negareh Ghasemi, Mark A.H. Broadmeadow, Gerard F. Ledwich, Queensland University of Technology, Australia

**P3511 • Improved Thermal Management of Multilevel Converter Building Module to Realize Higher Power Density**

Hidemine Obara, Yukihiko Sato, Chiba University, Japan

**P3512 • THD Minimization of Modular Multilevel Converter with Unequal DC Values**

Ghazal Falahi, Wensong Yu, Alex Q. Huang, North Carolina State University, United States

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**Poster Session: Passives and Converters**

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**N**

Room: Exhibit Hall C – North

Chairs: Jean Luc Schanen, Shuo Wang

**P3701 • Design and Analysis of 37.5% Energy-recycling Flyback-type Class-D Gate Driver IC with 5-to-15V Level-conversion**

Taewook Kang, Jaeha Kim, Seoul National University, Korea

**P3702 • Optimization and Analysis of PwrSoc Buck Converter with Integrated Passives for Automotive Application**

V. Šviković, J. Cortes, P. Alou, J. Oliver, J.A. Cobos, Universidad Politécnica de Madrid, Spain

**P3703 • A 9-11 Bits Phase-interpolating Digital Pulse-width Modulator with 1000X Frequency Range**

Yoontaek Lee, Taewook Kang, Jaeha Kim, Seoul National University, Korea

**P3704 • A Transient Core Loss Analysis of Multiple-gap Inductor Designed for the 2010 Prius**

Masaki Wasekura, Chi-Ming Wang, Robert D. Lorenz, Toyota Motor Corporation, Japan; Toyota Research Institute of North America, United States; University of Wisconsin-Madison, United States

**P3705 • Low AC Resistance Foil Cut Inductor**

Weyman Lundquist, Vivien Yang, Carl Castro, West Coast Magnetics, United States

**P3706 • Loss Minimization for Coupled Inductors with Significant Ac Flux**

Zhemín Zhang, Milisav Danilovic, Khai D.T. Ngo, Jeff L. Nilles, Virginia Polytechnic Institute and State University, United States; Texas Instruments Inc., United States

**P3707 • The Use of Dielectric Coatings in Capacitive Power Transfer Systems**

Baoyun Ge, Daniel C. Ludois, Rodolfo Perez, University of Wisconsin-Madison, United States

**P3708 • Litz Wire Pulsed Power Air Core Coupled Inductor**

Victor Sung, W.G. Odendaal, Virginia Polytechnic Institute and State University, United States

**P3709 • A 0.76W/mm<sup>2</sup> On-chip Fully-integrated Buck Converter with Negatively-coupled, Stacked-LC Filter in 65nm CMOS**

Minbok Lee, Yunju Choi, Jaeha Kim, Seoul National University, Korea

**P3710 • Understanding dv/dt of 15 kV SiC N-IGBT and its Control using Active Gate Driver**

Arun Kadavelugu, Subhashish Bhattacharya, Sei-Hyung Ryu, David Grider, Scott Leslie, Kamalesh Hatua, North Carolina State University, United States; Cree, Inc, United States; Powerex, Inc., United States; Indian Institute of Technology Madras, India

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**Poster Session: Grid-connected Power Converters and Control**

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**S**

Room: Exhibit Hall C – South

Chairs: Jean Luc Schanen, Shuo Wang

**P3901 • Grid-tie Switched Inductor with Voltage Multiplier Inverter**

Omar Abdel-Rahim, Funato Hirohito, Junnosuke Haruna, Aswan University, Egypt; Utsunomiya University, Japan

**P3902 • Voltage Droop Control of Dual Active Bridge for Integrating Battery Energy Storage to Utility Grid**

Srinivas Bhaskar Karanki, David Xu, Ryerson University, Canada

**P3903 • Performance Evaluation of a 3-level ANPC Photovoltaic Grid-connected Inverter with 650V SiC Devices and Optimized PWM**

Davide Barater, Carlo Concarì, Giampaolo Buticchi, Emre Gurpinar, Dipankar De, Alberto Castellazzi, University of Parma, Italy; University of Kiel, Germany; University of Nottingham, United Kingdom

**P3904 • Active Damping Control of LLCL Filters based on Virtual Resistor for T-type Three-level PWM Converters**

Payam Alemi, Dong-Choon Lee, Yeungnam University, Korea

**P3905 • Coordinative Control of Active Power and DC-link Voltage for Cascaded Dual-active-bridge and Inverter in Bidirectional Application**

YanJun Tian, Zhe Chen, Fujin Deng, Xiaofeng Sun, Yanting Hu, Aalborg University, Denmark; Yanshan University, China; Glyndwr University, United Kingdom

**P3906 • The Impact of Gate-driver Parameters Variation and Device Degradation in the PV-inverter Lifetime**

C. Sintamarean, H. Wang, F. Blaabjerg, F. Iannuzzo, Aalborg University, Denmark; University of Cassino and Southern Lazio, Italy

**P3907 • Control of a 19 Level Cascaded H-bridge Multilevel Converter Photovoltaic System**

N.D. Marks, T.J. Summers, R.E. Betz, University of Newcastle, Australia

**P3908 • A New DPWM Modulation for Three-level Neutral Point Clamped Inverter with Assuming Balanced Neutral-point Voltage**

Tzung-Lin Lee, Tsung-Yu Hsieh, National Sun Yat-Sen University, Taiwan

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**Poster Session: Off-grid Power Converters and Control**

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**S**

Room: Exhibit Hall C – South

Chair: Luca Zarri

**P4101 • Decentralized Architecture and Control of Photovoltaic Generation System based on Cascaded AC Module Integrated Converter**

Huan Hu, Xu She, Alex Huang, Texas Instrument, United States; GE Global Research, United States; North Carolina State University, United States



**P4102 • A New Modulation Technique for Wide-range Control of Output Voltage in Z-source Inverters**

M.S. Diab, A. Elserougi, A.S. Abdel-Khalik, A.M. Massoud, Shehab Ahmed, Alexandria University, Egypt; Qatar University, Qatar; Texas A&M University at Qatar, Qatar

**P4103 • A Novel ZVS and ZCS Three-port LLC Resonant Converter for Renewable Energy Systems**

Jiang Tianyang, Qizheng Lin, Junming Zhang, Yousheng Wang, Zhejiang University, China; Pinghu Electronics Co., Ltd., China

**P4104 • High Step-up Tapped Inductor SEPIC Converter with Charge Pump Cell**

Jia Yao, Alexander Abramovitz, Keyue Smedley, Southeast University, China; University of California, Irvine, United States

**P4105 • Piezoelectric Energy Harvesting Circuit using Full-wave Voltage Doubler Rectifier and Switched Inductor**

Yukito Kushino, Hirota Koizumi, Tokyo University of Science, Japan

**P4106 • Model Predictive Control of DC/DC Converter for Ultracapacitors Energy Storage Union based on T-S Model**

Jianfeng Liu, Qing Yan, Zhiwu Huang, Cheng Luo, Central South University, China

**P4107 • A Droop Controller Achieving Proportional Power Sharing without Output Voltage Amplitude or Frequency Deviation**

Yu Zeng, Qing-Chang Zhong, University of Sheffield, United Kingdom

**P4108 • A Novel Distributed PV System with Ultra-high-frequency-AC Bus for Residential Applications**

Mengqi Wang, Qingyun Huang, Alex Q. Huang, Wensong Yu, Ruiyang Yu, North Carolina State University, United States

**P4109 • Harmonics Analysis for a High-frequency-link (HFL) Inverter**

Alireza Tajfar, Hossein Riazmontazer, Sudip K. Mazumder, Enphase Energy, United States; University of Illinois, United States

**P4307 • Study of Suitable Motor Structure for IPMSM with High Flux Density Material**

Masashi Matsuhara, Masayuki Sanada, Shigeo Morimoto, Yukinori Inoue, Osaka Prefecture University, Japan

**P4308 • Comparison of Optimized Permanent Magnet Assisted Synchronous Reluctance Motors with 3-phase and 5-phase Systems**

Sai Sudheer Reddy Bonthu, Jaihoon Baek, Seungdeog Choi, University of Akron, United States; Korea Railroad Research Institute, Korea

**P4309 • A Comparison between Maximum Torque/Ampere and Maximum Efficiency Control Strategies in IPM Synchronous Machines**

James Goss, Mircea Popescu, Dave Staton, Rafal Wrobel, Jason Yon, Phil Mellor, Motor Design Ltd, United Kingdom; University of Bristol, United Kingdom

**P4310 • Design of Several Un-skewed Radial Flux Permanent Magnet Synchronous Motors with Asymmetric and Symmetric AC Windings — A Comparative Study**

Y. Demir, M. Aydin, MDS Motor Design Ltd., Turkey; Kocaeli University, Turkey

**P4311 • Optimal Design of 5-phase Permanent Magnet Assisted Synchronous Reluctance Motor for Low Output Torque Ripple**

Jaihoon Baek, Sai Sudheer Reddy Bonthu, Sangshin Kwak, Seungdeog Choi, Korea Railroad Research Institute, Korea; University of Akron, United States; Chung-Ang University, Korea

**P4312 • Interior PM Generator for Portable AC Generator Sets**

Wen L. Soong, Solmaz Kahourzade, Chong-Zhi Liaw, Paul Lillington, University of Adelaide, Australia; Radial Flux Laboratories Pty. Ltd., Australia

**P4313 • Prediction of Magnetically Induced Vibration in a PMSM using Time Stretched Pulse Excitation**

Doyeon Kim, Jeongyong Song, Gunhee Jang, Hanyang University, Korea

**P4314 • Optimal Rotor Shape Design to Reduce the Vibration of IPMSM**

Min-Chul Kang, Dong-Yeong Kim, Gyu-Tak Kim, Changwon National University, Korea

**P4315 • Cogging Torque Reduction of Single-phase Brushless DC Motor with a Tapered Air-gap using Optimizing Notch Size and Position**

Dae-kyong Kim, Young-un Park, Ju-Hee Cho, Suncheon National University, Korea; Korea Electronics Technology Institute, Korea

**P4316 • Verification of a Novel 5-axis Active Control Type Bearingless Canned Motor Pump Utilizing Passive Magnetic Bearing Function for High Power**

Kazuya Miyamoto, Masatsugu Takemoto, Satoshi Ogasawara, Masao Hiragushi, Hokkaido University, Japan; SEIKOW Chemical Engineering and Machinery, Ltd., Japan

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## Poster Session: PM Machines

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**W**

Room: Exhibit Hall C – West

Chairs: Abraham Gebregergis, Akira Chiba

**P4301 • Design of Consequent-pole, Toroidal-winding, Outer Rotor Vernier Permanent Magnet Machines**

Dawei Li, Ronghai Qu, Jian Li, Wei Xu, Huazhong University of Science and Technology, China

**P4302 • Design Process of Dual-stator, Spoke-array Vernier Permanent Magnet Machines**

Dawei Li, Ronghai Qu, Wei Xu, Jian Li, T.A. Lipo, Huazhong University of Science and Technology, China; University of Wisconsin-Madison, United States

**P4303 • Analysis of a PM Vernier Motor with Spoke Structure**

Byungtaek Kim, Thomas A. Lipo, Kunsan National University, Korea; University of Wisconsin-Madison, United States

**P4304 • A New Type of Harmonic Current Excited Brushless Synchronous Machine based on an Open Winding Pattern**

Lizhi Sun, Xiaolong Gao, Fei Yao, Quntao An, Thomas Lipo, Harbin Institute of Technology, China; University of Wisconsin-Madison, United States

**P4305 • Rotor Shape Optimization for Output Maximization of Permanent Magnet Assisted Synchronous Machines**

Katsumi Yamazaki, Kazuya Utsuno, Kazuo Shima, Tadashi Fukami, Masato Sato, Chiba Institute of Technology, Japan; Kanazawa Institute of Technology, Japan

**P4306 • Cancellation of Torque Ripple Accompanying Space Harmonics in SPMSM**

Shingo Ehara, Shoji Shimomura, Shibaura Institute of Technology, Japan

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## Poster Session: Control Issues in Electric Drives I

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**W**

Room: Exhibit Hall C – West

Chair: Mahesh Swamy

**P4501 • Sensorless Control Method using Differentiation Circuit for Switched Reluctance Motor**

Satoshi Sumita, Kenta Deguchi, Yoshitaka Iwaji, Yuji Enomoto, Hitachi, Ltd., Japan

**P4502 • Sensorless Control of PMSM in a Ultra High Speed Region taking Iron Loss into Account**

Junwoo Kim, Ilsu Jeong, Kwanghee Nam, Jaesik Yang, Taewon Hwang, POSTECH, Korea; Hyundai Motor Company, Korea

**P4503 • Implementation and Evaluation of Online System Identification of Electromechanical Systems using Adaptive Filters**

Parag Kshirsagar, Dong Jiang, Zhendong Zhang, United Technologies Research Center, United States

**P4504 • Control Strategy of a Permanent Magnet Synchronous Machine in the Flywheel Energy Storage System**

Wei Guo, Yue Wang, Xi'an Jiaotong University, China

**P4505 • Enhancement of Output Voltage using Current Shaping in Sensorless AC Machine Drive**

Jin-Woong Kim, Jung-Ik Ha, Seoul National University, Korea

**P4506 • Zero/Low Speed Magnet Magnetization State Estimation using High Frequency Injection for a Fractional Slot Variable Flux-intensifying Interior Permanent Magnet Synchronous Machine**

Chen-Yen Yu, Takashi Fukushige, Apoorva Athavale, Brent Gagas, Kan Akatsu, David Reigosa, Robert D. Lorenz, University of Wisconsin-Madison, United States; Nissan Motor Co., Ltd., Japan; Shibaura Institute of Technology, Japan; University of Oviedo, Spain

**P4507 • Operation of Doubly Fed Induction Generator in Ocean Wave Energy Conversion System by Stator Phase Sequence Switching**

Samir Hazra, Subhashish Bhattacharya, North Carolina State University, United States

**P4508 • Nonlinear Analysis for Interleaved Boost Converters based on Monodromy Matrix**

Haimeng Wu, Volker Pickert, Damian Giaouris, Newcastle University, United Kingdom; Centre for Research and Technology Hellas, Greece

Tuesday, September 16

3:30 pm – 5:00 pm

**Poster Session: Solar PV Systems**

**E**

Room: Exhibit Hall C – East

Chair: Dezso Sera

**P4701 • Comparison of the Perturb and Observe and Simulated Annealing Approaches for Maximum Power Point Tracking in a Photovoltaic System under Partial Shading Conditions**

S. Lyden, M.E. Haque, University of Tasmania, Australia

**P4702 • Statistical Analysis of Ramp Rates of Solar Photovoltaic System Connected to Grid**

Md Kamal Hossain, Mohd Hasan Ali, University of Memphis, United States

**P4703 • Single-phase ZVS Bidirectional AC-link Converter for EV Batteries-grid Integration**

Gamal M. Dousoky, Mostafa Mosa, Haitham Abu-Rub, Minia University, Egypt; Aswan University, Egypt; Texas A&M University at Qatar, Qatar

**P4704 • A High Performance Controller for a Single Phase Cascaded Multilevel Photovoltaic System**

Huan Hu, Xu She, Alex Q. Huang, Texas Instrument Inc., United States; GE Global Research, United States; North Carolina State University, United States

**Poster Session: Energy Storage Systems**

**E**

Room: Exhibit Hall C – East

Chair: Adel Nasiri

**P4901 • Balanced Supercapacitor Energy Storage Module based on Multifunctional ISOS Converter**

Wei Jiang, Xiaogang Wu, Renjie Hu, Wu Chen, Southeast University, China

**P4902 • Research of Multipurpose Optimization Control in Hybrid Energy Storage System**

Wei Jiang, Renjie Hu, Wu Chen, Xiaodong Wang, Zhong Li, Yongbiao Yang, Jinming Wang, Southeast University, China; Changzhi Electric Power Supply Company, China; NARI Technology Co., Ltd., China

**P4903 • A New Concept of Gas Turbine System: Motor-assisted Gas Turbine with High-speed Motor**

Noriaki Hino, Aung Kothet, Naohiro Kusumi, Hitachi, Ltd., Japan

**P4904 • A Unified Control Scheme of Battery Energy Storage System based on Cascaded H-bridge Converter**

Qiang Chen, Ning Gao, Rui Li, Xu Cai, Zhigang Lu, Shanghai Jiaotong University, China; Electric Power Research Institute, China

**P4905 • State-of-charge Balancing Control Strategy of Battery Energy Storage System based on Modular Multilevel Converter**

Feng Gao, Lei Zhang, Qi Zhou, Mengxing Chen, Tao Xu, Shaogang Hu, Shandong University, China; State Grid Anshan Electric Power Supply Company, China

**P4906 • The Impact of DC bias Current on the Modeling of Lithium Iron Phosphate and Lead-acid Batteries Observed using Electrochemical Impedance Spectroscopy**

Larry W. Juang, Phillip J. Kollmeyer, Ruxiu Zhao, T.M. Jahns, R.D. Lorenz, University of Wisconsin-Madison, United States

**P4907 • Investigation of a Data-driven SOC Estimator based on the Merged SMO and Degradation Mitigation for Series/Parallel-cell Configured Battery Pack**

Jonghoon Kim, Chosun University, Korea

**Poster Session: Power Converters for Alternative Energy Systems**

**E**

Room: Exhibit Hall C – East

Chairs: Paolo Mattavelli, Ion Exteberria

**P5101 • Modeling of Single-HB PWM Modulated Dual Active Bridge DC-DC Converter with Multifrequency Average Approach**

Yuan Gao, Yue Wang, Jun Huang, Ming Li, Xu Yang, Xi'an Jiaotong University, China

**P5102 • Modularized High Frequency High Power 3-level Neutral Point Clamped PEBB Cell for Renewable Energy System**

Sizhao Lu, Zhengming Zhao, Liqiang Yuan, Ting Lu, Yang Jiao, Mingkai Mu, Fred C. Lee, Tsinghua University, China; Virginia Polytechnic Institute and State University, United States

**P5103 • A Novel TRIAC Dimming LED Driver by Variable Switched Capacitance for Power Regulation**

Eun S. Lee, Jun P. Cheon, Duy N. Tan, Chun T. Rim, KAIST, Korea

**P5104 • Analysis and Design Considerations of Two-stage AC-DC LED Driver without Electrolytic Capacitor**

Siyang Zhao, Xianmian Ge, Xinke Wu, Junming Zhang, Huajian Zhang, Zhejiang University, China; Inventronics (Hangzhou), Inc., China

**Poster Session: Stability and Quality of Microgrids**

**E**

Room: Exhibit Hall C – East

Chairs: Norma Anglani, Feng Guo

**P5301 • Fault-decoupled Instantaneous Frequency and Phase Angle Estimation for 3-phase Grid-connected Inverters**

G. De Donato, G. Scelba, F. Giulii Capponi, G. Scarcella, University of Rome "La Sapienza", Italy; University of Catania, Italy

**P5302 • Fault Current and Overvoltage Calculations for Inverter-based Generation using Symmetrical Components**

Laura Wieserman, T.E. McDermott, University of Pittsburgh, United States

**P5303 • Power Quality Improvement of Single-phase Photovoltaic Systems through a Robust Synchronization Method**

Lenos Hadjidemetriou, Elias Kyriakides, Yongheng Yang, Frede Blaabjerg, University of Cyprus, Cyprus; Aalborg University, Denmark

**P5304 • Prediction and Avoidance of Grid-connected Converter's Instability caused by Wind Park Typical, Load-varying Grid Resonance**

F. Fuchs, A. Mertens, Leibniz Universität Hannover, Germany

**P5305 • Grid Synchronization using Fixed Filtering with Magnitude and Phase Compensation**

Bradford Trento, Leon M. Tolbert, Daniel Costinett, University of Tennessee, United States

**P5306 • Finite-time Frequency Synchronization in Microgrids**

Ali Bidram, Ali Davoudi, Frank L. Lewis, University of Texas-Arlington, United States

**P5307 • Quadrature Signal Generator based on All-pass Filter for Single-phase Synchronization**

Cristian Blanco, David Reigosa, Fernando Briz, Juan M. Guerrero, University of Oviedo, Spain

**P5308 • A DC Fault Clearance Method for Series Multiterminal HVDC System**

Xiaobo Yang, Dawei Yao, Chunming Yuan, Chengyan Yue, Chao Yang, River Tin-Ho Li, ABB (China) Limited, China

**P5309 • Virtual Impedance based Stability Improvement for DC Microgrids with Constant Power Loads**

Xiaonan Lu, Kai Sun, Lipei Huang, Josep M. Guerrero, Juan C. Vasquez, Yan Xing, University of Tennessee, United States; Tsinghua University, China; Aalborg University, Denmark; Nanjing University of Aeronautics and Astronautics, China

**P5310 • Analysis and Assessment of Microgrid Stability using the Nu Gap Approach**

Abdulgafor Alfares, Ahmed Sayed-Ahmed, Marquette University, United States; Rockwell Automation, United States

**P5311 • Comparison of Synchronous Condenser and STATCOM for Inertial Response Support**

Yang Liu, Shuitao Yang, Shao Zhang, Fang Zheng Peng, Michigan State University, United States

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**Poster Session: Single-phase AC-DC Converters**

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**N**

Room: Exhibit Hall C – North  
Chair: Yogesh Patel

**P5501 • Direct AC-DC Rectifier with Mitigated Low-frequency Ripple through Waveform Control**

Sinan Li, Guorong Zhu, Siew-Chong Tan, S.Y.R. Hui, University of Hong Kong, Hong Kong; Wuhan University of Technology, China

**P5502 • Design of Class E Resonant Rectifiers and Diode Evaluation for VHF Power Conversion**

Juan A. Santiago-González, Khalil M. Elbaggari, Khurram K. Afridi, David J. Perreault, Massachusetts Institute of Technology, United States; University of Colorado-Boulder, United States

**P5503 • Novel Zero-voltage Transition Semi Bridgeless Boost PFC Converter with Soft Switching Auxiliary Switch**

Wei Hu, Yong Kang, Xuehua Wang, Xiaoning Zhou, Huazhong University of Science and Technology, China; Wuhan Quanhua Optoelectronics Co. Ltd, China

**P5504 • An Electrolytic-free Offline LED Driver with a Ceramic-capacitor-based Compact SSC Energy Buffer**

Minjie Chen, Yu Ni, Curtis Serrano, Benjamin Montgomery, David Perreault, Khurram Afridi, Massachusetts Institute of Technology, United States; University of Colorado-Boulder, United States

**P5505 • A Comparison Study of Boost and Buck-boost Power Factor Corrector for Ultra-wide Input Voltage Range Applications**

Sheng-Yang Yu, Hung-Chi Chen, Texas Instruments Inc., United States; National Chiao Tung University, Taiwan

**P5506 • Analysis on Ringing Effect of Auxiliary Winding in Primary Side Regulated Flyback Converter**

Taizhi Zhang, Qinsong Qian, Manchao Xu, Weifeng Sun, Shengli Lu, Southeast University, China

**P5507 • A Single-phase Rectifier with a Neutral Leg to Reduce DC-bus Voltage Ripples**

Wen-Long Ming, Qing-Chang Zhong, Wanxing Sheng, University of Sheffield, United Kingdom; China Electric Power Research Institute, China

**P5508 • Modelling and Simulation of Bridgeless PFC modified SEPIC Rectifier with Multiplier Cell**

Ahmed M. Al Gabri, Abbas A. Fardoun, Esam H. Ismail, United Arab Emirates University, United Arab Emirates; College of Technological Studies, Kuwait

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**Poster Session: Single-phase DC-AC Converters**

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**N**

Room: Exhibit Hall C – North  
Chair: Marcello Pucci

**P5701 • A High Frequency Transformer Isolated Inverter Excepting No Duty Cycle Loss**

Zibo Lv, Yan Deng, Hao Peng, Ying Wang, Xiangning He, Zhejiang University, China

**P5702 • Active Buck-boost Inverter with Coupled Inductors**

Yu Tang, Yaohua He, Xianmei Dong, Nanjing University of Aeronautics and Astronautics, China

**P5703 • A Systematic Method to Synthesize New Transformerless Full-bridge Grid-tied Inverter**

Hongliang Wang, Sarah Burton, Yan-fei Liu, P.C. Sen, Josep M. Guerrero, Queen's University, Canada; Aalborg University, Denmark

**P5704 • Phase-shift Soft-switching Power Amplifier with Lower EMI Noise**

Ruxi Wang, Juan Sabate, Ying Mei, Jianguo Xiao, Song Chi, General Electric Global Research, United States

**P5705 • SiC Full-bridge Grid-tied Inverter with ZVS-switching**

Guangcheng Hu, Yawen Li, Yanan Chen, Min Chen, Dehong Xu, Yasuhiko Arita, Seiki Igarashi, Tatsuhiko Fujihira, Zhejiang University, China; Fuji Electric Co., Ltd, Japan

**P5706 • A Unified Switched Capacitor Converter**

Bin Wu, Smedley Keyue, Singer Sigmond, University of California-Irvine, United States; Tel-Aviv University, Israel

**P5707 • Improved Trans-current-fed Switched Inverter**

Soumya Shubhra Nag, Santanu Mishra, Indian Institute of Technology Kanpur, India

**P5708 • Compression of the Load Resistance Range in Constant Frequency Resonant Inverters**

Milislav Danilovic, Khai D.T. Ngo, Zhemin Zhang, Virginia Polytechnic Institute and State University, United States

**P5709 • Double Four-quadrants Single-phase Current Source Converter Sharing the Same DC-bus**

Montiê A. Vitorino, Mauricio B.R. Corrêa, Louelson C. Costa, Lucas V. Hartmann, Darlan A. Fernandes, Federal University of Campina Grande, Brazil; Federal University of Paraiba, Brazil

**P5710 • A Hybrid Inverter System for Medium Voltage Applications using a Low Voltage Auxiliary CSI**

Savvas Papadopoulos, Mohamed Rashed, Christian Klumpner, Pat Wheeler, University of Nottingham, United Kingdom

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**Poster Session: Devices and Modules**

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**N**

Room: Exhibit Hall C – North  
Chairs: Tanya Gachovska, Angus Bryant

**P5901 • Electrothermal Modeling and Characterization of SiC Schottky and Silicon PiN Diodes Switching Transients**

Saeed Jahdi, Olayiwola Alatise, Petros Alexakis, Li Ran, Phil Mawby, University of Warwick, United Kingdom

**P5902 • Static and Dynamic Characterization of High Power Silicon Carbide BJT Modules**

Muhammad Nawaz, Nan Chen, Filippo Chimento, Liwei Wang, ABB Corporate Research, Sweden

**P5903 • Analysis on Reverse Recovery Characteristics of SiC MOSFET Intrinsic Diode**

Zhaohui Wang, Jiajia Ouyang, Junming Zhang, Xinke Wu, Kuang Sheng, Zhejiang University, China

**P5904 • Analysis of Stray Inductance's Influence on SiC MOSFET Switching Performance**

Zhaohui Wang, Junming Zhang, Xinke Wu, Kuang Sheng, Zhejiang University, China

**P5905 • Design of Overcurrent Protection Circuit for GaN HEMT**

Bo Huang, Yan Li, Trillion Q. Zheng, Yajing Zhang, Beijing Jiaotong University, China

**P5906 • Insulated Gate Driver for eGaN FET**

Johan Delaine, Pierre-Olivier Jeannin, David Frey, Kevin Guepratte, University Grenoble Alpes, France; Thales Systemes Aeroportes, France

**P5907 • Physical Modeling and Optimization of a GaN HEMT Design with a Field Plate Structure for High Frequency Applications**

D. Cucak, M. Vasic, O. Garcia, Y. Bouvier, J. Oliver, P. Alou, J.A. Cobos, A. Wang, S. Martin-Horcajo, F. Romero, F. Calle, Universidad Politecnica de Madrid, Spain

**P5908 • Investigation of Soft-switching Behavior of 600 V Cascode GaN HEMT**

Weimin Zhang, Fred Wang, Leon M. Tolbert, Benjamin J. Blalock, Daniel Costinett, University of Tennessee-Knoxville, United States

**P5909 • A Temperature Dependent Simple Spice based Modeling Platform for Power IGBT Modules**

Georgios Sfakianakis, Muhammad Nawaz, Filippo Chimento, Eindhoven University of Technology, Netherlands; ABB Corporate Research, Sweden

**P5910 • An Ultra-fast SiC Phase-leg Module in Modified Hybrid Packaging Structure**

Zheng Chen, Yiyang Yao, Dushan Boroyevich, Khai Ngo, Wenli Zhang, Virginia Polytechnic Institute and State University, United States

**P5911 • Effect of Pulse Width on Dynamic Characteristics of High Voltage IGBTs**

John F. Donlon, Eric R. Motto, Eugen Wiesner, Eugen Stumpf, Shinichi Iura, Hitoshi Uemura, Powerex, Inc., United States; Mitsubishi Electric Europe B.V., Germany; Mitsubishi Electric Corp., Japan

**P5912 • Next Generation Industrial IGBT Module**

Eric R. Motto, John F. Donlon, Masaomi Miyazawa, Mitsuharu Tabata, Hiroki Muraoka, Tomohiro Hieda, Thomas Radke, Powerex Inc., United States; Mitsubishi Electric Corporation, Japan; Mitsubishi Electric Europe B.V., Germany

**P5913 • The Next Generation 6.5kV IGBT**

John F. Donlon, Eric R. Motto, Eugen Wiesner, Eckhard Thal, Kenji Hatori, Yasuhiro Sakai, Shuichi Kitamura, Tetsuo Motomiya, Kenji Ota, Yumie Kitajima, Shinichi Iura, Hiroshi Yamaguchi, Kazuhiro Kurachi, Powerex, Inc., United States; Mitsubishi Electric Europe B.V., Germany; Mitsubishi Electric Corp., Japan

**P5914 • A Temperature-dependent Thermal Model of IGBT Modules Suitable for Circuit-level Simulations**

Rui Wu, Huai Wang, Ke Ma, Pramod Ghimire, Francesco Iannuzzo, Frede Blaabjerg, Aalborg University, Denmark

**P5915 • Sensing Power MOSFET Junction Temperature using Gate Drive Turn-on Current Transient Properties**

He Niu, Robert D. Lorenz, University of Wisconsin Madison, United States

**Poster Session: Control and Applications in Renewable Energy, EMI and EVs**



Room: Exhibit Hall C – South

Chairs: Tanya Gachovska, Angus Bryant

**P6101 • An Electronically Isolated 12 Pulse Autotransformer Rectification Scheme to Improve Input Power Factor and Lower Harmonic Distortion in Variable Frequency Drives**

Mahesh M. Swamy, Yaskawa America Inc., United States

**P6102 • Three Level NPC Inverter dc Capacitor Sizing for a Synchronous Reluctance Machine Drive**

Lesedi Masisi, Pragasen Pillay, Sheldon S. Williamson, Concordia University, Canada

**P6103 • DG Control Strategies for Grid Voltage Unbalance Compensation**

Jinghang Lu, Farzam Nejabatkhah, Yunwei Li, Bin Wu, University of Alberta, Canada; Ryerson University, Canada

**P6104 • Design of LCL Filter for Improving Robustness of Grid-connected Voltage Source Inverter**

DongSul Shin, Hee-Je Kim, Jong-Pil Lee, Tae-Jin Kim, Dong-Wook Yoo, Pusan National University, Korea; Korea Electrotechnology Research Institute, Korea

**P6105 • Neutral Current Mitigation using Controlled Electric Springs Connected to Microgrids within Built Environment**

Krishnanand K.R., Syed Muhammad Farzan Hasani, Jayantika Soni, Sanjib Kumar Panda, National University of Singapore, Singapore

**P6106 • Resonant-repetitive Combined Control for Stand-alone Power Supply Units**

Alessandro Lidozzi, Chao Ji, Luca Solero, Pericle Zanchetta, Fabio Crescimbin, Roma Tre University, Italy; University of Nottingham, United Kingdom

**P6107 • Convertible Static Transmission Controller (CSTC) System Model Validation by Controller Hardware-in-the-loop-simulation**

Nima Yousefpoor, Babak Parkhideh, Ali Azidehak, Subhashish Bhattacharya, Quanta Technology, United States; North Carolina State University-Raleigh, United States; North Carolina State University-Charlotte, United States

**P6108 • Isolated Flyback Half-bridge OCC Micro-inverter**

Alexander Abramovitz, Mojtaba Heydari, Ben Zhao, Keyue Smedley, University of California-Irvine, United States

**Poster Session: Selected Topics in Control of Power Converters**



Room: Exhibit Hall C – South

Chairs: Luca Zarri, Brian Welchko

**P6301 • Optimal Algorithm of a Novel Infinite Impulse Response Digital Filter**

Liqing Tong, Fangzheng Peng, Fudan University, China; Michigan State University, United States

**P6302 • Output Impedance Analysis of Digitally Controlled DC-DC Converter**

Hua Wang, Hua Lin, Xing Li, Xingwei Wang, Huazhong University of Science and Technology, China

**P6303 • An Iteration Method for Determining Critical Stable Regions of Shunt Regulator with Multistage Hysteresis Control and its Complex Behaviors**

Hong Li, Jianing Shang, Xiaojie You, Shiheng Wang, Beijing Jiaotong University, China; State Grid Beijing Changping Electric Power Supply, China

**P6304 • An Analysis of False Turn-on Mechanism on Power Devices**

Akihiro Nishigaki, Hirokatsu Umegami, Fumiya Hattori, Wilmar Martinez, Masayoshi Yamamoto, Shimane University, Japan

**P6305 • PQ, DQ and CPT Control Methods for Shunt Active Compensators — A Comparative Study**

Ali Mortezaei, Christopher Lute, M. Godoy Simões, Fernando P. Marafão, Alessandro Bogila, Colorado School of Mines, United States; UNESP, Brazil

**P6306 • Comparison of the Gate Drive Parameter Space for Driving Power MOSFETs using Conventional and Cascode Configurations**

Mark A.H. Broadmeadow, Geoffrey R. Walker, Gerard F. Ledwich, Queensland University of Technology, Australia

**P6307 • Reduced-order Multifrequency Averaging in Naturally Sampled PWM Converters**

Fei Pan, Aaron M. Cramer, University of Kentucky, United States

**P6308 • Stability Analysis and Voltage Control Method based on Virtual Resistor and Proportional Voltage Feedback Loop for Cascaded DC-DC Converters**

Wen Cai, Babak Fahimi, Eva Cosoroaba, Fan Yi, University of Texas at Dallas, United States

**P6309 • Control and Modulation of the Stacked Polyphase Bridges Inverter**

Lebing Jin, Staffan Norrga, Oskar Wallmark, Mojgan Nikouei Harnefors, KTH Royal Institute of Technology, Sweden

**P6310 • Digitally Controlled Switch-mode Power Driver for Active Magnetic Bearings**

Tomer Ben Moha, Sergei Basovich, Mor Mordechai Peretz, Shai Arogeti, Ziv Brand, Ben-Gurion University of the Negev, Israel

**P6311 • Modular Interleaved Single-phase Series Voltage Injection Converter used in Small-signal D-Q Impedance Identification**

Jaksic Marko, Boroyevich Dushan, Burgos Rolando, Mattavelli Paolo, Shen Zhiyu, Cvetkovic Igor, Virginia Tech, United States; University of Padova, Italy

**Poster Session: Reliability and Fault Diagnostics in Power Converters**

**S**

Room: Exhibit Hall C – South  
Chairs: Luca Zarri, Brian Welchko

**P6501 • Duty Cycle-based Start-up Control for a ZVS Bidirectional DC-DC Converter**

Chi Xu, Hongbin Yu, Yunjie Gu, Pengfei Sun, Wuhua Li, Xiangning He, Fengwen Cao, Zhejiang University, China; Suzhou Vocational University, China

**P6502 • Reliability Evaluation Model of Wind Power Converter System Considering Variable Wind Profiles**

Hui Li, Haiting Ji, Yang Li, Shengquan Liu, Dong Yang, Xing Qin, Li Ran, Chongqing University, China; Chongqing Three Gorges University, China

**P6503 • Condition Monitoring and Failure Prognosis of IGBT Inverters based on On-line Characterization**

Andrew Babel, Annette Muetze, Roland Seebacher, Klaus Krischan, Elias G. Strangas, Michigan State University, United States; Graz University of Technology, Austria

**P6504 • Reliability and Energy Loss in Full-scale Wind Power Converter Considering Grid Codes and Wind Classes**

Dao Zhou, Frede Blaabjerg, Toke Franke, Michael Tonnes, Mogens Lau, Aalborg University, Denmark; Danfoss Silicon Power GmbH, Germany; Siemens Wind Power A/S, Denmark

**P6505 • Suppression of Real Power Back Flow of Non-regenerative Cascaded H-bridge Inverters Operating under Faulty Conditions**

Le Sun, Zhenxing Wu, Fei Xiao, Xinjian Cai, Xi'an Jiaotong University, China; Naval University of Engineering, China

**P6506 • Wide Bandwidth and Low Propagation Time Delay Current Sensor applied to a Laminated Bus Bar**

Keiji Wada, Atsushi Yamashita, Tokyo Metropolitan University, Japan

**P6507 • Comparison and Design of InterCell Transformer Structures in Fault-operation for Parallel Multicell Converters**

Sébastien Sanchez, Damien Risaletto, Frédéric Richardeau, Guillaume Gateau, University of Toulouse, France

**P6508 • Dynamic Thermal Analysis of DFIG Rotor-side Converter during Balanced Grid Fault**

Dao Zhou, Frede Blaabjerg, Aalborg University, Denmark

**Poster Session: Machine Diagnostics**

**W**

Room: Exhibit Hall C – West  
Chair: Pinjia Zhang

**P6701 • Automating the Broken Bar Detection Process via Short Time Fourier Transform and Two-dimensional Piecewise Aggregate Approximation Representation**

George Georgoulas, Petros Karvelis, Chrysostomos D. Stylios, Ioannis P. Tsoumas, Jose Alfonso Antonino-Daviu, Vicente Climente-Alarcon, Technological Institute of Epirus, Greece; Siemens Industry Sector-Drive Technologies, Germany; Universitat Politècnica de València, Spain

**P6702 • Detection of AC Machines Insulation Health State based on Evaluation of Switching Transients using Two Current Sensors and Eigenanalysis-based Parameter Estimation**

C. Zoeller, Th. Winter, Th. Wolbank, M. Vogelsberger, Vienna University of Technology, Austria; Bombardier Transportation Austria GmbH, Austria

**P6703 • Fault Diagnosis of Wind Turbine using Control Loop Current Signals**

Jun Hang, Jianzhong Zhang, Ming Cheng, Southeast University, China

**P6704 • Diagnosis of Stator Winding Short-circuit Faults in an Interior Permanent Magnet Synchronous Machine**

Jiangbiao He, Chad Somogyi, Andrew Strandt, Nabeel A.O. Demerdash, Marquette University, United States

**P6705 • Detecting Faults in Inverter-fed Induction Motors during Startup Transient Conditions**

M. Dlamini, P.S. Barendse, A.M. Khan, University of Cape Town, South Africa

**Poster Session: Machines for Automotive and Renewable Energy Applications**

**W**

Room: Exhibit Hall C – West  
Chair: Julia Zhang

**P6901 • A Novel Magnetic Lead Screw Active Suspension System for Vehicles**

Nick Ilsoe Berg, Rasmus Koldborg Holm, Peter Omand Rasmussen, Aalborg University, Denmark

**P6902 • Design of an Outer Rotor Ferrite Assisted Synchronous Reluctance Machine (Fa-SynRM) for Electric Two Wheeler Application**

Yateendra Deshpande, Hamid A. Toliyat, Texas A&M University, United States

**P6903 • Investigation and Development of a New Brushless DC Generator System for Extended-range Electric Vehicle Application**

Zhuoran Zhang, Li Yu, Chao Dai, Yangguang Yan, Nanjing University of Aeronautics and Astronautics, China

**P6904 • Dynamic Modeling of the Trans-rotary Magnetic Gear for the Point-absorbing Wave Energy Conversion Systems**

Siavash Pakdelian, Hamid A. Toliyat, Texas A&M University, United States

## Poster Session: Assorted Issues in Electric Drives II

W

Room: Exhibit Hall C – West

Chair: Fernando Briz

**P7101 • Efficiency Improvement in Motor Drive System with Single Phase Diode Rectifier and Small DC-link Capacitor**

*Yeongrack Son, Jung-Ik Ha, Seoul National University, Korea*

**P7102 • Ground Fault Location Self-diagnosis in High Resistance Grounding Drive Systems**

*Jiangang Hu, Lixiang Wei, Jeffrey McGuire, Zhijun Liu, Rockwell Automation Inc., United States*

**P7103 • Single to 2-phase Matrix Converter using GaN-based Monolithic Bidirectional Switch for Driving Symmetrical 2-phase Motor**

*Yuji Kudoh, Kenji Mizutani, Nobuyuki Otsuka, Satoru Takahashi, Masahiko Inamori, Hiroto Yamagiwa, Tatsuo Morita, Tetsuzo Ueda, Tsuyoshi Tanaka, Daisuke Ueda, Toshimitsu Morizane, Panasonic Corporation, Japan; Kyoto Institute of Technology, Japan; Osaka Institute of Technology, Japan*

**P7104 • Low-power Energy Conversion Systems with 2-phase PM Machine and a Rectifier with Reduced Number of Controlled Switches**

*Cursino B. Jacobina, Victor F.M.B. Melo, Filipe A. da C. Bahia, Italo Roger F.M.P. da Silva, Federal University of Campina Grande, Brazil*

**P7105 • High Fidelity Nonlinear IPM Modeling based on Measured Stator Winding Flux Linkage**

*Dakai Hu, Yazan Alsmadi, Longya Xu, Ohio State University, United States*

**P7106 • Rogowski Current Sensor Design and Analysis based on Printed Circuit Boards (PCB)**

*Ruxi Wang, Satish Prabhakaran, William Burdick, Raymond Nicholas, General Electric Global Research, United States*

**P7107 • A Capacitor-less Gate Drive Circuit using Two Parasitic Capacitors Suitable for Non-insulating-gate GaN FETs**

*Masataka Ishihara, Fumiya Hattori, Hirokatsu Umegami, Masayoshi Yamamoto, Shimane University, Japan*

**P7108 • Optimal Energy Saving Trajectories of Induction Motor with Suppression of Sudden Acceleration and Deceleration**

*Kaoru Inoue, Yuji Asano, Keito Kotera, Toshiji Kato, Doshisha University, Japan*

**P7109 • A High-performance 2x27 MVA Machine Test Bench based on Multilevel IGCT Converters**

*Jie Shen, Stefan Schröder, Bo Qu, Yingqi Zhang, Kunlun Chen, Fan Zhang, Yulong Li, Yan Liu, Peng Dai, Richard Zhang, GE Global Research, Germany; GE Global Research, China; GE Power Conversion, China*

**P7110 • Performance Evaluation of Current Control Strategies in LCL-filtered High-power Converters with Low Pulse Ratios**

*Jingkui Shi, Jie Shen, Qingyun Chen, Stefan Schröder, Hanno Stagge, Rik W. De Doncker, GE Global Research, China; GE Global Research, Germany; Aachen, Germany*

**P7111 • Analysis and Design of Active Inductor as DC-link Reactor for Lightweight Adjustable Speed Drive Systems**

*Dibyendu Rana, Bahaa Hafez, Pawan Garg, Somasundaram Essakiappan, Prasad Enjeti, Texas A&M University, United States*

**P7112 • A Novel Hysteresis Current Control Switching Method for Torque Ripple Minimization in Multi-phase Motors**

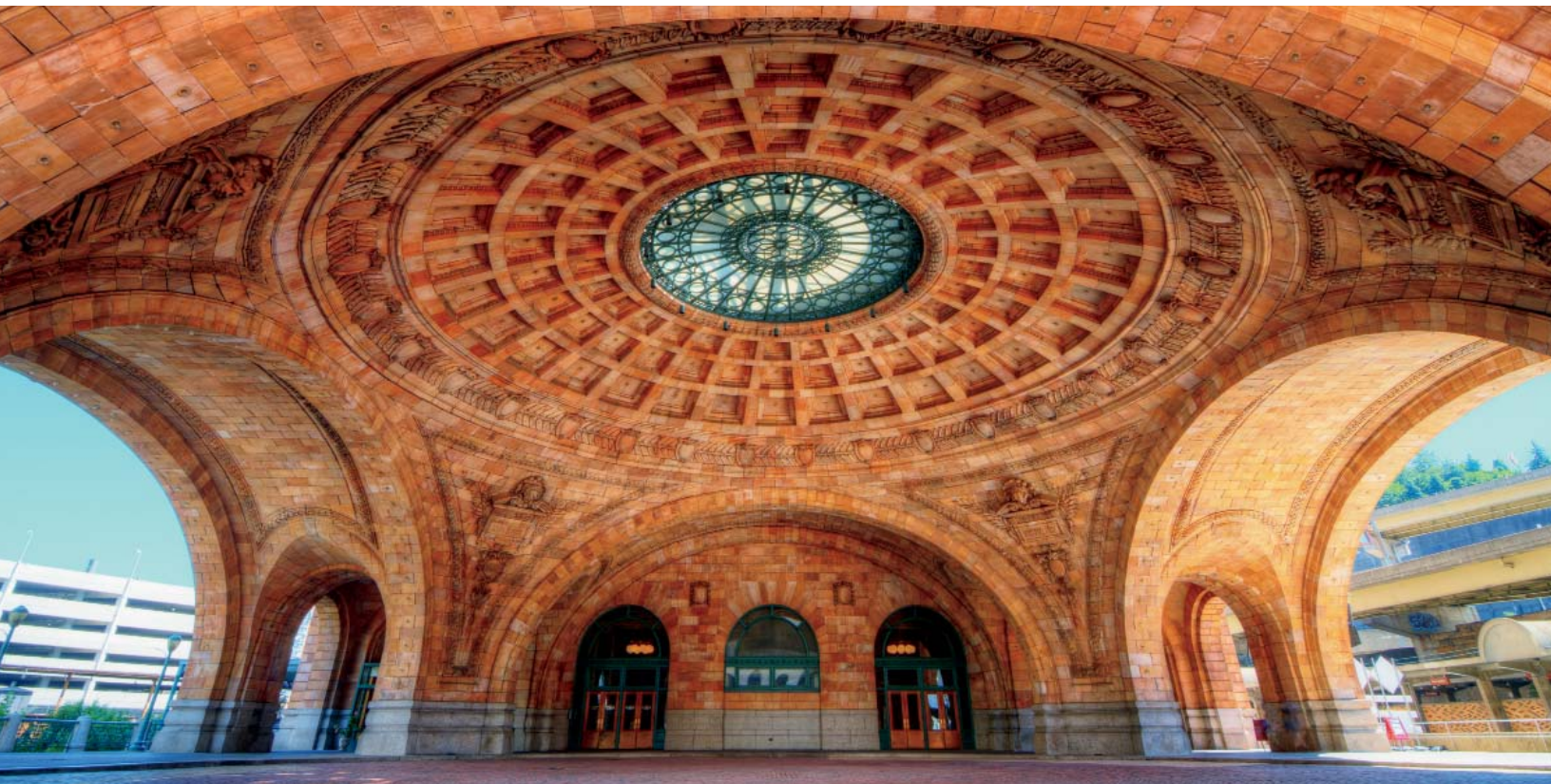
*Jae-Bum Park, Matthew Johnson, Hamid A. Toliyat, Texas A&M University, United States*

**P7113 • Development of Integrated Bi-directional Inverter for Switched Reluctance Motor Drive**

*Jianing Liang, Ming Chang, Guoqing Xu, Chinese Academy of Sciences, China; The Chinese University of Hong Kong, Hong Kong; Tongji University, China*

**P7114 • Influence of Machine Integration on the Thermal Behavior of a PM Drive for Hybrid Electric Traction**

*Christian Paar, Hendrik Kolbe, Annette Muetze, Magna Powertrain AG & Co KG, Austria; Graz University of Technology, Austria*





## > Committee Meetings

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All of the following meetings will be held at the David L. Lawrence Convention Center (except where otherwise noted).

### IAS and IAS/PELS Joint Committee Meetings

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#### IAS-IPCSA Effective IEEE Fellow Nomination Writing and Strategy Tutorial

Sunday, September 14  
4:00 pm – 5:00 pm  
Room: 330

#### IAS-IPCSA Department Meeting

Sunday, September 14  
7:00 pm – 8:00 pm  
Room: 338

#### IAS Industrial Power Converter Committee (IPCC)

Monday, September 15  
7:00 pm – 8:00 pm  
Room: 307

#### IAS Renewable and Sustainable Energy Conversion Systems (RESC)

Tuesday, September 16  
2:00 pm – 3:00 pm  
Room: 338

#### IAS Transportation Systems Committee (TSC) and PELS Technical Committee on Vehicle and Transportation Systems

Tuesday, September 16  
3:00 pm – 4:00 pm  
Room: 338

#### IAS Electrical Machines Committee (EMC)

Tuesday, September 16  
5:00 pm – 6:00 pm  
Room: 307

#### IAS Power Electronics Devices and Components (PEDCC) Committee Meeting

Tuesday, September 16  
6:00 pm – 7:00 pm  
Room: 323

#### IAS Industrial Drives Committee (IDC) and PELS Motor Drives and Actuators Committee

Tuesday, September 16  
6:00 pm – 7:00 pm  
Room: 324

#### IAS Board Meeting

Wednesday, September 17  
7:30 am – 6:00 pm  
Room: 310

### ECCE Committee Meetings

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#### ECCE 2015 Organizing Committee

Wednesday, September 17  
8:00 am – 9:00 am  
Room: 306

#### ECCE 2014-2016

Wednesday, September 17  
9:00 am – 11:00 am  
Room: 306

#### ECCE Steering Committee (America)

Wednesday, September 17  
12:00 pm – 2:00 pm  
Room: 307

#### ECCE/SMMA Meeting

Wednesday, September 17  
5:00 pm – 6:00 pm  
Room: 307

### PELS Committee Meetings

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#### PELS Magazine Editorial Board Meeting

Sunday, September 14  
12:00 pm – 3:00 pm  
Room: 336

#### PELS Bylaws Committee Meeting

Sunday, September 14  
2:00 pm – 4:00 pm  
Room: 330

#### PELS Industry Advisory Committee

Sunday, September 14  
3:00 pm – 6:00 pm  
Room: 336

#### PELS TC 2.8 Technical Subcommittee, IWIPP2015 and ICDCM2015 Planning Meetings

Monday, September 15  
11:00 am – 1:00 pm  
Room: 306

#### PELS Technical Committee and Standing Committee Chairs

Monday, September 15  
12:00 pm – 1:30 pm  
Room: 307

#### PELS Southern Conference Steering Committee (SPEC)

Tuesday, September 16  
7:30 am – 9:30 pm  
Room: 306



## PELS Committee Meetings (Continued)

### PELS Digital Media

Tuesday, September 16  
9:00 am – 10:00 am  
Room: 307

### IEEE International Future Energy Challenge (IFEC) Organizing Committee Meeting

Tuesday, September 16  
10:00 am – 12:00 pm  
Room 338

### PELS TC6 on High Performance and Emerging Technologies

Tuesday, September 16  
12:00 pm – 1:30 pm  
Room: 338

### PELS TC1 on Power and Control Core Technologies

Tuesday, September 16  
12:00 pm – 2:00 pm  
Room: 307

### PELS TC2 Power Conversion Systems and Components

Tuesday, September 16  
2:00 pm – 3:30 pm  
Room: 307

### PELS Technical Committee on Vehicle and Transportation Systems and IAS Transportation Systems Committee (TSC)

Tuesday, September 16  
3:00 pm – 4:00 pm  
Room: 338

### PELS Standards Committee

Tuesday, September 16  
3:30 pm – 5:00 pm  
Room: 307

### PELS TC7 on Communications Energy Systems (INTELEC)

Tuesday, September 16  
4:00 pm – 5:00 pm  
Room: 306

### PELS Three Editors Meeting

Tuesday, September 16  
4:00 pm – 5:00 pm  
Room: 338

### PELS Student / Young Professionals Reception (Pre-Registration Required)

Tuesday, September 16  
6:30 pm – 9:00 pm  
Perlé Restaurant  
25 Market Square, Pittsburgh PA

### PELS TC5 Sustainable Energy Technical Committee Meeting

Tuesday, September 16  
6:30 pm – 7:30 pm  
Room: 307

### PELS EXEC Team & Fincom

(Committee Members Only)  
Wednesday, September 17  
7:30 am – 9:00 am  
Room: 338

### PELS JESTPE Editorial Board

Wednesday, September 17  
8:00 am – 10:00 am  
Room: 307

### PELS / ECCE Global Partnership Coordinating Committee

Wednesday, September 17  
10:00 am – 12:00 pm  
Room: 307

### PELS Editorial Board Meeting IEEE Transactions on Power Electronics

Wednesday, September 17  
11:30 am – 1:30 pm  
Room: 306

### PELS Nominations Committee Meeting

(by invitation only)  
Wednesday, September 17  
12:00 pm – 2:00 pm  
Room: 311

### PELS Meetings Committee Meeting

Wednesday, September 17  
2:00 pm – 5:00 pm  
Room: 307

### PELS Membership Committee: Students/Liaisons & Chapter Chairs

Wednesday, September 17  
3:00 pm – 4:30 pm  
Room: 338

### PELS Awards Committee Meeting

(Committee Members and Nominations Only)  
Thursday, September 18  
8:30 am – 9:30 am  
Room: 306

### PELS Education Committee

Thursday, September 18  
9:30 am – 11:00 pm  
Room: 307

### PELS Awards Reception

Thursday, September 18  
10:30 am – 11:30 am  
Room: 306

### PELS Operations & Products Committee

Thursday, September 18  
1:30 pm – 6:00 pm  
Room: 307

### PELS Administrative Committee Dinner

Thursday, September 18  
6:30 pm – 1:00 pm  
LeMont Restaurant  
1114 Grandview Avenue, Pittsburgh, PA

### PELS Administrative Breakfast

Friday, September 19  
7:00 am – 8:00 am  
Westin Convention Center Pittsburgh  
Room: Pennsylvania East

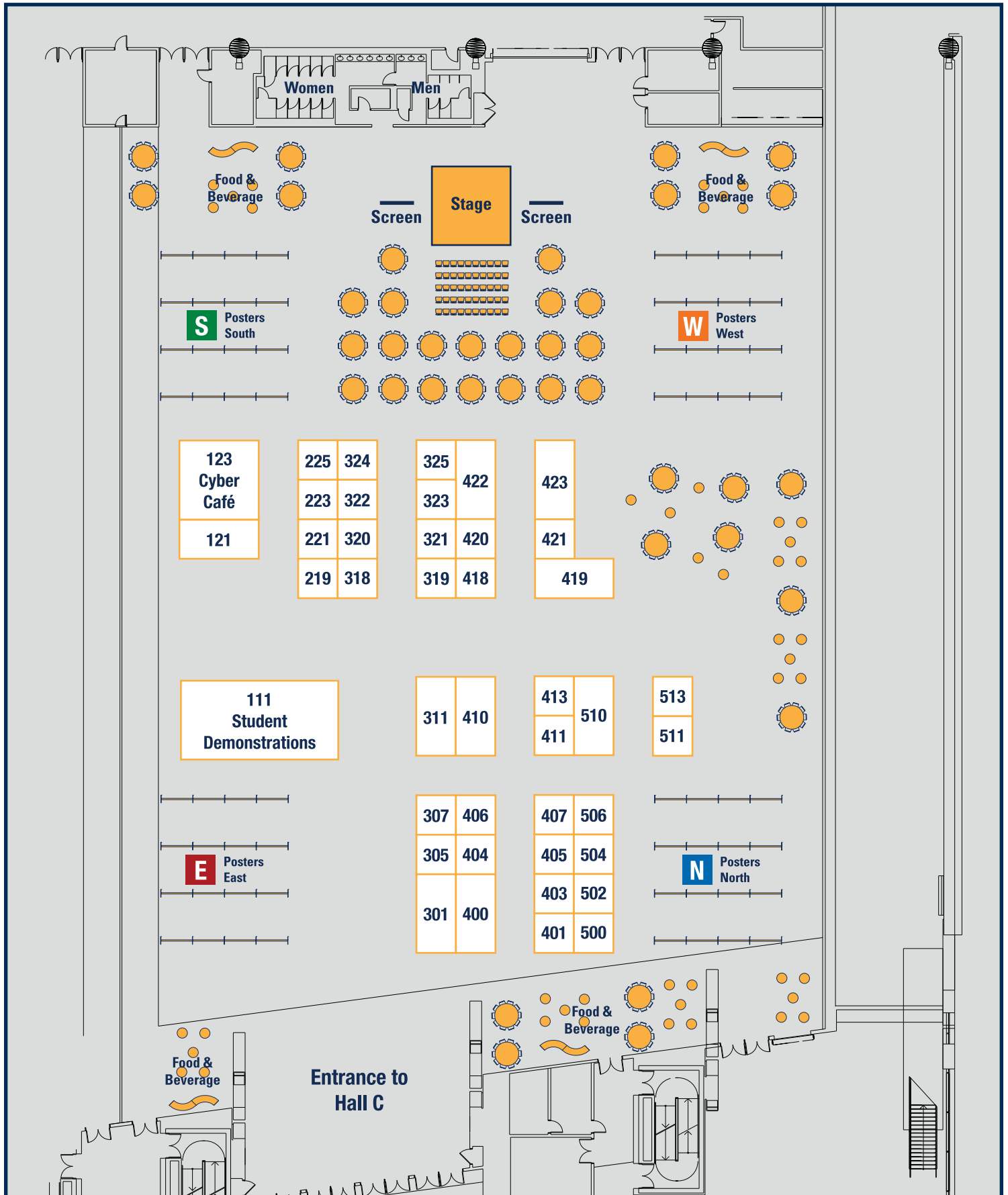
### PELS Administrative Committee Meeting

Friday, September 19  
8:00 am – 3:00 pm  
Westin Convention Center Pittsburgh  
Room: Pennsylvania West

### PELS Administrative Lunch

Friday, September 19  
11:30 am – 12:30 pm  
Westin Convention Center Pittsburgh  
Room: Pennsylvania East

# > Exhibit Hall Floor Plan



## > Exhibitor Listing

### Alphabetical Listing by Company Name:

Company	Booth(s)
5S Components	301
Advanced MotorTech	502
ANSYS, Inc.	322
Aperam Alloys USA	504
CD-adapco	406
CPS Technologies	225
CURRENT	506
Elantas PDG, Inc.	307
Electronic Concepts, Inc.	305
Ford Motor Company	325
GaN Systems Inc.	419
GMW Associates	323
How2Power.com	321
ICE Components, Inc.	405
IEEE ECCE 2015	500
IEEE Industry Applications Society (IAS)	423
IEEE Power Electronics Society (PELS)	422
Infolytica Corporation	319
Keysight Technologies	510
LORD Corporation	324
MagneForce Software Systems, Inc.	421
Magnetics	403
Magsoft Corporation	410
Mersen	121
NORWE, Inc.	513
OPAL RT	400
Payton America Inc.	411
Plexim, Inc.	401
Powerex, Inc.	407
Powersim, Inc.	311
Powersys (JMAG Division, JSOL Corporation)	404
Proto Laminations	318
Shin-Etsu Magnetics Inc.	420
SMMA - The Motor and Motion Association	221
TDK-Lambda Americas	202
Tektronix, Inc.	320
University of Pittsburgh Swanson School of Engineering	418
VAC Sales USA, LLC	413
Wiley	511

### Numerical Listing by Booth Number:

Company	Booth(s)
Mersen	121
TDK-Lambda Americas	202
SMMA - The Motor and Motion Association	221
CPS Technologies	225
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Elantas PDG, Inc.	307
Powersim, Inc.	311
Proto Laminations	318
Infolytica Corporation	319
Tektronix, Inc.	320
How2Power.com	321
ANSYS, Inc.	322
GMW Associates	323
LORD Corporation	324
Ford Motor Company	325
OPAL RT	400
Plexim, Inc.	401
Magnetics	403
Powersys (JMAG Division, JSOL Corporation)	404
ICE Components, Inc.	405
CD-adapco	406
Powerex, Inc.	407
Magsoft Corporation	410
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VAC Sales USA, LLC	413
University of Pittsburgh Swanson School of Engineering	418
GaN Systems Inc.	419
Shin-Etsu Magnetics Inc.	420
MagneForce Software Systems, Inc.	421
IEEE Power Electronics Society (PELS)	422
IEEE Industry Applications Society (IAS)	423
IEEE ECCE 2015	500
Advanced MotorTech	502
Aperam Alloys USA	504
CURRENT	506
Keysight Technologies	510
Wiley	511
NORWE, Inc.	513

## 5S Components

Booth 301

630 Fifth Avenue  
East McKeesport, PA 15035  
USA  
P +1 412.967.5858  
john@5scomponents.com  
www.5scomponents.com



5S Components is the US and Canadian distributor for ABB Power Semiconductors, ABB Current and voltage sensors, ICAR power film capacitors and Concept IGBT gate drivers. Stop by our booth to see the latest developments in power electronics components for demanding applications.

## Advanced MotorTech

Booth 502

4951 71st Avenue North  
Pinellas Park, FL 33781  
USA  
P +1 727.412.8200  
sales@advancedmotortech.com  
www.advancedmotortech.com



Advanced MotorTech leads in advanced electric motor and generator design engineering, including analysis, prototyping, testing and training, all from one industrial location. All machine types, all sizes, all speeds. We have unique, practical experience and expertise, based on academic theory, world-class CAE tools, manufacturing knowledge, and building what we design.

## ANSYS, Inc.

Booth 322

225 W. Station Square Drive  
Suite 200  
Pittsburgh, PA 15219  
USA  
P +1 412.208.3881  
jennifer.dorazio@ansys.com  
www.ansys.com



ANSYS, Inc. develops and globally markets engineering simulation software used by designers and engineers across a broad spectrum of industries. The company develops open and flexible simulation solutions that enable users to simulate design performance directly on the desktop, providing a common platform for fast, efficient and cost-effective product development, from design concept to final-stage testing and performance validation. Solutions from ANSYS for the electronics industry include: Signal and power integrity (SI/PI), electromagnetic interference and compatibility (EMI/EMC), microwave system design (RF/MW), electromechanical and system design, electronics cooling and mechanical reliability.

## Aperam Alloys USA

Booth 504

2650 Eisenhower Avenue  
Audubon, PA 19403  
USA  
P +1 610.666.0293



Aperam Alloys is an integrated mill source, leader in the design, development, manufacture, and marketing of advanced specialty nickel and cobalt alloys, in cold rolled, long and hot rolled forms, in particular magnetic rotor and stator grades (ASTM801). Our products are primarily focused on aerospace, electrical safety, and automotive markets.

## CD-adapco

Booth 406

60 Broadhollow Road  
Melville, NY 11747  
USA  
P +1 631.549.2300  
www.cd-adapco.com



CD-adapco is the world's largest independent CFD-focused provider of engineering simulation software, support and services. It has over 30 years of experience in delivering industrial strength engineering simulation to a wide range of industries and application.

## CPS Technologies

Booth 225

111 South Worcester Street  
Norton, MA 02766  
P +1 508.222.0614 x210  
bsullivan@alsic.com



CPS Technologies Corporation is the worldwide leader in the design and high-volume production of AlSiC (aluminum silicon carbide) for high thermal conductivity (up to 1000 W/mK with embedded Pyrolytic Graphite) and device compatible thermal expansion. AlSiC thermal management components manufactured by CPS include Hermetic electronic packages, Heat sinks, Microprocessor & Flip chip heat spreader lids, Thermal substrates, IGBT base plates, Cooler baseplates, Pin Fin baseplates for Hybrid Electric Vehicles (HEV), Microwave & Optoelectronic Housings.

## CURENT

Booth 506

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Knoxville, TN 37996  
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P +1 865.974.4799  
btrento@utk.edu  
http://curent.utk.edu



CURENT is a NSF Engineering Research Center established at University of Tennessee in 2011 that is jointly supported by NSF and the DOE. The partner schools include RPI, Northeastern University, and Tuskegee University. CURENT focuses on developing power systems and power electronics technologies for future transmission grids with high penetration of renewable energy sources.

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Electronic Concepts, Inc. is the recognized leader in film capacitor design and manufacture. With our extensive experience in all aspects of film capacitors, we are always developing new products and innovations. Our vertical integration and innovative design capability offers the flexibility to meet your most demanding requirements and applications.

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Ford Motor Company, a global automotive industry leader based in Dearborn, Michigan, manufactures or distributes automobiles across six continents. With about 171,000 employees worldwide, the company's automotive brands include Ford and Lincoln. Our mission is to deliver great products, create a strong business and make the world a better place.

### GaN Systems Inc.

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### How2Power.com

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HOW2POWER.COM. • A free power electronics website for engineers, students, and instructors. Great source of practical design information. Features a search tool, directories, and career information. A monthly newsletter (How2Power Today) goes deep into power supply topologies, control methods, circuits, magnetics, test, and the latest SiC & GaN developments.

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Helping to Engineer the Technology of Power: ICE Components is a supplier of standard and custom products for the power electronics market. Our product line includes current sensors, inductors, reactors, transformers and power supplies. At ICE we strive to offer the best value from the product design through final production.

### IEEE ECCE 2015

Booth 500



IEEE ENERGY CONVERSION CONGRESS & EXPO

MONTREAL, CANADA | SEPTEMBER 20-24, 2015

The Energy Conversion Congress and Exposition is the world's leading technical conference and exposition for people looking for energy conversion solutions: solutions that are innovative and practical, customer focused, market sensitive and cost effective. ECCE 2014 is the ideal place for companies to exhibit and promote their products and services to those driving innovation research and pushing the results of that research into the market.

## IEEE Industry Applications Society (IAS)

Booth 423

Piscataway, NJ 08854  
USA  
P +1 732.465.6627  
l.m.bernstein@ieee.org  
www.ias.ieee.org



The Industry Applications Society supports the advancement of the theory and practice of electrical and electronic engineering in the development, design, manufacture and application of electrical systems, apparatuses, devices and controls to the processes and equipment of industry and commerce; the promotion of safe, reliable and economical installations; industry leadership in energy conservation and environmental health and safety issues; the creation of voluntary engineering standards and recommended practices; and the professional development of its membership.

## IEEE Power Electronics Society (PELS)

Booth 422

445 Hoes Lane  
Piscataway, NJ 08854  
P +1 732.465.6480  
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www.ieee-pels.org



The Power Electronics Society is one of the fastest growing technical societies of the Institute of Electrical and Electronics Engineers (IEEE). For over 25 years, PELS has facilitated and guided the development and innovation in power electronics technology. This technology encompasses the effective use of electronic components, the application of circuit theory and design techniques, and the development of analytical tools toward efficient conversion, control and condition of electric power. Our 7,000 members include preeminent researchers, practitioners, and distinguished award winners. IEEE PELS Publishes the IEEE Transactions on Power Electronics, a top referenced journal among all IEEE publications.

## Infolytica Corporation

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## Keysight Technologies

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At ECCE 2014 Keysight will show its new B1506A power device analyzer for circuit design. The B1506A, which can source 1500 A and 3 kV, can evaluate all power device datasheet parameters (including capacitance and gate charge) across a wide range of operating conditions to improve power circuit design performance.

## LORD Corporation

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LORD Corporation is a diversified technology and manufacturing company developing highly reliable adhesives, coatings, motion management devices, and sensing technologies that significantly reduce risk and improve product performance. For 90 years, LORD has worked in collaboration with our customers to provide innovative aerospace, defense, automotive and industrial solutions. For more information, visit LORD.com.

## MagneForce Software Systems, Inc.

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Software for design and simulation of rotating electric machinery. MagneForce products combine Finite Element techniques together with various time based circuit models to provide a total electric machine design environment. Analysis of both the machine and the drive/load circuitry allows MagneForce to compute directly all machine performance parameters.

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Mersen integrates its extensive expertise in cooling, laminated bus bar, semiconductor fuses, and patented heatsink technology in Power Electronics applications to make them safe, reliable and profitable. With industrial operations in all three major economic regions of the globe, Mersen offers global service with close-to-the customer support.

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OPAL-RT TECHNOLOGIES is a leading developer of open, real-time digital simulators and Hardware-In-the-Loop testing equipment for electrical, electro-mechanical and power electronics systems. Our validation and test benches are used by engineers and researchers at leading manufacturers, utilities and universities worldwide. Our technological approach integrates parallel, distributed computing with commercial-off-the-shelf technologies.

**Payton America Inc.****Booth 411**

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Payton Planar Magnetics is the world leader in designing and manufacturing of Planar transformers and inductors. Payton is specializing in custom made inductive components as well as standard transformers and inductors. The group has worldwide sales offices and manufacturing facilities. Our top level quality management system including ISO 9001, ISO 14001, AS9100 and TS16949 position us as the top custom designer and producer of planar transformers and inductors in the world.

**Plexim, Inc.****Booth 401**

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Plexim's electrical engineering software PLECS is a complete power electronics system simulation package that yields robust and fast results. Available in two versions, PLECS Blockset works in the MATLAB/Simulink environment while PLECS Standalone offers an independent solution. Included with PLECS is a comprehensive component library, which covers not only the electrical, but also the magnetic, mechanical, and thermal aspects of power conversion systems and their controls.

**Powerex, Inc.****Booth 407**

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Powerex, Inc. ([www.pwr.com](http://www.pwr.com)) is a leading supplier of discrete devices, modules and integrated high power semiconductor solutions. Its broad product line includes IGBTs (Insulated Gate Bipolar Transistors), HVIGBTs, IPMs (Intelligent Power Modules), rectifiers, thyristors, custom power modules and assemblies.

**Powersim, Inc.****Booth 311**

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Rockville, MD 20850  
USA  
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Powersim is specialized in simulation and design tools for research and product development in power supplies, motor drives, and power conversion and control systems. Our mission is to provide the finest analysis and design tools to the industry. We strive to increase customers' efficiency and productivity by delivering software that reduces the development cost and time-to-market. With its comprehensive simulation and design capabilities, our flagship product PSIM offers a complete solution for research and development in various power electronics applications.

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JMAG is a simulation software for electromechanical design and development. Many companies and universities have supported and used JMAG since 1983. JMAG can accurately capture and quickly evaluate complex physical phenomena inside of machines. New and experienced users in simulation analysis can easily perform the simple operations required to obtain precise results.

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## Shin-Etsu Magnetics Inc.

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## SMMA — The Motor and Motion Association

Booth 221

PO P182  
South Dartmouth, MS 02748  
USA  
P +1 508.979.5935  
bill.chambers@smma.org  
www.smma.org



The Motor & Motion Association is the manufacturing trade association for the electric motor and motion control industries. More than 120 member companies include manufacturers, suppliers, users, consultants and universities. Markets served, both consumer and commercial, include appliance, transportation, medical equipment, office automation and computers, aerospace and industrial automation.

## TDK-Lambda Americas

Booth 202

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Neptune, NJ 07753  
USA  
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www.us.tdk-lambda.com/hp



TDK-Lambda Americas High Power Division is a leading manufacturer of Programmable, High Density Power Supplies located in Neptune, N.J.. The Genesys™ series of Programmable Power Supplies has the highest density in power levels from 750W through 15KW, with output ranges up to 600V and 1,000A.

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Booth 320

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## University of Pittsburgh Swanson School of Engineering

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www.engineering.pitt.edu/ece



The University of Pittsburgh's Post-Baccalaureate/Graduate Certificate in Electric Power Engineering is designed expressly for professionals. This distance-enabled program allows students to participate in real time via the Internet. The 15-credit program is rooted in core principles and focuses on expansion and enhanced reliability of electric power grid infrastructure.

## VAC Sales USA, LLC

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## > Student Demonstrations

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### Exhibit Hall C

In this event, nine university student teams will demonstrate their hardware or video of hardware operations. The objective of this student demo program is to show the prototype built by the students to the industry participants and provide an opportunity for potential technology transfer from academic research to industry products. Student demonstrations will take place in Exhibit Hall C during the following times:

**Monday, September 15, 4:00 pm – 6:30 pm** | **Tuesday, September 16, 12:00 pm – 2:00 pm**

### The demos are as follows:

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#### **Power Semiconductor Filter: Use of Series-Pass Device in Switching Converters for Input Filtering**

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Demonstrator: Po Wa Chow  
University: City University of Hong Kong, China  
Advisor: Dr. Henry S. H. Chung

#### **A High-Frequency Data Aggregation and Communications Metering Node for Smart DC Microgrids**

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Demonstrator: Matthew Backes  
University: Iowa State University, USA  
Advisor: Dr. Seth Sanders (UC-Berkeley)

#### **An Electrolytic-Free Offline LED Driver with a Ceramic-Capacitor-Based Compact Stacked Switched Capacitor (SSC) Energy Buffer**

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Demonstrator: Saad Pervaiz  
University: University of Colorado Boulder, USA  
Advisor: Dr. Khurram Afridi

#### **Compact and Efficient Wireless Power Charger for Electric Vehicle Applications**

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Demonstrator: Lebing Jin  
University: KTH Royal Institute of Technology, Sweden  
Advisor: KTH Royal Institute of Technology, Sweden

#### **Advanced Integrated Electric Drives for Electric and Hybrid Electric Vehicles**

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Demonstrator: Lebing Jin  
University: KTH Royal Institute of Technology, Sweden  
Advisor: Dr. Staffan Norrga

#### **Reducing the cost of PV micro-inverter system with system-level and inverter-level innovations**

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Demonstrator: Ghazal Falahi  
University: North Carolina State University, USA  
Advisor: Dr. Alex Q. Huang

#### **100 MHz Buck converter tracking 20 MHz LTE envelope signal**

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Demonstrator: Yuanzhe Zhang  
University: University of Colorado at Boulder, USA  
Advisor: Dr. Dragan Maksimović

#### **Megahertz-Switched Induction Cooking for Aluminum Cookware**

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Demonstrator: Andrew Amrhein  
University: Virginia Tech, USA  
Advisor: Dr. Jason Lai

#### **Grid Operation of Medium Voltage Solid State Transformer with 13kV SiC MOSFET & JBS Diode**

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Demonstrator: Fei Wang  
University: North Carolina State University, USA  
Advisor: Dr. Jason Lai



IEEE ENERGY CONVERSION CONGRESS & EXPO



MONTREAL, CANADA | SEPTEMBER 20-24, 2015

## ECCE 2015 Call for Papers

The Seventh Annual IEEE Energy Conversion Congress and Exposition (ECCE 2015) will be held in Montreal, Canada, on September 20 - 24, 2015. ECCE 2015 is the pivotal international conference and exposition event on electrical and electromechanical energy conversion field. To be held for the first time outside the USA in Montreal, Canada, ECCE 2015 will feature both industry-driven and application-oriented technical sessions, as well as industry expositions and seminars. ECCE 2015 will bring together practicing engineers, researchers and other professionals for interactive and multidisciplinary discussions on the latest advances in various areas related to energy conversion.

### Important Dates

**January 15th, 2015:** Digest submitted via the website.

**May 1st, 2015:** Notification of acceptance or rejection.

**July 1st, 2015:** Final papers with IEEE copyright forms.

**Paper Submission Guideline:** Prospective authors are requested to submit a digest no longer than five (5) pages, single column, single spaced, summarizing the proposed paper. The digest should include key equations, figures, tables and references as appropriate, but no author names or affiliations. Deviations from these essential requirements will be grounds for immediate rejection. The digests must clearly state the objectives of the work, its significance in advancing engineering or science, and the methods and specific results in sufficient detail. The digests will be reviewed using a double-blind peer review process to ensure confidentiality and fair review. Please refer to the conference website for a detailed list of technical topics and the digest submission method.

**About Montreal:** A breathtaking combination of European charm and North American energy, Montreal is a major global metropolitan celebrated not only for its international-calibre culture, history, entertainment, cuisine and shopping, but also as a world leader in industries such as biotechnology, manufacturing, energy, information, and finance. Nestled on the majestic St. Lawrence River, Montreal has direct flights from major cities worldwide. ECCE 2015 will be held in the Palais des congrès (Montreal Convention Centre) in downtown, known for its ultramodern facilities and superior sustainable energy performance, as well as the hub linking Montreal's international district, Old Montreal and Chinatown.

Technical papers are solicited on any subject pertaining to the scope of the conference that includes, but is not limited to, the following topics:

#### Energy Conversion Systems and Technologies

- Renewable energy systems — solar, wind, wave, energy harvesting, and energy storage
- Smart grid and utility applications — renewable energy integration, distributed resources and micro-grids, HVDC, FACTS, V2G-G2V, and electronic transformers
- Energy efficiency and industrial applications — lighting, smart appliances, high efficiency motor drives, smart buildings, consumer electronics and others
- Computer and telecommunication applications — power supplies, UPS, energy storage, and system architectures
- Transportation applications — electric and hybrid vehicles, infrastructure, traction, marine and aerospace
- Power conversion systems stability and power quality
- Special track on emerging power electronics technology: wireless power transfer, sustainable buildings, DC micro grid, energy harvesting, bio-medical applications, 3D power packaging

#### Components and Subsystems for Energy Conversion

- Electric machines and actuators
- Electric motor drives
- Power converters
- Power semiconductor devices and packaging
- Magnetic materials and other passive components
- Converter-level packaging and integration
- Converter and components modeling, control and EMI, focused on circuits, advanced controls, measurement and sensing, reliability and thermal modeling
- Reliability, diagnostics and prognostics

Visit <http://2015.ecceconferences.org> for more information or contact the ECCE 2015 Technical Program Chairs at [ecce2015tpc@gmail.com](mailto:ecce2015tpc@gmail.com). For exhibiting at ECCE 2015, please contact Exhibition Chair, Steve Sprague at [ssprague@protolam.com](mailto:ssprague@protolam.com). To learn about Montreal, please visit <http://www.tourisme-montreal.org/>.

#### ECCE 2015 Technical Program Chairs

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IEEE ENERGY CONVERSION CONGRESS & EXPO



MONTREAL, CANADA | SEPTEMBER 20-24, 2015

## ECCE 2015 Call for Tutorials

The Seventh Annual IEEE Energy Conversion Congress and Exposition (ECCE 2015) will be held in Montreal, Canada on September 20-24, 2015. The conference will bring together practicing engineers, researchers and other professionals for interactive discussions on the latest advances in various areas related to energy conversion. ECCE has grown to become the foremost technical conference and exposition for people looking for energy conversion solutions; solutions that are timely, practical, customer focused, market sensitive, and cost effective. Engineers from throughout the energy conversion industry's broad spectrum come to ECCE specifically to take advantage of the concentrated brain trust assembled annually in one very special location to do business in a convivial and innovative atmosphere, a perfect blend of state of the art technical prowess and commercial opportunities under one roof.

### Important Dates

**February 16<sup>th</sup>, 2015:** Submission of completed one-page Tutorial Proposal Form.

**March 27<sup>th</sup>, 2015:** Notification of acceptance. Accepted tutorials will be advertised by the committee after this date.

**July 1<sup>st</sup>, 2015:** Full tutorial materials must be submitted for publication in the tutorials book.

### Tutorial Proposal Submission Guidelines

Tutorial proposals should be submitted as a digest summarizing the content of the tutorial. Please follow the tutorial proposal form on the next page as the tutorial submission guideline.

**Please submit the completed Tutorial Proposal Form and any questions regarding this call directly to the Tutorials Chair, Wei Qiao, via email at [wqiao@engr.unl.edu](mailto:wqiao@engr.unl.edu).** For more conference information, please visit <http://2015.ecceconferences.org>

### ECCE 2015 Plenary and Tutorials Chairs

Dehong Xu, Zhejiang University, China,  
Sudip K. Mazumder, University of Illinois at Chicago, USA  
Wei Qiao, University of Nebraska-Lincoln, USA

The ECCE organizing committee invites proposals for half-day tutorials to be presented on Sunday September 20, 2015. The organizing committee is particularly interested in tutorials that are of value to the practicing engineer, with an emphasis on solutions to practical problems. Tutorials are solicited on any subject pertaining to the scope of the conference that includes, but is not limited to, the major topics listed below.

### Energy Conversion Systems and Technologies

- Renewable and alternative energy systems.
- Smart grid and utility applications, e.g., renewable energy integration, distributed resources, microgrids, HVDC, FACTS, V2G-G2V, solid state transformers.
- Energy storage systems.
- Energy conversion systems for Information Technologies (IT), e.g., communication, computing, data centers, etc.
- Technologies and systems for energy harvesting.
- Energy efficiency and industrial applications, e.g., lighting, smart appliances, smart buildings, consumer electronics, etc.
- Wireless power transfer (WPT), e.g., WPT for appliances and electric vehicles.
- Transportation systems, e.g., electric-drive vehicles, infrastructure, marine and aerospace applications.
- High power conversion and applications, e.g., multilevel inverter, MMC converter.

### Materials, Components, and Subsystems for Energy Conversion

- Advanced Si devices and applications.
- Wide band-gap devices and applications.
- Power conversion topologies, modulation, and control.
- New materials for energy conversion.
- Electric machines and actuators.
- Electric motor drives.
- Passive components and their constitutive materials.
- Packaging and integration for energy conversion components and systems.
- Modeling of energy conversion components and systems.
- Reliability, diagnostics, prognostics, and health management for energy conversion components and systems.
- Measurement and sensing techniques, EMC.

Tutorials accepted for presentation will receive one conference registration together with an honorarium for \$1000. Note that publication of a technical paper at the conference will still require a full paid registration.

[2015.ecceconferences.org](http://2015.ecceconferences.org)





IEEE ENERGY CONVERSION CONGRESS & EXPO



MONTREAL, CANADA | SEPTEMBER 20-24, 2015

# ECCE 2015 Tutorial Proposal Form

## 1. Title of Tutorial

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## 2. Abstract

*(No more than 500 words. If the tutorial is accepted, this abstract will be published on the conference website, program, and proceedings)*

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## 3. Outline of Tutorial

*(Outline would only define the topics and the subtopics that would be covered. No detailed descriptions should be included in the proposal)*

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## 4. Lead Instructor

*(Name, affiliation, and contact information)*

Name Affiliation

Email Phone

## 5. Other Instructor(s) if applicable

*(Name, affiliation, and contact information)*

Name Affiliation

Email Phone

## 6. Instructor Bios: ~150 words each

*(Please provide a brief biography for each instructor, describing the qualifications for presenting the proposed tutorial, including the work and publications that are most relevant to the proposal)*

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IEEE ENERGY CONVERSION CONGRESS & EXPO



MONTREAL, CANADA | SEPTEMBER 20-24, 2015

## ECCE 2015 Call for Special Session Organizers

The Seventh Annual IEEE Energy Conversion Congress and Exposition (ECCE 2015) will be held in Montreal, Canada, on September 20-24, 2015. ECCE is the pivotal international conference and exposition event on electrical and electromechanical energy conversion field. To be held for the first time outside USA, ECCE 2015, in Montreal, Canada, will feature both industry-driven and application-oriented technical sessions, as well as industry expositions and seminars. ECCE 2015 will bring together practicing engineers, researchers and other professionals for interactive and multidisciplinary discussions on the latest advances in various areas related to energy conversion. ECCE has grown to become the foremost technical conference and exposition around electrical and electromechanical energy conversion. It focuses on solutions that are industrially oriented. People from a broad spectrum of the energy conversion industry and academia gather yearly at ECCE to interact in a convivial and innovative atmosphere, a perfect blend of state of the art, technical prowess and commercial opportunities in one attractive location.

The ECCE organizing committee invites organizers interested in organizing **Special Sessions**. Such sessions consist of oral presentations only, without written papers and are strongly oriented towards the interests of industry, as well as towards the interaction of it with academia. Presentations might be of a somewhat more overview and commercial nature than those related to the papers in the standard technical sessions.

Presentations are solicited on any subject pertaining to the scope of the conference described in its Call for Papers (obtainable from <http://2015.ececonferences.org>). Those that will address the following aspects of growing interest and innovation are encouraged:

- Standard development for power electronics systems / products
- Power Supply on Chip (PwrSoC) and related technology
- High Efficiency, flicker free LED light fixtures
- DC Microgrid: trend, requirement, and technologies
- Innovative materials for improved components and/or systems in electrical and electromechanical energy conversion
- Components and systems for electrical applications in the oil & gas and mining sectors.
- Technologies and systems for large, cycle-efficient and cycle-intensive energy storage.
- Modelling of materials oriented to improve the estimation of the energy efficiency in the components and systems using them.
- Reliability, diagnostics and prognostics of components and modular systems.

### Proposal Submission Guidelines

Special Session organizers are requested to submit a maximum five page proposal summarizing the proposed Special Session with 4 or 8 presentations. The proposal should contain the session title, session organizer, title of each presentation, presenter for each presentation (with a short biography) and a summary of each presentation. **Please submit the proposal directly to ECCE 2015 Technical Program Committee Chairs via email at [ecce2015tpc@gmail.com](mailto:ecce2015tpc@gmail.com).**



### Important Dates

**March 31<sup>st</sup>, 2015:** Special Session proposal submissions deadline (maximum five pages).

**May 1<sup>st</sup>, 2015:** Notification of session acceptance.

For more conference information, please visit <http://2015.ececonferences.org>. For exhibiting at ECCE 2015, please contact conference Exhibition Chair at [ssprague@protolam.com](mailto:ssprague@protolam.com). For more about Montreal and its surrounding areas, please visit <http://www.tourisme-montreal.org/>. For submission and information regarding the ECCE 2015 Special Sessions, please contact the ECCE Technical Program Committee Chairs ([ecce2015tpc@gmail.com](mailto:ecce2015tpc@gmail.com)).

#### ECCE 2015 Technical Program Chairs

Dan Ionel, Regal Beloit Corp., USA  
Xinbo Ruan, Nanjing University of Aero. & Astro., China  
Nasir Uddin, Lakehead University, Canada  
Bin Wu, Ryerson University, Canada

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IEEE ENERGY CONVERSION CONGRESS & EXPO



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