United Technologies Research Center (UTRC) develops the world’s most advanced technologies and processes to help ensure the products delivered to market by the UTC businesses are the best available.

The challenges undertaken at UTRC require the best minds working together to generate ideas, test theories, challenge assumptions and ultimately deliver solutions.

UTRC has approximately 500 employees and more than 96% of our technical staff hold advanced degrees.

Founded in 1929, UTRC is located in East Hartford, Connecticut (U.S.), and also operates research and development centers in Berkeley, California, Shanghai, China, and Cork, Ireland.

The Systems Department at UTRC develops innovative technology solutions and concepts in the area of complex adaptive systems to provide growth and competitive advantage to UTC’s businesses.

We focus on solving problems related to designing, controlling and managing systems that are characterized by complex interactions between a large number of independent and heterogeneous components (and sub-systems).

The Department’s core strengths and expertise are articulated along the following disciplines:

- Systems Dynamics & Optimization
- Controls Systems
- Power Electronics Systems
- Embedded Systems & Networks
- Decision Support & Machine Intelligence

The Power Electronics Systems group conducts research in the fields of heterogeneous components in power electronics, motors and drives and intelligent energy management of distributed and decentralized systems and its application to micro grid and smart grid.

Core activities are: high density converters, converter topologies, high temperature and high frequency devices, local and global control of electric systems, and high fidelity modeling and control.
It gives us great pleasure to be able to welcome you to Phoenix for the 3rd Annual IEEE Energy Conversion Congress & Exposition®. This conference is the merging of the PELS Power Electronics Specialist Conference and the Industrial Power Conversion Systems Department sessions of the IAS Annual Meetings. ECCE 2011 continues to integrate the successful IEEE Energy 2030 conference that was initiated to foster energy conversion technology, policy and economic framework directed at the creation of a sustainable, global, energy infrastructure by 2030.

ECCE 2011 is replete with distinguished plenary speakers, tutorials given by experts from industry and academia, panels of experts in rap session, and ample opportunity to network and make new acquaintances in the energy conversion field. The approximately 600 high-quality technical papers to be presented in oral and poster sessions will take you into the practical and theoretical underpinnings of all aspects of energy conversion technology.

We hope you will take away a deeper appreciation for emerging systems and applications having electric power processing at their core, efficiency and sustainability as their goal, and mandate to tackle energy sustainability head-on through conservation, overall carbon emissions reductions, and with environmental and policy changes to anchor to. It is our hope that we can all be proud of ECCE, as it strives to be the preeminent conference in energy conversion technologies. ECCE is also the place to renew old acquaintances and make new ones, network with colleagues and enjoy the good company of your colleagues from around the world. It won’t be all work and no play at ECCE 2011 😊.

We would also like to welcome everyone to America’s sunniest metropolis, Phoenix, Arizona. Phoenix is the gateway to the Grand Canyon, and its history is a testament to the spirit of puebloans, ranchers, miners and visionaries. High tech, aerospace and service industries make up the major portion of the economic base of Phoenix. Phoenix is recognized as a preferred location for high-tech institutes. Projected against the rich backdrop is a panorama of urban sophistication: resorts and spas that drop jaws, stadiums and arenas worthy of the world’s biggest sports spectacles, restaurants with inspired cuisine, and golf courses that beckon players the year round. We hope you enjoy your time here in Phoenix.

Finally, we would like to thank all the members of the organizing committee, the program chairs and vice chairs, the program committee, and the authors for their efforts in putting together this event. We would also like to thank Opal-RT Technologies Inc., General Atomics Electromagnetics, Power-One, United Technologies Research, GE Global Research and Nexteer Automotive for their support of ECCE 2011. We hope that you enjoy this important technical meeting in a most timely and exciting field!
ECCE 2011 would like to express our gratitude for the generous support received from the following:

### Silver Supporters

![Logo](image1.png)

- GENERAL ATOMICS
- ELECTROMAGNETICS
- United Technologies Research Center
- Power-one®
  Renewable Energy Solutions

### Media Partners

![Logo](image2.png)

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### Industry Student Dinner Supporters

![Logo](image3.png)

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Gui-Jia Su, Oak Ridge National Laboratories, USA

Components, Materials, Packaging, and Other Enabling Technologies
Alex Huang (Vice Chair), North Carolina State University, USA
Jian Sun (Vice Chair), Rensselaer Polytechnic Institute, USA
J. Brahman Ferreira, Delft University of Technology, Netherlands
Jean-Luc Schanen, G2E Lab, France
Adam Skorek, University of Quebec, Canada
Charlie Sullivan, Dartmouth College, USA

Other Energy Conversion Related Topics
Subhashish Bhattacharya (Vice Chair), North Carolina State University, USA
Avoki Omekanda (Vice Chair), General Motors, USA
Jian Sun (Vice Chair), Rensselaer Polytechnic Institute, USA
**SUNDAY, SEPTEMBER 18, 2011**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00 am – 7:00 pm</td>
<td>Registration Open</td>
<td>Phoenix Convention Center, West Hall 1</td>
</tr>
<tr>
<td>9:00 am – 6:00 pm</td>
<td>Tutorials Group 1 • 8:30 am – 12:00 pm</td>
<td>Atrium Lobby</td>
</tr>
<tr>
<td>12:00 pm – 1:00 pm</td>
<td>Lunch on Own</td>
<td></td>
</tr>
<tr>
<td>9:00 am – 6:00 pm</td>
<td>Tutorials Group 2 • 1:00 pm – 5:00 pm</td>
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**MONDAY, SEPTEMBER 19, 2011**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00 am – 10:20 am</td>
<td>AM Break</td>
<td>Atrium Lobby</td>
</tr>
<tr>
<td>12:00 pm – 1:20 pm</td>
<td>Lunch on Own</td>
<td></td>
</tr>
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</table>

**Breakout Sessions • 10:20 am – 12:00 pm**

<table>
<thead>
<tr>
<th>Ellis West</th>
<th>Curtis</th>
<th>Cassidy</th>
<th>Ellis East</th>
<th>Remington</th>
<th>Cowboy Artists</th>
<th>Russell</th>
<th>Cassidy</th>
<th>Phoenix</th>
<th>Regency ABCD</th>
</tr>
</thead>
</table>

**Breakout Sessions • 12:00 pm – 3:20 pm**

<table>
<thead>
<tr>
<th>Ellis West</th>
<th>Curtis</th>
<th>Cassidy</th>
<th>Ellis East</th>
<th>Remington</th>
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<th>Russell</th>
<th>Cassidy</th>
<th>Phoenix</th>
<th>Regency CD</th>
</tr>
</thead>
</table>

**Breakout Sessions • 3:30 pm – 5:00 pm**

<table>
<thead>
<tr>
<th>Ellis West</th>
<th>Curtis</th>
<th>Cassidy</th>
<th>Ellis East</th>
<th>Remington</th>
<th>Cowboy Artists</th>
<th>Russell</th>
<th>Cassidy</th>
<th>Phoenix</th>
<th>Regency CD</th>
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</thead>
</table>

**TUESDAY, SEPTEMBER 20, 2011**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00 am – 8:00 am</td>
<td>Registration Open</td>
<td>Phoenix Convention Center, West Hall 1</td>
</tr>
<tr>
<td>8:00 am – 9:00 am</td>
<td>AM Break</td>
<td>Phoenix Convention Center, West Hall 1</td>
</tr>
<tr>
<td>9:00 am – 10:00 am</td>
<td>Student Demonstrations</td>
<td>Phoenix Convention Center, West Hall 1</td>
</tr>
<tr>
<td>9:30 am – 11:00 am</td>
<td>GE Industrial Seminar</td>
<td>Phoenix Convention Center, West Hall 1</td>
</tr>
<tr>
<td>12:00 pm – 2:00 pm</td>
<td>Lunch in the Exhibit Hall</td>
<td>Phoenix Convention Center, West Hall 1</td>
</tr>
<tr>
<td>2:00 pm – 3:00 pm</td>
<td>Freescale Semiconductors Industrial Seminar</td>
<td>Phoenix Convention Center, West Hall 1</td>
</tr>
<tr>
<td>3:00 pm – 5:00 pm</td>
<td>PM Break</td>
<td>Phoenix Convention Center, West Hall 1</td>
</tr>
<tr>
<td>5:00 pm – 6:00 pm</td>
<td>J MAG Industrial Seminar and Cocktail Reception</td>
<td>Phoenix Convention Center, West Hall 1</td>
</tr>
</tbody>
</table>
### WEDNESDAY, SEPTEMBER 21, 2011

**7:00 am – 7:00 pm** | Registration Open | Phoenix Convention Center, North 120 B-D
---|---|---
**9:40 am – 10:00 am** | AM Break | Atrium Lobby
**11:40 am – 1:30 pm** | Lunch on Own | Atrium Lobby
**11:40 am – 1:30 pm** | Breakout Sessions | Atrium Lobby
**3:10 pm – 3:30 pm** | PM Break | Atrium Lobby
**7:00 pm – 9:30 pm** | ECCE Banquet | Phoenix Convention Center, North 120 B-D

### THURSDAY, SEPTEMBER 22, 2011

**7:00 am – 3:00 pm** | Registration Open | Phoenix Convention Center, North 120 B-D
---|---|---
**9:40 am – 10:00 am** | AM Break | Atrium Lobby
**11:45 am – 1:40 pm** | Awards Luncheon | Regency ABCD
**1:40 pm – 3:20 pm** | Rap Sessions | Phoenix Convention Center, North 120 B-D
---|---|---
**3:20 pm – 3:40 pm** | PM Break | Phoenix Convention Center, North 120 B-D
**3:40 pm – 5:00 pm** | Breakout Sessions | Atrium Lobby

---

### Schedule-at-a-Glance

**TUESDAY, SEPTEMBER 20, 2011 (Continued)**

<table>
<thead>
<tr>
<th>Time</th>
<th>Breakout Sessions</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:40 am – 9:40 am</td>
<td>Russell</td>
<td>Atrium Lobby</td>
</tr>
<tr>
<td>11:45 am – 1:40 pm</td>
<td>Remington</td>
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<tr>
<td>1:40 pm – 3:20 pm</td>
<td>Russell</td>
<td>Atrium Lobby</td>
</tr>
<tr>
<td>3:20 pm – 5:00 pm</td>
<td>Remington</td>
<td>Atrium Lobby</td>
</tr>
<tr>
<td>5:00 pm – 7:00 pm</td>
<td>Russell</td>
<td>Atrium Lobby</td>
</tr>
<tr>
<td>7:00 pm – 9:00 pm</td>
<td>Remington</td>
<td>Atrium Lobby</td>
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<tr>
<td>9:00 pm – 11:00 pm</td>
<td>Russell</td>
<td>Atrium Lobby</td>
</tr>
<tr>
<td>11:00 pm – 1:00 am</td>
<td>Remington</td>
<td>Atrium Lobby</td>
</tr>
</tbody>
</table>

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### Wednesday, September 21, 2011

**Breakout Sessions • 8:00 am – 9:40 am**

<table>
<thead>
<tr>
<th>Time</th>
<th>Breakout Sessions</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 am – 9:40 am</td>
<td>Russell</td>
<td>Atrium Lobby</td>
</tr>
<tr>
<td>9:40 am – 10:00 am</td>
<td>Remington</td>
<td>Atrium Lobby</td>
</tr>
<tr>
<td>10:00 am – 11:40 am</td>
<td>Russell</td>
<td>Atrium Lobby</td>
</tr>
<tr>
<td>11:40 am – 1:30 pm</td>
<td>Remington</td>
<td>Atrium Lobby</td>
</tr>
<tr>
<td>1:30 pm – 3:10 pm</td>
<td>Russell</td>
<td>Atrium Lobby</td>
</tr>
<tr>
<td>3:10 pm – 4:50 pm</td>
<td>Remington</td>
<td>Atrium Lobby</td>
</tr>
</tbody>
</table>

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### Thursday, September 22, 2011

**Breakout Sessions • 8:00 am – 9:40 am**

<table>
<thead>
<tr>
<th>Time</th>
<th>Breakout Sessions</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 am – 9:40 am</td>
<td>Russell</td>
<td>Atrium Lobby</td>
</tr>
<tr>
<td>9:40 am – 10:00 am</td>
<td>Remington</td>
<td>Atrium Lobby</td>
</tr>
<tr>
<td>10:00 am – 11:40 am</td>
<td>Remington</td>
<td>Atrium Lobby</td>
</tr>
<tr>
<td>11:40 am – 1:40 pm</td>
<td>Remington</td>
<td>Regency ABCD</td>
</tr>
<tr>
<td>1:40 pm – 3:20 pm</td>
<td>Remington</td>
<td>Phoenix</td>
</tr>
<tr>
<td>3:20 pm – 5:00 pm</td>
<td>Remington</td>
<td>Atrium Lobby</td>
</tr>
</tbody>
</table>
SATURDAY, SEPTEMBER 17, 2011

3:00 pm – 5:00 pm  Registration Open ................................................................. Atrium Lobby

SUNDAY, SEPTEMBER 18, 2011

7:00 am – 7:00 pm  Registration Open ................................................................. Atrium Lobby

<table>
<thead>
<tr>
<th>Tutorials Group 1</th>
<th>8:30 am – 12:00 pm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russell</td>
<td>Ellis West</td>
</tr>
<tr>
<td>T1-1 Practical Aspects in Modern Design Process of Electric Motors</td>
<td>T1-2 Understanding of Electrical Concepts in Wind Turbines and Photovoltaic Arrays</td>
</tr>
<tr>
<td>Cowboy Artists</td>
<td>Cassidy</td>
</tr>
<tr>
<td>T1-3 Carrier Based PWM Methods For AC-DC-AC and AC-AC Power Conversion Systems</td>
<td>T1-4 Reliability of IGBT Modules in Energy Conversion</td>
</tr>
<tr>
<td>Ellis East</td>
<td>Curtis</td>
</tr>
<tr>
<td>T1-5 Ultra-Capacitors in Power Conversion: Analysis, Modeling, and Design in Theory and Practice</td>
<td>T1-6 Inductive Wireless Power Transmission</td>
</tr>
</tbody>
</table>

12:00 pm – 1:00 pm Lunch on Own

<table>
<thead>
<tr>
<th>Tutorials Group 2</th>
<th>1:00 pm – 5:00 pm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russell</td>
<td>Ellis West</td>
</tr>
<tr>
<td>T2-1 Practical Aspects of Wind Power Transmission Development</td>
<td>T2-2 Understanding of Electrical Concepts in Wind Turbines and Photovoltaic Arrays</td>
</tr>
<tr>
<td>Cowboy Artists</td>
<td>Cassidy</td>
</tr>
<tr>
<td>T2-3 Artificial Intelligence Techniques in Power Electronics and Motor Drives</td>
<td>T2-4 Practical Design and Challenges of Traction Inverter for Electrified Vehicles</td>
</tr>
<tr>
<td>Ellis East</td>
<td>Curtis</td>
</tr>
<tr>
<td>T2-5 Designing with Lithium-Ion Batteries: An Engineering Perspective</td>
<td>T2-6 Multilevel Converters: Recent Development of Topologies and PWM Control Methods</td>
</tr>
</tbody>
</table>

4:30 pm – 5:00 pm New to ECCE/PELS/IAS Reception (for those new to the organizations) ................................................................. Atrium

5:00 pm – 7:00 pm Opening Reception ................................................................. Atrium

MONDAY, SEPTEMBER 19, 2011

7:00 am – 7:00 pm  Registration Open ................................................................. Atrium Lobby

8:00 am – 10:00 am  Plenary Session ................................................................. Regency ABCD

10:00 am – 10:20 am AM Break ................................................................. Atrium Lobby

Breakout Sessions • 10:20 am – 12:00 pm

<table>
<thead>
<tr>
<th>Ellis West</th>
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<th>Russell</th>
<th>Sundance</th>
<th>Borein</th>
<th>Phoenix</th>
<th>Regency ABCD</th>
</tr>
</thead>
</table>

10:20 am – 10:45 am Novel Non-flat Photovoltaic Module Geometries and Implications to Power Conversion

Study and Realization of a High Power Density Electronics Device Cooling Loop Using a Liquid Metal Coolant

Sensorless Induction Motor Drive Based on a Speed Observer Operating with Third-Order Field Harmonics

A Full-Feedforward Scheme of Grid Voltages for a Three-Phase Grid-Connected Inverter With an LCL Filter

Design and Analysis for ZVS Forward-Flyback DC-DC Converter

Stray Losses in the Stator and Rotor of Induction Machines with Sinusoidal Supplies

Virtual-Vector-Based Space Vector Pulse Width Modulation of the DC-AC Multilevel-Clamped Multilevel Converter (MLC2)

Integrated CMOS DC-DC Converter with Digital Maximum Power Point Tracking for a Portable Thermophotovoltaic Power Generator

Modulation of Indirect Matrix Converter Under Unbalanced Source Voltage Condition

Development of a Drive Cycle Based Evaluation Method for Variable Voltage Converter in Vehicle Electrification Applications

Power Electronics Converters for Wind Turbine Systems

10:45 am – 11:10 am A Test Bench for Accelerated Thermal Ageing of III-V Concentration Solar Cells Using Forward Bias Injection

Drift Region Integrated Microchannel Structure for Direct Cooling of Power Electronics

Square Root Uncertainty Kalman Filters for State Estimation of Induction Motor Drives

Optimal Size and Location of Distributed Generation Unit for Voltage Stability Enhancement

Interleaved Power Converter with Current Ripple Cancellation at a Selectable Duty Cycle

Harmonic Loss and Torque Analysis of High Speed Induction Motors

A New Voltage-Balancing Controller in Cascaded Multilevel Converters

Study and Evaluation of Load Current Based MPPT Control for PV Solar Systems

An Investigation of High Efficiency Operation Conditions for a Three-Port Energy Source Using an Indirect Matrix Converter

Small-Scale Light-Weight Transformer with New Core Structure for Contactless Electric Vehicle Power Transfer System

A Commercial Perspective on Wind Technology Development Needs
### MONDAY, SEPTEMBER 19, 2011 (Continued)

#### Breakout Sessions • 10:20 am - 12:00 pm (Continued)

<table>
<thead>
<tr>
<th>Ellis West</th>
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<th>Phoenix</th>
<th>Regency ABCD</th>
</tr>
</thead>
</table>

#### 12:00 pm – 1:20 pm

- **Lunch on Own**

#### Breakout Sessions • 1:20 pm - 3:00 pm

<table>
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<tr>
<th>Ellis West</th>
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<th>Ellis East</th>
<th>Remington</th>
<th>Cowboy Artists</th>
<th>Russell</th>
<th>Sundance</th>
<th>Borein</th>
<th>Phoenix</th>
<th>Regency ABCD</th>
</tr>
</thead>
</table>
## Detailed Schedule

### Monday, September 19, 2011

<table>
<thead>
<tr>
<th>Time</th>
<th>Breakout Sessions</th>
<th>Location</th>
<th>Room</th>
<th>Panelists</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:10 pm</td>
<td>Wind Energy: Power Electronic Converters</td>
<td>Atrium Lobby</td>
<td>Remington</td>
<td>A Simple Method for Accounting of Losses in Full Bridge Converters</td>
</tr>
<tr>
<td>2:30 pm</td>
<td>Wind Energy: Power Electronic Converters</td>
<td>Atrium Lobby</td>
<td>Remington</td>
<td>A Nonintrusive Method for Evaluation of Inrush Currents in Electrical Machines</td>
</tr>
<tr>
<td>3:00 pm</td>
<td>Wind Energy: Power Electronic Converters</td>
<td>Atrium Lobby</td>
<td>Remington</td>
<td>A New SiC MOSFET Converter Design Method for Inverter Using Dynamic Phasor Method</td>
</tr>
<tr>
<td>4:10 pm</td>
<td>Wind Energy: Power Electronic Converters</td>
<td>Atrium Lobby</td>
<td>Remington</td>
<td>A Grid Synchronization Method for Stability Analysis of Inverters, for Power Plant</td>
</tr>
<tr>
<td>4:30 pm</td>
<td>Wind Energy: Power Electronic Converters</td>
<td>Atrium Lobby</td>
<td>Remington</td>
<td>Analysis on Load Currents for Microgrid Applications</td>
</tr>
<tr>
<td>2:10 pm</td>
<td>Mechanical Stress Reduction in Wind Turbine Drivetrains</td>
<td>Atrium Lobby</td>
<td>Cassidy</td>
<td>A Novel Control Method for Calculating Optimal Driving Voltage in Full Bridge Converters</td>
</tr>
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<td>Cassidy</td>
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</tr>
<tr>
<td>3:15 pm</td>
<td>Mechanical Stress Reduction in Wind Turbine Drivetrains</td>
<td>Atrium Lobby</td>
<td>Cassidy</td>
<td>A New Method for Calculating Optimal Driving Voltage in Full Bridge Converters</td>
</tr>
<tr>
<td>4:10 pm</td>
<td>Mechanical Stress Reduction in Wind Turbine Drivetrains</td>
<td>Atrium Lobby</td>
<td>Cassidy</td>
<td>Analysis of Load Currents for Mechanical Stress Reduction in Wind Turbine Drivetrains</td>
</tr>
</tbody>
</table>

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### Additional Information

- **Breakout Sessions** are scheduled throughout the day for various topics related to energy conversion. Each session is located in different rooms and led by different panelists.
- **Location** indicates the location of the breakout sessions, which are held in the Atrium Lobby or Cassidy.
- **Room** specifies the specific room where each breakout session is held.
- **Panelists** list the names of the panelists leading each session.

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**Note:** The schedule includes sessions on Wind Energy, Mechanical Stress Reduction in Wind Turbine Drivetrains, and other related topics. Each session is designed to provide detailed insights into the latest research and developments in the field of energy conversion.
### Breakout Sessions • 3:20 pm - 5:00 pm (Continued)

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:10 pm – 4:35 pm</td>
<td>- Power Density Investigation on the Press-Pack IGBT 3L-HB-VSCs Applied to Large Wind Turbines</td>
</tr>
<tr>
<td></td>
<td>- Iron Loss Evaluation of Filter Inductor Used in PWM Inverters</td>
</tr>
<tr>
<td></td>
<td>- The Influence of Magnetic Hysteresis on HF Injection Based Inductance Calculation</td>
</tr>
<tr>
<td></td>
<td>- Phase Locked Loop Control of Inverters in a Microgrid</td>
</tr>
<tr>
<td></td>
<td>- Simple Large-Signal Model Based on Gyrator for System Level Analysis</td>
</tr>
<tr>
<td></td>
<td>- Loss Measurement of a 40 kW High-Speed Bearingless PM Synchronous Motor</td>
</tr>
<tr>
<td></td>
<td>- High Performance AC Current Regulation for Low Pulse Ratio Inverters</td>
</tr>
<tr>
<td></td>
<td>- Power Control in Three-Phase Grid-Connected Current-Source Boost Inverter</td>
</tr>
<tr>
<td></td>
<td>- Study of the Bi-Directional Power Flow in Back-to-Back Converters by using Linear and Nonlinear Control Strategies</td>
</tr>
<tr>
<td></td>
<td>- Mitigating Distribution Transformer Lifetime and Nonlinear Control Strategies</td>
</tr>
<tr>
<td></td>
<td>- Current Sensor and Metrology Technologies for EV Charging</td>
</tr>
<tr>
<td></td>
<td>- EV Charging Standards</td>
</tr>
<tr>
<td>4:35 pm – 5:00 pm</td>
<td>- A Comparison of Medium Voltage High Power DC-DC Converters with High Step-Up Conversion Ratio for Offshore Wind Energy Systems</td>
</tr>
<tr>
<td></td>
<td>- Development and Evaluation of Single Sided Flux Couplers for Contactless Electric Vehicle Charging</td>
</tr>
<tr>
<td></td>
<td>- Saliency Based Sensorless Control of Induction Machines at Frequency Overlap of Signal Components</td>
</tr>
<tr>
<td></td>
<td>- Enabling High Droop Gain for Improvement of Reactive Power Sharing Accuracy in an Electrically-Interfaced Autonomous Microgrid</td>
</tr>
<tr>
<td></td>
<td>- Modeling of Multiple-Input DC-DC Converters Considering Input-Coupling Effects</td>
</tr>
<tr>
<td></td>
<td>- Induction Motor Rotor Temperature Estimation Using Superheterodyne Receivers</td>
</tr>
<tr>
<td></td>
<td>- Swinging Bus Inverters: New Requirements in Renewable Power and the Natural Switching Surface</td>
</tr>
<tr>
<td></td>
<td>- An Integrated Filter and Controller Design for Direct Matrix Converter</td>
</tr>
<tr>
<td></td>
<td>- A Study on Receiver Circuit Topology of a Cordless Battery Charger for Electric Vehicles</td>
</tr>
</tbody>
</table>

### TUESDAY, SEPTEMBER 20, 2011

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00 am – 6:00 pm</td>
<td>Registration Open</td>
</tr>
<tr>
<td>9:00 am – 6:00 pm</td>
<td>Exhibit Hall Open</td>
</tr>
<tr>
<td>9:00 am – 6:00 pm</td>
<td>Student Demonstrations</td>
</tr>
<tr>
<td>9:20 am – 9:40 am</td>
<td>AM Break</td>
</tr>
<tr>
<td>9:30 am – 10:00 am</td>
<td>GE Industrial Seminar</td>
</tr>
<tr>
<td>10:00 am – 10:30 am</td>
<td>Ford Motor Company Industrial Seminar</td>
</tr>
<tr>
<td>10:30 am – 12:00 pm</td>
<td>Poster Session I</td>
</tr>
<tr>
<td>12:00 pm – 12:30 pm</td>
<td>Lunch in the Exhibit Hall</td>
</tr>
<tr>
<td>1:30 pm – 2:00 pm</td>
<td>Magnetics Industrial Seminar</td>
</tr>
<tr>
<td>2:00 pm – 2:30 pm</td>
<td>Opal-RT Technologies Industrial Seminar</td>
</tr>
<tr>
<td>2:30 pm – 3:00 pm</td>
<td>Freescale Semiconductors Industrial Seminar</td>
</tr>
<tr>
<td>3:00 pm – 3:30 pm</td>
<td>PM Break</td>
</tr>
<tr>
<td>3:30 pm – 5:00 pm</td>
<td>Poster Session II</td>
</tr>
<tr>
<td>5:00 pm – 6:00 pm</td>
<td>JMag Industrial Seminar and Cocktail Reception Supported in part by JMag Corporation and Powerys, Inc</td>
</tr>
</tbody>
</table>

### Rap Sessions • 7:30 pm – 9:00 pm

- **Remington**: Mission Impossible? A 100% Renewable Energy Society, organized by Dan M. Ionel
- **Russell**: Vehicle Electrification Technologies, Today and Tomorrow, organized by Chris Mi
- **Borein**: Plug-in Electric Vehicles and the Electric Power Grid: Colliding Industries, organized by Jin Wang
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 am – 8:25 am</td>
<td>A New DC-DC Converter with a Fault Isolation Module and Its Impact on System Performance</td>
</tr>
<tr>
<td>8:25 am – 8:50 am</td>
<td>The Resonant LLC Converter — Comparing Efficiency and Transient Performance with a Series Reactive Element Nearing MERS</td>
</tr>
<tr>
<td>8:50 am – 9:15 am</td>
<td>High Frequency Inductor Design and Comparison for a Single-Phase DC-DC Converter using High Density POLs with GaN Devices</td>
</tr>
<tr>
<td>9:15 am – 9:40 am</td>
<td>Soft Switching Chopper with an Adaptive Control for High Efficiency and Low Cost Current Source Inverters</td>
</tr>
<tr>
<td>9:40 am – 10:00 am</td>
<td>AM Break</td>
</tr>
</tbody>
</table>
### Breakout Sessions • 10:00 am - 11:40 am

<table>
<thead>
<tr>
<th>10:00 am – 10:25 am</th>
<th>Vector Control of Multiple-Module Transformer Flux PM Generator for Large-Scale Direct-Drive Wind Turbines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Investigation of SiIGBT Operation at 200 Degree Centigrade for Traction Application</td>
</tr>
<tr>
<td></td>
<td>Magnet Temperature Estimation in Surface PM Machines During Six-Step Operation</td>
</tr>
<tr>
<td></td>
<td>Leakage Current Analysis of Grid-Connected Transformerless Solar Inverters with Zero Vector Isolation</td>
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<td></td>
<td>Serial or Parallel Linear-Assisted Switching Converter as Envelope Amplifier: Optimization and Comparison</td>
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<td></td>
<td>Detection and Classification of Rotor Demagnetization and Eccentricity Faults for PM Synchronous Motors</td>
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<td></td>
<td>Fast Current-Tracking Control for Grid-Connected Inverter with an LCL Filter by Sinusoidal Compensation</td>
</tr>
<tr>
<td></td>
<td>Multi-Channel Constant Current (MC3) LLC Resonant LED Driver</td>
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<td></td>
<td>Boundary Control of Boost-Derived PFCs Using the Natural Switching Surface-Derivation and Enhanced Properties</td>
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<tr>
<td></td>
<td>Battery Modeling Based on the Coupling of Electrical Circuit and Computational Fluid Dynamics</td>
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<td></td>
<td>Towards Commercial Application of HTS Rotating Machines</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10:25 am – 10:50 am</th>
<th>Direct Grid Connection of a Slip-Permanent Magnet Wind Turbine Generator</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Characterization of a High Temperature Multichip SiC JFET-Based Module</td>
</tr>
<tr>
<td></td>
<td>Adaptive Flux-Weakening Controller for IPMSM Drives</td>
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<td></td>
<td>Towards Next Generation Photovoltaic Inverters</td>
</tr>
<tr>
<td></td>
<td>A Large DC-Gain Highly Efficient Hybrid Switched-Capacitor-Boost Converter for Renewable Energy Systems</td>
</tr>
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<td></td>
<td>Detection of Inter-Coil Short Circuits in the Stator Winding of a PM Machine by Using Saliency Tracking Schemes</td>
</tr>
<tr>
<td></td>
<td>Wide Bandwidth System Identification of AC System Impedances by Applying Perturbations to an Existing Converter</td>
</tr>
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<td></td>
<td>An Energy Conservation Based High-Efficiency Dimmable Multi-Channel LED Driver</td>
</tr>
<tr>
<td></td>
<td>Digital Primary-Side Sensing and PFC Control of a Flyback Converter</td>
</tr>
<tr>
<td></td>
<td>Improved Nonlinear Model for Electrode Voltage–Current Relationship for More Consistent Online Battery System Identification</td>
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<td></td>
<td>Fault Current Limiting HTS Power Transformer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10:50 am – 11:15 am</th>
<th>Predictive Direct Control of Doubly Fed Induction Generator for Grid Synchronization in Wind Power Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Development of a 10 kW High Temperature High Power Density Three-Phase AC-DC-AC SiC Converter</td>
</tr>
<tr>
<td></td>
<td>Voltage Disturbance State-Filter Design for Precise Torque-Controlled Interior PM Synchronous Motors</td>
</tr>
<tr>
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<td>Single-Stage Grid-Connected Forward Microinverter with Boundary Mode Control</td>
</tr>
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<td></td>
<td>A Gallium-Nitride Switched-Capacitor Circuit Using Synchronous Rectification</td>
</tr>
<tr>
<td></td>
<td>Bearing Fault Detection Capability of Frequency Response Measurement in Speed-Sensorless Operated Two-Mass-Systems</td>
</tr>
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<td></td>
<td>A Frequency Adaptive Resonant Controller for Fixed Point Digital Implementation at High Sampling Frequency</td>
</tr>
<tr>
<td></td>
<td>Analysis of the Asymmetrical Half-Bridge for Street LED-Lighting Applications</td>
</tr>
<tr>
<td></td>
<td>A Snubber Cell for Single-Stage PFC with a Boost Type Input Current Shaper and Isolated DC-DC Converter</td>
</tr>
<tr>
<td></td>
<td>A Transient-Based Approach for Estimating the Parameters of a Lithium-Ion Battery Model</td>
</tr>
<tr>
<td></td>
<td>Overview on the Development of High-Temperature Superconducting HTS Machines at Siemens</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>11:15 am – 11:40 am</th>
<th>Feed-Forward Transient Compensation Control for DFIG Wind Generators During Both Balanced and Unbalanced Grid Disturbances</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Design Comparison of High Power Medium-Voltage Converters Based on 6.5kV Si-IGBT/Si-PIN Diode, 65kV Si-IGBT/SiC-JBS Diode, and 100V SiC MOSFET/SiC-JBS Diode</td>
</tr>
<tr>
<td></td>
<td>Torque Ripple Control for Synchronous Motors Using Instantaneous Torque Estimation</td>
</tr>
<tr>
<td></td>
<td>Research on a Non-Complementary Active Clamp Flyback Converter for High Reliability and High Input Voltage Applications</td>
</tr>
<tr>
<td></td>
<td>A Novel Push-Pull Forward Converter for Fractional Pitch Concentrated Winding Machines</td>
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<tr>
<td></td>
<td>A Low Conductivity Composite Rotor for Fractional Pitch Concentrated PMS Machines</td>
</tr>
<tr>
<td></td>
<td>Current Mode with RMS Voltage and Offset Control Loops for a Single-Phase Aircraft Inverter Suitable for Parallel and Three-Phase Operation Modes</td>
</tr>
<tr>
<td></td>
<td>Single Switch Three-Level Boost Converter for PWM Dimming LED Lighting</td>
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<tr>
<td></td>
<td>The Input EM1 Filter Design of Interleaved Critical Conduction Mode Boost PFC Converter with Coupled Inductor</td>
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<tr>
<td></td>
<td>A Three-Phase High Frequency Semi-Controlled Battery Charging Power Converter for Plug-In Hybrid Electric Vehicles</td>
</tr>
<tr>
<td></td>
<td>Design Considerations for Large Direct Drive Wind Turbine Generators with Superconductor Field Windings</td>
</tr>
</tbody>
</table>

| 11:40 am – 1:30 pm | Lunch on Own |

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**Detailed Schedule**

**WEDNESDAY, SEPTEMBER 21, 2011 (Continued)**

<table>
<thead>
<tr>
<th>Ellis West</th>
<th>Regency C</th>
<th>Cassidy</th>
<th>Ellis East</th>
<th>Remington</th>
<th>Cowboy Artists</th>
<th>Russell</th>
<th>Sundance</th>
<th>Borein</th>
<th>Regency D</th>
<th>Regency AB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakout Sessions • 1:30 pm – 3:10 pm</td>
<td>Detailed Schedule</td>
<td></td>
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<tr>
<td><strong>1:30 pm – 1:55 pm</strong></td>
<td><strong>1:55 pm – 2:20 pm</strong></td>
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<tr>
<td><strong>2:45 pm – 3:10 pm</strong></td>
<td><strong>3:10 pm – 3:30 pm</strong></td>
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</table>

### 1:30 pm – 1:55 pm

**Session A**
- **Room A**: The Impact of Renewable Energy on the Electric Grid
- **Room B**: Smart Grid Technologies and Applications

### 1:55 pm – 2:20 pm

**Session B**
- **Room A**: Energy Storage Solutions for Distributed Energy Systems
- **Room B**: Advanced Battery Technologies

### 2:45 pm – 3:10 pm

**Session C**
- **Room A**: Electric Vehicle Technologies and Infrastructure
- **Room B**: Sustainable Transportation Solutions

### 3:10 pm – 3:30 pm

**Session D**
- **Room A**: Future Trends in Energy Efficiency
- **Room B**: Renewable Energy Policy and Regulation
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Location</th>
<th>Speaker(s)</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Regency A</td>
<td>Cassidy</td>
<td>Hybrid Half- and Full-Bridge High-Efficiency DC-DC Converter Design for Distributed Power Systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Regency D</td>
<td>Sundeace</td>
<td>Theory and Design of Hybrid Half- and Full-Bridge High-Efficiency DC-DC Converter Design for Distributed Power Systems</td>
</tr>
<tr>
<td>3:55 pm – 4:20 pm</td>
<td>PWM Switching Frequency Sensing Techniques with Wide Range Voltage Injection</td>
<td>Regency C</td>
<td>Ellis East</td>
<td>Two Methods for Addressing Voltage Injection for PWM Switching Frequency Sensing Techniques with Wide Range Voltage Injection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Regency A</td>
<td>Cassidy</td>
<td>Hybrid Half- and Full-Bridge High-Efficiency DC-DC Converter Design for Distributed Power Systems</td>
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<tr>
<td></td>
<td></td>
<td>Regency D</td>
<td>Sundeace</td>
<td>Theory and Design of Hybrid Half- and Full-Bridge High-Efficiency DC-DC Converter Design for Distributed Power Systems</td>
</tr>
<tr>
<td>4:20 pm – 4:45 pm</td>
<td>Power Quality and Voltage Quality of Power Conversion Systems</td>
<td>Regency C</td>
<td>Ellis East</td>
<td>Power Quality and Voltage Quality of Power Conversion Systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Regency A</td>
<td>Cassidy</td>
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<td></td>
<td></td>
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<td>Sundeace</td>
<td>Theory and Design of Hybrid Half- and Full-Bridge High-Efficiency DC-DC Converter Design for Distributed Power Systems</td>
</tr>
<tr>
<td>4:45 pm – 5:10 pm</td>
<td>Voltage Oscillation Damping Methods for Single-Phase PFC Boost Converters</td>
<td>Regency C</td>
<td>Ellis East</td>
<td>Voltage Oscillation Damping Methods for Single-Phase PFC Boost Converters</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Regency A</td>
<td>Cassidy</td>
<td>Hybrid Half- and Full-Bridge High-Efficiency DC-DC Converter Design for Distributed Power Systems</td>
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<td></td>
<td></td>
<td>Regency D</td>
<td>Sundeace</td>
<td>Theory and Design of Hybrid Half- and Full-Bridge High-Efficiency DC-DC Converter Design for Distributed Power Systems</td>
</tr>
<tr>
<td>7:00 pm – 9:30 pm</td>
<td>ECCE Banquet</td>
<td>Phoenix Convention Center, North 120 B-D</td>
<td></td>
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</tr>
<tr>
<td>Time</td>
<td>Session Description</td>
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<tr>
<td>8:00 am - 8:25 am</td>
<td>Interleaved Smart Burp PV Charger for Lead Acid Batteries with Incremental Conductance MPPT</td>
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<tr>
<td>8:25 am - 8:50 am</td>
<td>Design and Implementation of a Bi-Directional Isolated DAB-Based DC-DC Converter in Home Area Networks</td>
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<tr>
<td>8:50 am - 9:15 am</td>
<td>Power Control Strategy of a CSC Based Wind Energy Conversion System with Superconducting Magnetic Energy Storage System in DC Side</td>
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<tr>
<td>9:15 am - 9:40 am</td>
<td>Lithium-based Energy Storage Management for DC Distributed Renewable Energy System</td>
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<tr>
<td>9:40 am - 10:00 am</td>
<td>AM Break</td>
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</tbody>
</table>
## Breakout Sessions • 10:00 am - 11:40 am

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00 am</td>
<td>Battery Ripple Current Reduction in a Three-Phase Interleaved DC-DC Converter for 5kW Battery Charger</td>
<td>Curtis A, Cassidy</td>
</tr>
<tr>
<td>10:25 am</td>
<td>Torque Ripple Minimization of Switched Reluctance Machines through Current Profiling</td>
<td>Curtis A, Cassidy</td>
</tr>
<tr>
<td>10:50 am</td>
<td>Self-Reconfigurable Multicell Batteries</td>
<td>Curtis A, Cassidy</td>
</tr>
<tr>
<td>11:15 am</td>
<td>Evaluating the Application of Energy Storage and Day-Ahead Solar Forecasting to Firm the Output of a Photovoltaic Plant</td>
<td>Curtis A, Cassidy</td>
</tr>
<tr>
<td>10:00 am</td>
<td>Energy Storage: Batteries</td>
<td>Curtis A, Cassidy</td>
</tr>
<tr>
<td>10:25 am</td>
<td>Solar PV System Design and Architecture</td>
<td>Cassidy</td>
</tr>
<tr>
<td>10:50 am</td>
<td>Switched Reluctance Machines</td>
<td>Cassidy</td>
</tr>
<tr>
<td>11:15 am</td>
<td>Switched Reluctance Generators for Optimal Power Generation and Battery Charging</td>
<td>Cassidy</td>
</tr>
<tr>
<td>10:00 am</td>
<td>Drive Control</td>
<td>Remington</td>
</tr>
<tr>
<td>10:25 am</td>
<td>Automated Bi-Objective Design Optimization of Multi-MW Direct-Drive PM Machines Using CE-REA and Differential Evolution</td>
<td>Remington</td>
</tr>
<tr>
<td>10:50 am</td>
<td>Photovoltaic-Wind Hybrid System with Battery Back-up Optimized for Apartment Complexes and other Community Living Environments</td>
<td>Remington</td>
</tr>
<tr>
<td>11:15 am</td>
<td>Input Power Factor Compensation for PWM-SCC Based High-Power Synchronous Motor Drives</td>
<td>Remington</td>
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<tr>
<td>10:00 am</td>
<td>DC-DC Converters: Controls II</td>
<td>Cowboy Artists</td>
</tr>
<tr>
<td>10:50 am</td>
<td>Progressing Smooth Transition for Four-Switch Buck-Boost Converter in Photovoltaic Applications</td>
<td>Cowboy Artists</td>
</tr>
<tr>
<td>11:15 am</td>
<td>A Switching Strategy for Multiple-Input Converters</td>
<td>Cowboy Artists</td>
</tr>
<tr>
<td>10:00 am</td>
<td>Permanent Magnet Machine Optimization</td>
<td>Russell</td>
</tr>
<tr>
<td>10:25 am</td>
<td>A Novel Switching Loss Minimized PWM Method for a High Switching Frequency Three-Level Inverter with a SiC Clamp Diode</td>
<td>Russell</td>
</tr>
<tr>
<td>10:50 am</td>
<td>Fast Optimization of an IPMSM with Space Mapping Technique</td>
<td>Russell</td>
</tr>
<tr>
<td>11:15 am</td>
<td>Introducing the Elliptical Carrier for PWM Inverters: Derivation and Properties for Phase-Shift Compensation</td>
<td>Russell</td>
</tr>
<tr>
<td>10:00 am</td>
<td>STATCOM Controls</td>
<td>Sundance</td>
</tr>
<tr>
<td>10:25 am</td>
<td>A Unified Modular Transformer Inverter (MTI) System with Advanced Angle Control Structure</td>
<td>Sundance</td>
</tr>
<tr>
<td>10:50 am</td>
<td>Multiloop Interleaved Control for Two-Stage Three-Capacitor Three-Level SMR without Capacitor Voltage Balancing Loop</td>
<td>Sundance</td>
</tr>
<tr>
<td>11:15 am</td>
<td>High Power Factor Multi-Pulse Rectifiers</td>
<td>Sundance</td>
</tr>
<tr>
<td>10:00 am</td>
<td>General Inverter Technologies</td>
<td>Phoenix</td>
</tr>
<tr>
<td>10:25 am</td>
<td>Photovoltaic-Wind Hybrid System with Battery Back-up Optimized for Apartment Complexes and other Community Living Environments</td>
<td>Phoenix</td>
</tr>
<tr>
<td>10:50 am</td>
<td>Photovoltaic-Wind Hybrid System with Battery Back-up Optimized for Apartment Complexes and other Community Living Environments</td>
<td>Phoenix</td>
</tr>
<tr>
<td>11:15 am</td>
<td>Input Power Factor Compensation for PWM-SCC Based High-Power Synchronous Motor Drives</td>
<td>Phoenix</td>
</tr>
<tr>
<td>11:45 am</td>
<td>Awards Luncheon</td>
<td>ABCD</td>
</tr>
<tr>
<td>Time Slot</td>
<td>Breakout Sessions</td>
<td></td>
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</tr>
<tr>
<td>1:40 pm – 2:05 pm</td>
<td>Wave Energy Converter with Widerband Power Absorption</td>
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<td></td>
<td>Control of PWM Voltage Source Inverter in the Pulse Dropping Region to Reduce Reflected Wave Motor Over-Voltage</td>
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<td></td>
<td>Utility Grid Impact with High Penetration PV Micro-Inverters Operating Under Burst Mode Using Simplified Simulation Model</td>
<td></td>
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<td></td>
<td>Canonical Small-Signal Model of Double-Input Converters Based on H-Bridge Cells</td>
<td></td>
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<tr>
<td></td>
<td>Damper Windings for the Magnetic Gear</td>
<td></td>
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<tr>
<td>2:05 pm – 2:30 pm</td>
<td>Efficient Energy Harvester for Microbial Fuel Cells Using DC-DC Converters</td>
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<tr>
<td></td>
<td>Embedded-Friendly Online Dead-Time Compensation Using PWM Timer</td>
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<td>Energy Capture Improvement of a Solar PV System with a Multilevel Inverter</td>
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<td></td>
<td>A Novel Half-Bridge Converter with Current Ripple Reduction</td>
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<td></td>
<td>Experimental Evaluation of a Motor Integrated Permanent Magnet Gear</td>
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<tr>
<td>2:30 pm – 2:55 pm</td>
<td>Universal Power Management for Small-Scale Energy Harvesting with Adaptive Impedance Matching</td>
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<td></td>
<td>High-Bandwidth, High-Fidelity In-Circuit Measurement of Power Electronic Switching Waveforms for EMI Generation Analysis</td>
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<td></td>
<td>Feedback Control for SPMSM with Final State Control Based on Voltage Limit Circle with Transient Term</td>
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<td></td>
<td>A DC-Link Voltage Control Scheme for Single-Phase Grid-Connected PV Inverters</td>
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<td>Design Considerations of a Multiple-Input Isolated Single Ended Primary Inductor Converter (SEPIC) for Distributed Generation Sources</td>
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<td></td>
<td>A Line-Fed Permanent Magnet Motor Solution for Drum-Motor and Conveyor-Roller Applications</td>
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<tr>
<td>2:55 pm – 3:20 pm</td>
<td>Design and Experiments of Linear Tubular Generators for the Inertial Sea Wave Energy Converter</td>
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<td></td>
<td>Experimental Study of Power Module with SiC Devices</td>
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<td></td>
<td>On-Line Condition Monitoring for MOSFET and IGBT Switches in Digitally Controlled Drives</td>
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<td></td>
<td>A Variable Frequency Soft Switching Controlled Boost-Flyback Converter for High Step-Up Applications</td>
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<td></td>
<td>Design Study of a Three-Phase Brushless Exciter for Aircraft Starter/Generator</td>
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<td></td>
<td>Capacitor Voltage Balancing Control Based on CPS-PWM of Modular Multilevel Converter</td>
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<tr>
<td>3:20 pm – 3:40 pm</td>
<td>PM Break</td>
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<td>..........................................................................................................................</td>
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<tr>
<td>Time</td>
<td>Session Name</td>
<td>Location</td>
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<td>--------------</td>
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</tr>
<tr>
<td>3:40 pm - 4:05 pm</td>
<td>S107: DC Microgrids</td>
<td>Ellis East</td>
</tr>
<tr>
<td></td>
<td>S108: Multiphase DC-DC Converters</td>
<td>Remington</td>
</tr>
<tr>
<td>4:05 pm - 4:30 pm</td>
<td>S109: Multiphase DC-DC Converters</td>
<td>Sundance</td>
</tr>
<tr>
<td></td>
<td>S110: Boost Inverters</td>
<td>Russell</td>
</tr>
<tr>
<td>4:30 pm - 4:55 pm</td>
<td>S111: Boost Inverters</td>
<td>Russell</td>
</tr>
<tr>
<td></td>
<td>S112: Utility Applications</td>
<td>Russell</td>
</tr>
<tr>
<td>4:55 pm - 5:00 pm</td>
<td>S113: Utility Applications</td>
<td>Russell</td>
</tr>
<tr>
<td></td>
<td>S115: Boost Inverters</td>
<td>Russell</td>
</tr>
</tbody>
</table>
**Registration Booth**

Saturday through Thursday  
*Atrium (Hyatt Regency Phoenix)*

On-site registration will be open during the following hours:  
Saturday, September 17 ...................................... 3:00 pm – 5:00 pm  
Sunday, September 18 ........................................ 7:00 am – 7:00 pm  
Monday, September 19 ....................................... 7:00 am – 7:00 pm  
*Tuesday, September 20 ..................................... 7:00 am – 6:00 pm  
Wednesday, September 21 ................................. 7:00 am – 7:00 pm  
Thursday, September 22 ..................................... 7:00 am – 3:00 pm

*On Tuesday, the registration booth will be located in West Hall Prefunction at the Phoenix Convention Center.*

**Full Conference Registration**

Full Conference Registration admits one entrance into all technical sessions, plenary sessions, rap sessions, access to the exhibition and all social functions (except the Industry Student Dinner). Additional guest tickets for receptions can be purchased at the Registration Desk.

**Full Conference Registration Rates**

<table>
<thead>
<tr>
<th>Category</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE Member</td>
<td>$675.00</td>
</tr>
<tr>
<td>Student IEEE Member</td>
<td>$225.00</td>
</tr>
<tr>
<td>Society Member</td>
<td>$625.00</td>
</tr>
<tr>
<td>Life Member</td>
<td>$300.00</td>
</tr>
<tr>
<td>Non-Member</td>
<td>$900.00</td>
</tr>
</tbody>
</table>

**One-Day Registration**

One-Day Registration admits one entrance into that day’s technical sessions, the plenary sessions**, rap sessions**, industrial seminars**, and access to the exhibition (Monday only).

**One-Day Registration Rates**

<table>
<thead>
<tr>
<th>Category</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Society Member</td>
<td>$325.00</td>
</tr>
<tr>
<td>IEEE Member</td>
<td>$375.00</td>
</tr>
<tr>
<td>Non-Member</td>
<td>$425.00</td>
</tr>
</tbody>
</table>

**Certificate of Attendance**

Certificates of Attendance will not be provided for ECCE 2011.

**Tutorial Registration**

Tutorials will take place on Sunday, September 18, 2011. You may select one morning session and one afternoon session. The rates are outlined below. The registration fee is the same if you choose to attend either one or two tutorials. The registration fee includes materials for all 12 tutorials.

<table>
<thead>
<tr>
<th>Category</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Society Member</td>
<td>$325.00</td>
</tr>
<tr>
<td>IEEE Member</td>
<td>$350.00</td>
</tr>
<tr>
<td>Non-Member</td>
<td>$375.00</td>
</tr>
</tbody>
</table>

**Expo Only**

Expo Only Registration gives admission to the Exposition, only, on Tuesday, September 20. Admission is $25 for those entering between 9:00 am – 1:30 pm, free to those entering after 1:30 pm. Registration is required. You may purchase an Expo Only Registration at the Registration Desk located just outside the Exhibit Hall on Tuesday.

**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.

<table>
<thead>
<tr>
<th>Event</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening Reception</td>
<td>$60.00</td>
</tr>
<tr>
<td>ECCE Banquet</td>
<td>$75.00</td>
</tr>
<tr>
<td>Awards Luncheon</td>
<td>$60.00</td>
</tr>
<tr>
<td>Lunch</td>
<td>$30.00</td>
</tr>
<tr>
<td>Industry Student Dinner</td>
<td>$100.00</td>
</tr>
</tbody>
</table>

**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 at the Registration Desk.

**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.

**Message and Information Center**

Saturday through Thursday  
*Atrium (Hyatt Regency Phoenix)*

If you need to reach a fellow attendee, messages and notices may be placed on the Message Board. Please plan to check these boards regularly in case other attendees are trying to reach you. Outside of registration hours it is recommended that messages be left at the attendee’s hotel. Attendees will not be paged.
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

Thy Hyatt Regency Phoenix Business Center is located on the first floor, lobby level and is open every day, Sunday through Saturday from 9:00 am – 5:00 pm. Services include copies, faxing, and internet.

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

The Security Department at the Hyatt Regency Phoenix is equipped with basic first aid supplies. If you are in need of emergency services or hospital care, the nearest hospitals are as follows:

- **Good Samaritan Medical Center**
  1111 E McDowell
  Phoenix, AZ 85006
  602-239-2000
  1.9 miles from hotel

- **St Luke Medical Center**
  1800 E Van Buren
  Phoenix, AZ 85006
  602-251-8100
  1.9 miles from hotel

Hotels

The ECCE 2011 headquarters hotel is the Hyatt Regency Phoenix:

- **Hyatt Regency Phoenix**
  122 North 2nd Street
  Phoenix, Arizona, USA 85004
  Tel: (602) 252-1234 Fax: (602) 254-9472

Internet Access

Complimentary wireless internet access will be available for ECCE 2011 attendees in the designated hot spot area of the Expo Hall (West Hall 1) at the Phoenix Convention Center on Tuesday and in the Atrium at the Hyatt Regency Phoenix on Monday through Thursday.

Local Transportation

The Phoenix Sky Harbor International Airport is located 6.5 miles from the hotel, or about a 15 minute drive. A taxi fare will run about $18.00, one way and Taxis are readily available 24hrs a day both at the airport and outside the Hyatt Regency Phoenix. For private pickups, AAA Sedans is the preferred vendor and they can be reached at 1-480-888-8888 to schedule a pickup.

You may also choose to take the Valley Metro Light rail from the Airport to and from the Hyatt Regency Phoenix. To get to the Hyatt on the light rail you will need to take the Free PHX airport shuttle to the **44th & Washington** Metrorail stop and take the train to stop #14 — **3rd & Washington**. Once off the train, exit left (West) off the train towards 2nd Street. Head right (North) on 2nd Street and the Hyatt will be one block North on your left-hand side. For more information and rates for the light rail, please visit www.valleymetro.org.

Lost & Found

Lost and found is located at the event registration desk in the Atrium at the Hyatt Regency Phoenix.

Parking

Self-parking at the Hyatt Regency Phoenix is available in the city run and owned garage at the corner of 2nd Street and Adams Street. Per day pricing is currently $19.00 and is subject to change without notification. Self-parking is on a first come, first serve basis. Valet parking is also available at the hotels front drive, current valet parking price is $27.00 per day. Self and valet parking can be posted to guest rooms. Please inquire at the front desk for this service.
Full conference registration includes all meals, refreshments and social functions (except the Industry Student Dinner) provided by ECCE 2011.

**Morning Refreshments**
Monday, Wednesday and Thursday — Atrium (Hyatt Regency Phoenix), Tuesday — West Hall 1 (Phoenix Convention Center)
Monday, September 19 .............................. 10:00 am – 10:20 am
Tuesday, September 20 .............................. 9:20 am – 9:40 am
Wednesday, September 21 ......................... 9:40 am – 10:00 am
Thursday, September 22 ......................... 9:40 am – 10:00 am

**Lunch**
Tuesday — West Hall 1 (Phoenix Convention Center)
Tuesday, September 20 .......................... 12:00 pm – 1:20 pm

**Afternoon Refreshments**
Monday, Wednesday and Thursday — Atrium (Hyatt Regency Phoenix), Tuesday — West Hall 1 (Phoenix Convention Center)
Monday, September 19 .............................. 3:00 pm – 3:20 pm
Tuesday, September 20 .............................. 3:00 pm – 3:30 pm
Wednesday, September 21 ......................... 3:10 pm – 3:30 pm
Thursday, September 22 ......................... 3:20 pm – 3:40 pm

**Meet and Greet the Fellows Reception**
Sunday, 5:00 pm – 7:00 pm
Atrium (Hyatt Regency Phoenix)

Meet and Greet the Fellows Reception within the Sunday evening Opening Reception of ECCE 2011. A chance to chat, take photos and congratulate the 2011 IEEE Power Electronics Society Class of Fellows that have chosen to receive their award at ECCE.

**PELS Fellows**

**Ivo Barbi** PEL, IE
Federal University of Santa Catarina Department of Electrical Engineering
Honored for contributions to soft switching converter technology.

**Bo Cho** PEL, IA, AES, IE
Seoul National University School of EE and Computer Science
Honored for contributions to large-scale distributed power electronics systems.

**Fujio Kurokawa** PEL, IA, IE
Nagasaki University
Honored for contributions to switching power converter control.

**Zheng Shen** PEL
University of Central Florida
Honored for contributions to the development of lateral power metal-oxide semiconductor field-effect transistors.

**Vatche Vorperian** PEL
Jet Propulsion Laboratory California Institute of Technology
Honored for contributions to pulse width modulated and resonant converters.

**IAS Fellows**

**Ram Bhatia** PEL, IA
ABB Group
Honored for leadership in management of large motor projects.

**Joseph Ojo** PEL, PE, IA, IE
Tennessee Tech University
Honored for contributions to dual stator winding electric machines.
Special Events

New to ECCE/PELS/IAS Reception
Sunday, 4:30 pm – 5:00 pm
Atrium (Hyatt Regency Phoenix)

Are you new to ECCE and have not previously been involved with PELS or IAS? Attend this reception to meet other new attendees and the organization’s leaders to enhance your ECCE experience.

Opening Reception
Sunday, 5:00 pm – 7:00 pm
Atrium (Hyatt Regency Phoenix)

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

Guest Breakfast
Monday, 9:00 am – 10:00 am
Suite 322 (Hyatt Regency Phoenix)

ECCE guest ticket holders are invited to attend the ECCE Guest Breakfast. The hotel concierge will join you at 9:30 am to discuss things to do while you are in Phoenix and to answer any specific questions about the city.

Expo Reception
Monday, 5:00 pm – 7:00 pm
West Hall 1 (Phoenix Convention Center)
Supported in part by Opal-RT Technologies, Inc.

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.

Industry Student Dinner
Monday, 8:00 pm – 10:00 pm
West Hall 1 (Phoenix Convention Center)
Supported by GE Global Research and Nexteer Automotive

The Industry Student Dinner will bring together students and industry for an information exchange session. Leading industry representatives will present information on the latest technologies and products they are developing and provide opportunity for the student community to see how their learning experiences are applied in the industry.

All ECCE 2011 student registrants can attend this event for free. Exhibitors have been given three free tickets to the dinner and may purchase additional tickets for $50. Tickets for individuals from non-sponsoring/non-exhibiting organizations are available for $100 and can be purchased at the ECCE Registration Desk.

During the dinner, students will have the opportunity to display posters displaying student projects or other industry-related interests to discuss with industry partners during this event. At the end of the night, each industry participant will be able to vote for the top three posters. These posters will be displayed and announced in the exhibit hall during lunch on Tuesday.

Many students reserved space for their posters in advance of the conference. If you were unable to do so, we still welcome you to bring your poster but space will be allotted on a first come, first serve basis for all posters not reserved in advance. All posters must be removed by 10:10 pm on Monday night.

We look forward to you joining us for a productive evening!

ECCE Banquet
Wednesday, 7:00 pm – 9:30 pm
North 120 B-D (Phoenix Convention Center)

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

Speaker Ready Room
Saturday through Thursday
Moran (Hyatt Regency Phoenix)

ALL Oral Presenters must check in at the Speaker Ready Room at least 4 hours prior to their scheduled presentation. Even if you have submitted your presentation in advance and have no changes, you must check and confirm that the presentation is correct.

The hours of operation of the Speaker Ready Room are:
Saturday, September 17 ...................................... 3:00 pm – 5:00 pm
Sunday, September 18 ........................................ 7:00 am – 7:00 pm
Monday, September 19 ....................................... 7:00 am – 7:00 pm
Tuesday, September 20 ....................................... 7:00 am – 6:00 pm
Wednesday, September 21 ................................. 7:00 am – 7:00 pm
Thursday, September 22 ..................................... 7:00 am – 3:00 pm

You may also edit your presentation at this time. When you are finished reviewing your presentation and verify it is ready, the AV personnel will queue your presentation onto the networked conference computers. The file will then be transferred to the computer network for presentation in the scheduled room.

Oral Presenters’ Orientation and Breakfast
A Presenters’ orientation will be held for all presenters and session chairs from 7:00 am – 8:00 am, Monday, Wednesday and Thursday in the Phoenix Ballroom at the Hyatt Regency Phoenix. 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 breakfast on days on which you are scheduled to speak.

Poster Presenters

Poster Presentation Schedule
Tuesday
West Hall 1 (Phoenix Convention Center)

Poster Session I ............................................... 10:30 am – 12:00 pm
Poster Session II .................................................. 3:30 pm – 5:00 pm

300 posters will be on display on Tuesday in West Hall 1 of the Phoenix 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 will be presented, please review the complete Technical Program schedule starting on page 34.

Poster Session I Setup
Presenters will have access to the exhibit hall, West Hall 1 (Phoenix Convention Center), starting at 8:30 am to set up their poster. Presenters for Poster Session I must have their posters set-up no later than 10:30 am. Poster presenters must then take their posters down promptly at 12:00 pm. Any posters that remain on the poster boards at 12:30 pm, and do not belong in Poster Session II will be removed and kept at the Registration Desk. Uncollected posters will be discarded if not picked up by Wednesday at 5:00 pm.

Poster Session II Setup
Presenters for Poster Session II will have from 1:30 pm to 3:00 pm to set-up their posters. Posters for Poster Session II must be set up no later than 3:00 pm and must be removed no later than 5:00 pm.

Do not leave your presentation on the poster board. Posters remaining after 5:30 pm on Tuesday will be removed and kept at the Registration Desk. Uncollected posters will be discarded if not picked up by Wednesday at 5:00 pm.

Poster Boards & Push-pins
4’x8’ 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.

Poster Presenter’s Orientation and Breakfast
The poster presenter’s orientation will be held from 7:00 am - 8:00 am, on Tuesday, in the Phoenix Ballroom of the Hyatt Regency Phoenix. Presenters should meet with their respective session chair to review the format and timing of the session and alert conference management of any changes. Only one presenting author per poster should attend; you may only attend breakfast on the day you are scheduled to present (Tuesday).
All of the following meetings will be held at the Hyatt Regency Phoenix.

IAS Committee Meetings

Industrial Power Conversion Systems Department
Sunday, September 18
7:00 pm – 8:00 pm
Sundance

Industrial Drive Committee
Monday, September 19
7:00 pm – 8:00 pm
Russell

PEDCC
Monday, September 19
7:00 pm – 8:00 pm
Cowboy Artists

Electric Machines Committee
Tuesday, September 20
6:00 pm – 8:00 pm
Cowboy Artists

IPCC in conjunction with PELS Technical Committee (Power Conversion Systems and Components)
Tuesday, September 20
6:00 pm – 7:00 pm
Ellis East

ECCE Committee Meetings

2013 ECCE Organizing Committee
Sunday, September 18
8:00 pm – 9:00 pm
Sundance

Technical Program Committee
Monday, September 19
7:00 pm – 8:00 pm
Boardroom, Second Floor

2012 ECCE Organizing Committee
Tuesday, September 20
6:30 pm – 7:30 pm
Suite 318

ECCE Steering Committee
Wednesday, September 21
1:30 pm – 3:30 pm
Boardroom, Second Floor

PELS Committee Meetings

PELS Meetings Committee
Sunday, September 18
11:30 am – 4:30 pm
Borein

Editorial Meeting IEEE Trans. on PE
Sunday, September 18
4:00 pm – 7:00 pm
Suite 324

IEEE PELS Sustainable Energy Technical Committee
Monday, September 19
7:30 pm – 8:30 pm
Remington

PELS Bylaws and Constitution Committee
Tuesday, September 20
8:00 am – 9:00 am
Boardroom, Second Floor

IEEE Power Electronics Society Standards Committee (PELSC)
Tuesday, September 20
6:00 pm – 7:00 pm
Suite 324

Technical Committee (High Performance and Low Cost Applications)
Wednesday, September 21
11:40 am – 1:30 pm
Suite 324

PELS Nominating Committee
Wednesday, September 21
12:00 pm – 1:00 pm
Suite 318

PELS Electronics Transformers Technical Thrust
Wednesday, September 21
1:00 pm – 4:00 pm
Suite 314

Power Magnetics for Smart Grid: IEEE Standards Roadmap
Wednesday, September 21
4:00 pm – 6:30 pm
Suite 324

PELS TC Chairs
Thursday, September 22
12:00 pm – 2:00 pm
Boardroom, Second Floor

PELS Operations Committee
Thursday, September 22
4:00 pm – 10:00 pm
Cassidy

PELS AdCom Committee Meeting
Friday, September 23
7:00 am – 3:00 pm
Ellis
Events held at the Hyatt Regency Phoenix (see map above)

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<thead>
<tr>
<th>Event</th>
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<tr>
<td>Tutorials</td>
<td>Russell, Borein, Cowboy Artist, Curtis, Ellis and Cassidy</td>
<td>September 18</td>
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<tr>
<td>ECCE Opening Reception</td>
<td>Atrium</td>
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<tr>
<td>Breakout Sessions</td>
<td>Regency, Phoenix, Sundance, Remington, Russell, Borein, Cowboy Artist, Curtis, Ellis West, Ellis East, and Cassidy</td>
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<tr>
<td>Plenary Session</td>
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<td>Rap Sessions</td>
<td>Remington, Russell and Borein</td>
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<tr>
<td>Awards Luncheon</td>
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Events held at the Phoenix Convention Center *(see map above)*

<table>
<thead>
<tr>
<th>Event</th>
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<tbody>
<tr>
<td>Exposition</td>
<td>West Hall 1</td>
<td>September 19-20</td>
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<tr>
<td>Expo Reception</td>
<td>West Hall 1</td>
<td>Supported in part by Opal-RT Technologies, Inc. September 19</td>
</tr>
<tr>
<td>Industry Student Dinner</td>
<td>West Hall 1</td>
<td>Supported by GE Global Research and Nexteer Automotive September 19</td>
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<tr>
<td>Student Demonstrations</td>
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<td>Industrial Seminars</td>
<td>West Hall 1</td>
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<td>Poster Sessions</td>
<td>West Hall 1</td>
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<tr>
<td>Cocktail Reception</td>
<td>West Hall 1</td>
<td>Supported in part by JSOL Corporation and Powersys, Inc. September 20</td>
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<tr>
<td>ECCE Banquet</td>
<td>North 120 B-D</td>
<td>September 21</td>
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The Phoenix Convention Center West Building is located directly across the street from the front entrance of the Hyatt Regency Phoenix. The entrance to the West Building is on 2nd Street. From there, you will need to take the escalators down one floor to the West Hall located on the Lower Level.

The entrance to the North Building is on Monroe Street.
Plenary Session
Monday, September 19 8:00 am – 10:00 am

Chair: K. Rajashekara, Rolls Royce Corporation, USA
Regency ABCD

GaN as a Displacement Technology for Silicon in Power Management

For the past three decades, power management efficiency and cost have shown steady improvement as innovations in power MOSFET structures, technology, and circuit topologies have paced the growing need for electrical power in our daily lives. In the last few years, however, the rate of improvement has slowed as the silicon power MOSFET has asymptotically approached its theoretical bounds. We will address the new game-changing power management products, available today and planned for the near future, that are built using Gallium-Nitride. Enhancement mode eGaNTM FETs, first introduced in June 2009, will be demonstrated in various applications and compared against state-of-the-art silicon power MOSFETs. GaN roadmaps for improved device performance and for system-on-chip integration will also be discussed. Performance is only one dimension in the equation leading to the conclusion that GaN-on-silicon is a broad displacement technology for silicon-based power devices. The other dimensions are product reliability, ease of use, and cost. These topics will also be discussed showing that the capability to displace silicon across a significant portion of the power management market is now in hand.

Dr. Alex Lidow is Co-founder and CEO of Efficient Power Conversion Corporation (EPC). EPC is privately funded and designs, develops, and produces Gallium-Nitride-on-Silicon transistors and integrated circuits used in power management.

The Past, Present, and Future of Photovoltaics

The solar cell industry has grown at an astonishingly high rate over the past decade. This growth has been both in what one could consider the “traditional” areas such as flat panel crystalline silicon arrays, as well as in “new” technologies such as thin film CdTe arrays on glass. A review will be presented of the past developments in the photovoltaic landscape from the early days and their use in space exploration to their explosive growth in terrestrial power production today. A snapshot of the current PV industry along with a summary of the current technological barriers will be given. Finally, examples of the future areas of research and a summary of what is needed to continue to accelerate PV adoption in the U.S. will be provided.

Dr. Ryne Raffaelle is presently the Vice President for Research and Associate Provost at Rochester Institute of Technology, Rochester, NY. Prior to this, he was the Director of National Center for Photovoltaics in the U.S. Department of Energy’s (DOE) National Renewable Energy Laboratory (NREL).

A Joule in Hand Is Worth Ten in the Ground

In many applications, the energy converted to useful work is a small fraction of the potential energy of the natural resource used. Consequently, there is a vast resource of wasted energy available to be tapped. This is the near-term opportunity of energy efficiency and can be harnessed by adopting a systems approach and recognizing the value of demand-side management together with advances on the supply side. Within this broader context, power conversion technologies play a critical role enabling gains in overall system efficiency in applications ranging from buildings to airplanes over their full life cycle.

Dr. David Parekh serves as Vice President, Research, and Director, UTRC, responsible for advancing the corporation’s commitment to growth through technology and innovation. UTRC is the corporate research center for the businesses of United Technologies.
R3  Plug-in Electric Vehicles and the Electric Power Grid: Colliding Industries

Borein

With the predicted rise of Plug-in hybrid electric vehicles, the first time in the history, automotive manufacturers and electric power companies are working together to identify conflicts, challenges, and benefits. Collaborative fleet studies are being carried out around the country. Automotive companies are investigating fuel economy, battery life, and warranty related issues; and electric power companies are looking at impact to existing infrastructure and possible usages of PHEVs to alleviate problems such as mismatch between demand and supply. Meanwhile, to make things more complex, large fleet owners are expecting to maximize the return of their investments by providing ancillary functions such as frequency regulation. For all the parties involved, expectations and doubts co-exist. Thus, with three presentations by experts from industry, national lab, and academia, this rap session will focus on the interactions between Plug-in hybrid vehicles and electric power grids. Load impact, vehicle to grid, communication, ancillary functions, ownership, charging facilities, policy and standards will be discussed.

Moderator
Jin Wang, Professor, Ohio State University

Presenters
Jin Wang, Professor, Ohio State University
Haukur Asgeirsson, Manager, DTE Energy
Ted Bohn, Senior Researcher, Argonne National Laboratory

R2  Vehicle Electrification Technologies, Today and Tomorrow

Russell

Electric drive vehicles use grid electricity to displace the usage of gasoline and reduce total emissions in personal and commercial transportation systems. It is clear that, with strong support from government and industry around the world, the paradigm shift is inevitable. Power electronics and electric machines are the enabling technology propelling this paradigm shift. Manufacturers and suppliers are racing to develop and perfect new technologies which will not only affect consumers, but will also affect society as a whole, having economic, governmental and also environmental impacts. This rap session is to look at the emerging technologies in the field that may have profound impacts on the electrification of the automobile.

Moderator
Chris Mi, Associate Professor, University of Michigan – Dearborn

Presenters
Chris Mi, Associate Professor, University of Michigan – Dearborn
Jim Spangler, Senior Researcher, Argonne National Laboratory
Burak Ozpineci, Group Leader, Oak Ridge National Laboratory
Chun-Taek Rim, Professor, Korea Advanced Institute of Science and Technology

R1  Mission Impossible? A 100% Renewable Energy Society

Remington

Two presentations by invited experts will briefly describe the latest initiatives and plans for Hawaii in the US and for Denmark in the EU. In “The US Story — Hawaii”, Professor Anthony Kuh from the University of Hawaii will discuss the Hawaii Clean Energy Initiative and Renewable Energy and Island Sustainability (REIS) program at the University of Hawaii at Manoa. In “The European Story — Denmark”, Dr. Carsten Hein Westergaard will discuss the current state of wind energy in Denmark, and what it takes to go beyond and even reach 100%.

Moderator
Dan M. Ionel, Chief Scientist, Vestas Americas

Presenters
Anthony Kuh, Chair, Electrical Engineering Department, University of Hawaii, and Director, Renewable Energy and Island Sustainability (REIS) Center
Carsten Hein Westergaard, Director of Global Technology, Vestas Americas
The tutorial covers from an industrial perspective some of the latest developments in the subject of electric machines and includes timely topics such as heating and ventilation, the effect of manufacturing tolerances, the influence of fabrication processes on material properties, the unbalanced magnetic pull and the torque ripple due to eccentricity, manufacturing technologies like segmented stators for brushless PM machines and die-cast copper rotors for induction motors, the role of computer aided engineering in the industrial environment. The fundamental theory of brushless DC, inverter and line-fed synchronous PM, induction and switched reluctance machines is briefly reviewed. The relative merits of each machine type are discussed. The state of the art topologies and the emerging trends are also presented. Particular emphasis is placed on the possible shortage of NdFeB magnets and on potential alternatives for rare-earth free or even magnet free solutions. The presentation includes the main aspects of power electronics and controls directly affecting the electric machines. Topics such as the risk for PM demagnetization, the effect of switching frequency, supplementary losses and heating are discussed. Design procedures that include a multi-physics approach encompassing the electromagnetic and the thermal field together with the mechanical stress are described. The electromagnetic methods range from analytical closed-form techniques to ultra-fast simplified FEA and time stepping transient FEA. A lumped parameter model is preferred for the thermal study. Extensive details are provided for the thermal analysis of electric machines, which is a topic less covered in the published literature. Many examples are provided from a variety of industries ranging from very small motors for house hold appliances, to fans and pumps that account for the largest proportion of energy consumption and go all the way to some of the largest traction motors and generators developed for renewable and alternative energy applications. A discussion of the trends and anticipated industry developments is also included. The course topics are structured as follows: (I) Efficient multi-physics analysis of electrical motors; (II) Thermal analysis of electrical machines – the neglected design aspect; (III) Application example – Interior permanent magnet motor; (IV) Manufacturing process effects on the electrical motors design procedures.
**T1-4 Reliability of IGBT Modules in Energy Conversion**

Ellis East  
Instructors: John F. Donlon and Eric R. Motto, Powerex, Inc., USA

This tutorial addresses the reliability of the IGBT power module which is the heart of converters used in energy conversion applications. It has proven to be a highly reliable and rugged component. However, it must be applied within its ratings and capabilities. This tutorial will discuss the proper selection of the IGBT, its limitations and failure modes, the precautions that must be taken to ensure long life, and the design and application considerations that affect reliability. Attendees will gain an understanding of the need to protect the IGBT from internal and external disturbances and practical solutions to over current, over voltage, and over temperature conditions. The workshop is intended to be of interest to those who use, apply, procure, or specify power electronic products based on the IGBT as the power switch.

**T1-5 Ultra-Capacitors in Power Conversion: Analysis, Modeling and Design in Theory and Practice**

Cassidy  
Instructor: Petar J. Grbovic, HUAWEI Technologies, Germany

In this tutorial, we will discuss application of ultra-capacitors in power conversion, with particular attention on analysis, modeling and design. In first part of the tutorial background and history of power conversion systems will be presented. Needs for the use of energy storage in these applications will be identified and discussed. Background theory of ultra-capacitors will be given in the second part of the tutorial. The ultra-capacitor modeling with attention to the application oriented model will be given. Method to compute the ultra-capacitor current stress and power losses for different conditions will be discussed. We will see how the ultra-capacitor losses depend on the charge/discharge frequency and how the losses can be computed when the charge/discharge current frequency is in range of mHz (very low frequency) and in range of couple of Hz (low frequency). Some application examples, such as variable speed drives with braking and ride through capability will be given. In the third part of the tutorial, structure of a typical power conversion system with ultra-capacitor energy storage will be presented. Different power conversion systems such as variable speed drives, renewable applications (wind for example), autonomous diesel generators, STATCOM devices with short term active power capability and short term UPS will be discussed. The main functional blocks of such systems will be identified. In the fourth part the tutorial, we will discuss selection and design of the ultra-capacitor module. We will see how the ultra-capacitor rated voltage and capacitance should be selected according to the application requirement. Then, losses and efficiency of the ultra-capacitor module versus size and cost will be discussed. Couple of application examples such as variable speed drives will be given. Finally, some aspects of the ultracapacitor module design will be presented. Series connection of elementary ultra-capacitor cells and voltage balancing issue will be discussed. The module thermal design will be considered too. Further, some details of the interface dc-dc converters will be given. Needs for the dc-dc converter will be discussed. State of the art topologies will be compared according to the applications requirement and design guidelines will be given. Couple of design examples will be given. In concluding part of the tutorial, trends in development of the ultra-capacitors and applications will be discussed. This tutorial is aimed at power electronics engineers who want to improve their knowledge and understanding of advanced ultra-capacitor energy storage devices and their application in power conversion, nowadays as well as in the near future.

**T1-6 Inductive Wireless Power Transmission**

Curtis  
Instructor: Eberhard Waffenschmidt, Fachhochschule Köln, Germany

Wireless power transmission is known since more than a century, but recently it got more and more attention, because users demand wireless operation for a growing number of applications. Cheap power electronics at suitable operating frequencies are nowadays available and could make those whishes possible. However, the design of such a system is not always straight forward, and engineers are facing a number of issues they didn't have before. Therefore, this tutorial is offered to all, who intend to design an inductive wireless power system and to those, who have to decide, whether an application would be possible. The tutorial covers the following topics: (1) Applications — From Milliwatts to Kilowatts: A number of examples for wireless power applications will be presented ranging from small mobile devices to electric vehicle charging. These will be existing products and examples from R&D; (2) Resonant power transmission: It will be discussed, what the real benefit of resonant operation is. The differences of resonances on the transmitter and the receiver side and parallel and series resonant operation will be investigated. Based on this, the influence on power transfer, losses, efficiency and control will be explained; (3) Limits of inductive power transmission: The wireless power transfer is limited by several parameters. Here, the limits which are determined by efficiency and by magnetic emissions will be determined; (4) Free positioning of receivers: Many wireless power applications benefit from a free placement of a power receiver. Suitable coil arrangements and winding designs will be presented; (5) Design of transmitter and receiver inductors: The quality factor of the transmitter and receiver coils is a crucial parameter for an efficient wireless power system. However, at higher operating frequencies AC losses significantly deteriorate the coil properties. The losses can be minimized by an optimized design, which will be shown for wire-wound and printed circuit board inductors; (6) The Wireless Power Consortium and the Qi standard for mobile devices: In 2010 the Wireless Power Consortium released the first worldwide inductive wireless power standard for mobile devices named Qi. Details of this standard including operating frequency, power control, device detection, and communication format will be explained.
The design and modeling of dual fed induction generators is considered in this tutorial. The topic will be covered by using examples that are focused primarily for wind power generation applications. The tutorial will begin with an overview of such systems and component identification. The design and modeling methodologies and challenges of various components will be discussed. This will be followed by discussions on the design of induction generators and their field oriented control strategies. Topics covered will include design strategy for initial design (sizing, material and winding designs), load point analysis, and machine performance etc. Multiphysics aspect (electromagnetic, thermal, and mechanical) of the design algorithms will also be discussed. Aside from generator design, there will also be some general discussions on inverter topology and simulation specific to such devices. Modern computer aided design software will be used to illustrate the various design and simulation strategies related to such systems. As well, a literature review will accompany the presentation to highlight the state-of-the-art of such systems.

With the advent of thin film technology, solar photovoltaic (PV) systems can now be installed on any surface which facilitates a paradigm shift from the traditional building applied rigid planar modules to free-form building integrated photovoltaic systems. PV arrays installed on curved surfaces enable new concepts for PV applications but also presents new challenges for balance-of-system components, electrical interconnections and power conditioning electronics. Non-uniform and rapid changes in insolation complicate maximum power point tracking. The aim of this tutorial is to present design considerations for photovoltaic systems installed in or on non-planar surfaces and their associate power conditioning architectures. The tutorial begins with examples of traditional PV systems and emerging applications. Detailed analysis is presented for estimating the available electrical power for PV systems installed on arbitrarily non-planar curved surface along with an analytical thermal model to predict the cell-by-cell operating temperature, which is an important factor in cell efficiency and reliability as well as an important consideration for module integrated power electronics. By way of example, it will be shown that a) conventional “string” PV architectures in which PV modules are connected in series/parallel to a central DC-AC inverter and b) module integrated micro-inverters are not optimal for PV systems installed on highly curved or irregular surfaces. Several new approaches are then reviewed for extracting maximum power along with possible interconnection of module integrated converters with PV cells. Throughout the course numerous design examples of PV systems installed on curved surfaces will be presented with simulation and experimental. Power electronic design engineers who deal with DC-DC, DC-AC converters for renewable energy systems will find this course informative and new knowledge gained in this seminar can be immediately applied.

**T2-1 Design and Modeling of Dual Fed Asynchronous Generators: Application to Wind Power Generation**

*Instructor: Russell*

*Instructors: James Hendershot and Tanvir Rahman, Infolytica Corporation, USA*

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**T2-2 Design Considerations for Photovoltaic Systems Installed on Curved Surfaces**

*Instructor: Ellis West*

*Instructors: Robert S. Balog and Prasad N. Enjeti, Texas A&M University, USA*

With the advent of thin film technology, solar photovoltaic (PV) systems can now be installed on any surface which facilitates a paradigm shift from the traditional building applied rigid planar modules to free-form building integrated photovoltaic systems. PV arrays installed on curved surfaces enable new concepts for PV applications but also presents new challenges for balance-of-system components, electrical interconnections and power conditioning electronics. Non-uniform and rapid changes in insolation complicate maximum power point tracking. The aim of this tutorial is to present design considerations for photovoltaic systems installed in or on non-planar surfaces and their associate power conditioning architectures. The tutorial begins with examples of traditional PV systems and emerging applications. Detailed analysis is presented for estimating the available electrical power for PV systems installed on arbitrarily non-planar curved surface along with an analytical thermal model to predict the cell-by-cell operating temperature, which is an important factor in cell efficiency and reliability as well as an important consideration for module integrated power electronics. By way of example, it will be shown that a) conventional “string” PV architectures in which PV modules are connected in series/parallel to a central DC-AC inverter and b) module integrated micro-inverters are not optimal for PV systems installed on highly curved or irregular surfaces. Several new approaches are then reviewed for extracting maximum power along with possible interconnection of module integrated converters with PV cells. Throughout the course numerous design examples of PV systems installed on curved surfaces will be presented with simulation and experimental. Power electronic design engineers who deal with DC-DC, DC-AC converters for renewable energy systems will find this course informative and new knowledge gained in this seminar can be immediately applied.

**T2-3 Artificial Intelligence Techniques in Power Electronics and Motor Drives**

*Instructor: Bimal K. Bose, University of Tennessee, USA*

Artificial intelligence (AI) techniques, such as expert system (ES), fuzzy logic (FL), artificial neural network (ANN), and genetic algorithm (GA) have recently brought a new and advancing frontier in power electronics and motor drives area, which is already a complex and interdisciplinary technology. The goal of AI is to plant human intelligence in a computer so that a computer can think intelligently like a human being. Computational intelligence has been debated over a long time. There is no denying the fact that AI techniques can solve complex problems which are difficult to solve by traditional methods. Currently, AI technology is advancing at a fast rate, and its applications in power electronics and motor drives are growing fast, as evident by large number of publications in IEEE journals. Recent advancement of powerful DSPs and FPGAs is making implementation of fuzzy and neural systems economical with improvement of performance, compact and more competitive. Evidently, the future impact of this technology on power electronics and motor drives is very significant. The frontier of AI is bringing a new challenge to the traditional engineers specialized in power electronics and motor drives. The tutorial presentation will discuss comprehensively the principles of AI and its applications in power electronics and motor drives. In the beginning, the importance of AI will be reviewed, which will be followed by brief discussion on principles of different AI techniques. However, the presentation will mainly focus on fuzzy logic and neural network (main focus) applications in the control and estimation of power electronic systems, illustrating some application examples. Fuzzy logic example applications will include robust motor speed control, online efficiency optimization of ac drive, and optimal control of modern wind generation system. The ANN application examples will include space vector PWM wave synthesis for 2-level and multi-level converters, delayless filtering of inverter output waves, waveform generation for converters, model referencing adaptive control (MRAC) of ac drives, drift-free flux estimation of drives (approaching zero speed), and neuro-fuzzy control of drives. Time permitting, computer-aided design examples of fuzzy and neural systems will be discussed. Finally, in conclusion, the future prognosis of the technology will be reviewed.
T2-4 Practical Design and Challenges of Traction Inverter for Electrified Vehicles

Ellis East
Instructor: Lihua Chen, Ford Motor Company, USA

Specifications provided by automakers for electric drive vary considerably and can leave the traction inverter suppliers with many questions regarding power delivery and key component selection. Requirements the traction inverter designer must meet include voltage and current ratings, steady-state and transient power delivery, high reliability and durability, size, package, and cost, etc. However, compared with regular inverter designs, the harsh vehicle operating environment and worst case scenarios usually are not fully understood by designers until their inverters are failed in vehicle test. The intent of this seminar is to introduce the design and challenges of traction inverter for electrified vehicle applications from a practical point of view. Traction inverter design specifications derived from vehicle applications will be explained; questions and concerns an inverter designer might have will be addressed by technical details and benchmarking inverter examples. Inverter key component selection and sizing will be intensively discussed. Vehicle operation related extreme conditions and worst case scenarios which usually drive the inverter design will also be explained. The attendee should leave the seminar with improved knowledge of particular requirements of traction inverter design and practical challenges. The seminar is to aid design engineer better understanding of traction inverter design to meet automotive application requirements. It should also be of interest to engineers who work on power electronics circuitry for various power conversion applications.

T2-5 Designing with Lithium-Ion Batteries: An Engineering Perspective

Cassidy
Instructor: Ashish Arora, Exponent, Arizona, USA

The Lithium-ion chemistry is being adopted rapidly by new sectors of the electronics and electrical industry with the automotive sectors being the latest markets to move towards using Lithium-ion as a power source. Low cost, high energy density, high reliability and low weight are all features commonly listed as reasons that have made various industries move away from Nickel based chemistries (NiCad and NiMH) towards Lithium-ion over the past decade. However, the speed of adaptation of this technology has varied by industries. While the consumer electronics industry has been quick to transition almost completely to using Lithium-ion as an energy storage medium, other industries such as the medical electronics industry has been a slower adapter. Part of the reason for the reluctance by certain industries may be that although Lithium-ion batteries are highly reliable, they do have some unique failure modes. Under rare circumstances, Lithium-ion batteries can go into thermal runaway. During this four hour tutorial, the following topics will be covered: (1) Introduction of the lithium-ion technology and an insight into how the chemistry functions; (2) Comparison of the lithium-ion technology with other battery technologies; (3) Discussion of the typical steps involved in the manufacturing of lithium-ion cells and the quality checks performed during the manufacturing process; (4) Discussion of the safety concerns typically associated with the lithium-ion technology and steps taken to mitigate these concerns in battery and system designs; (5) Discussion of the various industry standards that have been developed for evaluating both the safety and reliability of lithium-ion batteries. This will include a description of the approaches taken by the various industry standards. It is expected that the attendee through this tutorial will gain an understanding of lithium-ion batteries and understand not only how the chemistry functions, but also gain insight into techniques used and things to consider when adapting this technology for real-world applications.

T2-6 Multilevel Converters: Recent Development of Topologies and PWM Control Methods

Curtis
Instructors: Yongdong Li, Tsinghua University, China; Hirofumi Akagi, Tokyo Institute of Technology, Japan; Fangzheng Peng, Michigan State University, USA; Jose Rodriguez, Universidad Técnica Federic Santa Maria, Chile, and Thiery Meynard, Institut National Polytechnique de Toulouse, France

Multilevel converters have become the enabling power conversion technology for high voltage high power applications in power systems and large motor drives. Since the mid of 1990s, many contributors have made great effort in developing new multilevel inverter topologies because the existing multilevel topologies have certain limitations and are not operable in some applications. In this tutorial, the relationship between the existing topologies of multilevel converters, like NPC, flying capacitor, cascaded, MMC and next generation multilevel converters will be analyzed and the different control methods be summarized, and their pros and cons in practical applications are reviewed by the world-class specialists. The emphasis of the tutorial is given to recent development of topologies and their control methods, and the following issues will be covered: (1) Multilevel inverters: a survey of topologies, controls, and application; (2) Recent Advances in Multilevel Converter/Inverter Topologies and Applications; (3) Topologies of Multi-level Converters and their development; (4) Classification, and Application of Modular Multilevel Cascade Converter; and (5) Multi-level conversion: SMC high voltage inverters.
Technical Program Schedule

Monday, September 19 10:20 am – 12:00 pm

**S1  Solar PV Technology**

Ellis West
Chair: Ahmed Elasser, GE Global Research Center, USA, and David Torrey, Advanced Energy Conversion, USA

10:20 am • **Novel Non-Flat Photovoltaic Module Geometries and Implications to Power Conversion**
Amulya Karavadi and Robert Balog, Texas A and M University, College Station, USA

10:45 am • **A Test Bench for Accelerated Thermal Ageing of III-V Concentration Solar Cells Using Forward Bias Injection**
Fabio Immovilli, Claudio Bianchini, Alberto Bellini and Andrea Sala, DISMI - University of Modena and Reggio Emilia, Italy

11:10 am • **Challenges to Overcurrent Protection Devices Under Line-Line Faults in Solar Photovoltaic Arrays**
Ye Zhao, Brad Lehman, Jean-François De Palma, Jerry Mosesian and Robert Lyons, Northeastern University, USA; Mersen USA Newburyport-MA, MA., USA

11:35 am • **Analysis and Mitigation of Common Mode Voltages in Photovoltaic Power Systems**
Somasundaram Essakiappan, Prasad Enjeti, Robert Balog and Shehab Ahmed, Texas A and M University, USA; Texas A and M University - Qatar, Qatar

**S2  Power Semiconductors: Thermal Management**

Curtis
Chair: Adam Skorek, University of Québec at Trois-Rivières, Canada

10:20 am • **Study and Realization of a High Power Density Electronics Device Cooling Loop Using a Liquid Metal Coolant**
Mansour Tawk, Yvan Avenas, Aref Kedous-Lebouc and Mickael Petit, Grenoble INP-UJF, France

10:45 am • **Drift Region Integrated Microchannel Structure for Direct Cooling of Power Electronics**
Kremena Vladimirova, Jean-Christophe Crebier, Yvan Avenas and Christian Schaeffer, G2Elab, France

11:10 am • **Thermal Management of Compact SMT Multilayer Power Converters**
Ivan Josifovic, Jelena Popovic-Gerber and Jan Abraham Ferreira, Delft University of Technology, Netherlands

11:35 am • **Development and Electrical Characterization of a Vertical Electrical and Thermal Test Chip (VTTC)**
Benoit Thollin, Jean-Christophe Crebier, Yvan Avenas, Pierre-Olivier Jeannin, Zoubir Khadir and Laurent Dupont, G2Elab, France; LTN/IFSTTAR, France

**S3  Model-Based Sensorless Control**

Cassidy
Chair: Fernando Briz, University of Oviedo, Spain

10:20 am • **Sensorless Multiphase Induction Motor Drive Based on a Speed Observer Operating with Third-Order Field Harmonics**
Luca Zarri, Michele Mengoni, Angelo Tani, Giovanni Serra and Domenico Casadei, University of Bologna, Italy

10:45 am • **Square Root Unscented Kalman Filters for State Estimation of Induction Motor Drives**
Saeed Jafarzadeh, Cristian Lascu and Fadali Sami, University of Nevada Reno, USA

11:10 am • **The Opportunities of Two-Phase Hybrid Stepping Motor Back EMF Sampling**
Stijn Derammelaere, Lennart Carlier, Peter Cox, Bram Vorvisch and Colin Debruyne, Technical University College of West-Flanders, Belgium; ON Semiconductor, Belgium

11:35 am • **Analysis and Design of a Position Observer with Resistance Adaptation for Synchronous Reluctance Motor Drives**
Toni Tuovinen, Marko Hinkkanen and Jorma Luoma, Aalto University School of Electrical Engng, Finland

**S4  Distributed Utility Voltage Regulation**

Ellis East
Chairs: Liuchen Chang, University of New Brunswick, Canada, and Remus Teodorescu, Aalborg University, Denmark

10:20 am • **A Full-Feedforward Scheme of Grid Voltages for a Three-Phase Grid-Connected Inverter with an LCL Filter**
Weiwei Li, Donghua Pan, Xinbo Ruan and Xuehua Wang, Huazhong University of Science and Technology, China

10:45 am • **Optimal Size and Location of Distributed Generation Unit for Voltage Stability Enhancement**
Mamdouh Abdel-Akher, Abdel-Fatah Ali, Ahmed Eid and Hassan El-Kishky, South Valley University, Egypt; University of Texas at Tyler, USA

11:10 am • **A Time-Coordination Approach for Compensating Pulse-Load Using Flywheel**
Hamed Afshari, Mahdi Saghaleini, Brian Hadley, Behrooz Mirafzal and Chris Edrington, Florida International University, USA; Florida State University, USA

**S5  DC-DC Converters: Topologies I**

Remington
Chairs: Gerry Moschopoulos, University of Western Ontario, Canada, and Luca Corradini, University of Colorado at Boulder, USA

10:20 am • **Design and Analysis for ZVS Forward-Flyback DC-DC Converter**
Frank Chen, Haibing Hu, Khalid Rustom, John Shen and Issa Batarseh, University of Central Florida, USA; Petrasolar, USA

10:45 am • **Interleaved Power Converter with Current Ripple Cancelation at a Selectable Duty Cycle**
Julio Rosas-Caro, Jesus Valdez-Resendiz, Jonathan Mayo-Maldonado, Ruben Salas-Cabrera, Juan Ramirez-Aredondo and Joel Salome-Baylon, Madero City Technological Institute, Mexico; CINVESTAV Unidad Guadalajara, Mexico

11:10 am • **Comparison of Bi-Directional Isolated Full-bridge Converters with Combinations of Active and Passive Snubbers**
Tsai-Fu Wu, Jeng-Gung Yang, Chia-Ling Kuo, Kun-Han Sun and Yu-Kai Chen, EPARC, Natl. Chung Cheng University, Taiwan; IDEAL, National Formosa University, Taiwan
11:35 am • Study and Implementation of a Novel Bi-Directional DC-DC Converter with High Conversion Ratio
Wei-Chih Liao, Tsorng-Juu Liang, Hsiu-Hao Liang, Hsuheh-Ko Liao, Lung-Sheng Yang, Kai-Cheung Juang and Jiann-Fuh Chen, National Cheng Kung University, Taiwan; Far East University, Taiwan; Information and Communications Research Laboratory, Taiwan

S6 Induction Machines
Cowboy Artists
Chairs: Emmanuel Agamloh, Advanced Energy Corporation, USA and Andrea Cavagnino, Politecnico di Torino, Italy

10:20 am • Stray Losses in the Stator and Rotor of Induction Machines with Sinusoidal Supplies
Omar Laldin, Purdue University, USA

10:45 am • Harmonic Loss and Torque Analysis of High Speed Induction Motors
Katsumi Yamazaki, Akihiro Suzuki, Motomichi Ohto and Teruyuki Takakura, Chiba Institute of Technology, Japan; Yaskawa Electric Corporation, Japan

11:10 am • Analysis and Modeling of Rotor Slot Enclosure Effects in High Speed Induction Motors
Aldo Boglietti, Radu Bojoi, Andrea Cavagnino, Paolo Guglielmi and Alessio Miotto, Politecnico di Torino, Italy; Politecnico di Torino, Italy

11:35 am • Measurement Proven Analytical and Numerical Models for Calculation of the Teeth Flux Pulsations and Harmonic Torques of Skewed Squirrel Cage Standard Induction Machines
Thomas Knopik and Andreas Binder, Darmstadt University of Technology, Germany

S7 Multilevel Converters I
Russell
Chair: Jinjun Liu, Xi An Jiaotong University, China

10:20 am • Virtual-Vector-Based Space Vector Pulse Width Modulation of the DC-AC Multilevel-Clamped Multilevel Converter (MLC2)
Pedro Rodriguez, Raul S. Munoz-Aguilar, Sergio Busquets-Monge, Maria D. Bellar and Frede Blaabjerg, Universitat Politècnica de Catalunya, Spain; Universidad do Estado do Rio de Janeiro, Brazil; Aalborg University, Denmark

10:45 am • A New Voltage-Balancing Controller in Cascaded Multilevel Converters
Xu She, Alex Huang, Gangyao Wang, Tiefu Zhao, Fei Wang and Wenxi Yao, North Carolina State University, USA; Eaton Corporation, USA; Zhejiang University, China

11:10 am • Multilevel Cascade H-Bridge Inverter DC Voltage Estimation Through Output Voltage Sensing
Faete Filho, Leon Tolbert and Burak Ozpineci, The University of Tennessee, USA; Oak Ridge National Laboratory, USA

11:35 am • Experimental Verification of Loss Reduction in Diode-Clamped Multilevel Inverters
Yukihiro Sato and Takumi Ito, Chiba University, Japan

S8 MPPT Algorithms for Solar PV Systems
Sundance
Chairs: Adel Nasiri, University of Wisconsin, Milwaukee, USA, and Jian Sun, Rensselaer Polytechnic Institute, USA

10:20 am • Integrated CMOS DC-DC Converter with Digital Maximum Power Point Tracking for a Portable Thermophotovoltaic Power Generator
Robert Pilawa-Podgurski, Wei Li, Ivan Celanovic and David Perreault, MIT, USA

10:45 am • Study and Evaluation of Load Current Based MPPT Control for PV Solar Systems
Yunccong Jiang and Jaber Abu Qahouq, The University of Alabama, USA

11:10 am • Improved MPPT Short-Circuit Current Method by a Fuzzy Short-Circuit Current Estimator
Nelson Diaz, Adriana Luna and Oscar Duarte, Universidad Distrital F.J.C., Colombia; Universidad Libre, Colombia; Universidad Nacional, Colombia

11:35 am • An Optimal Control Method for Grid-Connected Photovoltaic Micro-Inverter to Improve the Efficiency at Light-Load Condition
Zhe Zhang, Chen Min, Gao Mingzhi, Qiong Mo and Zhaoming Qian, Zhejiang University, China

S9 Indirect AC-AC Converters I
Borein
Chairs: Lixiang Wei, Rockwell Automation, USA, and Vietson Nguyen, Hamilton Sundstrand, United Technologies, USA

10:20 am • Modulation of Indirect Matrix Converter Under Unbalanced Source Voltage Condition
Vishal Vekhande, B. B. Pimple and B. G. Fernandes, Indian Institute of Technology Bombay, India

10:45 am • An Investigation of High Efficiency Operation Conditions for a Three-Port Energy Source System Using an Indirect Matrix Converter
Koji Kato and Jun-ichi Itoh, Sanken Electric CO, LTD., Japan; Nagaoka University of Technology, Japan

11:10 am • A Compact Versatile Matrix Converter to Integrate Various Energy Resources to Utility Network
Xiong Liu, Poh Chiang Loh, Peng Wang and Frede Blaabjerg, EEE, Nanyang Technological University, Singapore; Aalborg University, Denmark

11:35 am • Hybrid PWM Control for Z-Source Matrix Converter
Qin Lei, Baoming Ge and Fangzheng Peng, Michigan State University, USA

S10 Transportation Applications: General
Phoenix
Chair: Gui-Jia Su, Oak Ridge National Lab, USA

10:20 am • Development of a Drive Cycle Based Evaluation Method for Variable Voltage Converter in Vehicle Electrification Applications
Lihua Chen, Liwen Xu, Nagaraj Narayanachar and Shahram Zarei, Ford Motor Company, USA
SP1 Special Session: Wind Energy Conversion

Regency ABCD
Chair: Dan Ionel, Vestas Technology R&D Americas, Inc.

10:20 am • Power Electronics Converters for Wind Turbine Systems
Freda Blaabjerg, Marco Liserre and Ke Ma, Aalborg University, Denmark

10:45 am • A Commercial Perspective on Wind Technology Development Needs
Juan M. de Bedout, GE Global Research Center, USA

11:00 am • Short Term Energy Storage in Wind Power Generation
Eduard Muljadi, National Renewable Energy Laboratory (NREL), USA

11:30 am • Wind Power Plant Grid Connection — Challenges, Opportunities and Solutions Ahead
Philip Carne Kjaer, Vestas Wind Systems A/S, Denmark

Monday, September 19
1:20 pm – 3:00 pm

S11 Wind Energy: Generators and Drives

Ellis West
Chairs: Yao Duan, Vestas Technology R&D Americas, Inc., USA, and Hamid Toliyat, Texas A and M University, USA

1:20 pm • Quasi-Z Source Inverter Based PMSG Wind Power Generation System
Yushan Liu, Baoming Ge, Fang Zheng Peng, Abu Rub Haitham and Anibal T de Almeida, Beijing Jiaotong University, China; Michigan State University, USA; Texas A and M University at Qatar, Qatar; University of Coimbra, Portugal

1:45 pm • Supercapacitor Energy Storage for Wind Energy Integration
Eunice Naswali, Chianne Alexander, Hai-Yue Han, David Naviux, Alexander Bistrika, von Jouanne Annette, Yokochi Alexandre and Brekken Ted, Oregon State University, USA

2:10 pm • Mechanical Stress Reduction in Variable Speed Wind Turbine Drivetrains
Goran Mandic, Adel Nasiri, Eduard Muljadi, Ehsan Ghotbi and Francisco Oyague, UW-Milwaukee, USA; National Renewable Energy Lab, USA; Boulder Wind Power, USA

2:35 pm • Bearing Fault Detection for Direct-Drive Wind Turbines via Stator Current Spectrum Analysis
Xiang Gong and Wei Qiao, University of Nebraska-Lincoln, USA

S12 Power Semiconductors: Packaging

Curtis
Chair: Kai Ngo, Virginia Tech, USA

1:20 pm • Thermomechanical Reliability Investigation of Large Temperature Excursions in Power Electronics Packages
Puqi Ning, Fred Wang and Khai Ngo, Oak Ridge National Lab, USA; CPES of Virginia Tech, USA

1:45 pm • Design of Power Converters on 3D-MIDs for Driving Three-Dimensional LED-Lamps
Werner Thomas and Johannes Pforr, University of Applied Sciences Ingolstadt, Germany

2:10 pm • A Novel Hybrid Packaging Structure for High-Temperature SiC Power Modules
Ruxi Wang, Zheng Chen, Dushan Boroyevich, Yiyin Yao and Li Jiang, Virginia Tech, CPES, USA

2:35 pm • In-Situ Measurement of Wirebond Strain in Electrically Active Power Semiconductors
Seth Avery and Robert Lorenz, University of Wisconsin-Madison, USA

S13 Direct Torque Control

Cassidy
Chair: Radu Bojoi, Politecnico di Torino, Italy

1:20 pm • Sensorless Direct Flux and Torque Control for Direct Drive Washing Machine Applications
Justin Rado Bojoi, Biao He, Fabio Rosa and Fernando Pegoraro, Politecnico di Torino, Italy; Whirlpool Corporation, USA

1:45 pm • Model Predictive Direct Torque Control: Derivation and Analysis of the Explicit Control Law
Tobias Geyer, The University of Auckland, New Zealand

2:10 pm • Model Predictive Direct Torque Control of a Five-Level ANPC Converter Drive System
Tobias Geyer and Silvia Mastellone, The University of Auckland, New Zealand; ABB Corporate Research, Switzerland

2:35 pm • Deadbeat-Direct Torque and Flux Control for Interior PM Synchronous Motors Operating at Voltage and Current Limits
Jul-Ki Seok, Chan-Hee Choi and Robert Lorenz, YeungNam University, Republic of Korea; UW-Madison, USA

S14 Distributed Grid Controls

Ellis East
Chairs: Jian Sun, Rensselaer Polytechnic Institute, USA, and Fancisco Canales, ABB Corporate Research, Switzerland

1:20 pm • Optimized Pole and Zero Placement with State Observer for LCL-Type Grid-Connected Inverter
Mingyu Xue, Yu Zhang, Fangrui Liu, Yong Kang and Yongxian Yi, Huazhong University of Science and Technology, China; Huazhong University of Science and Technology, China

1:45 pm • Smart-Grid Technologies and Progress in Europe and the United States
Marcelo Simoes, Robin Roche, Elias Kyriakides, Abdellatif Miraoui, Benjamin Blunier, Kerry McBee, Siddharth Suryanarayanan, Phuong Nguyen and Paulo Ribeiro, Colorado School of Mines, USA; University of Technology of Belfort-Montbeliard, France; University of Cyprus, Cyprus; Colorado State University, USA; Technische Universiteit Eindhoven, Netherlands
S15 DC-DC Converters: Controls I

Remington
Chairs: Jaber Abu-Qahouq, University of Alabama
Tuscaloosa, USA, and Jon Cronk, Power Products, USA

S16 Thermal Analysis and Losses I

Cowboy Artists
Chairs: Mircea Popescu, Motor Design Ltd, UK, and Aldo Bogiotti, Politecnico di Torino, Italy

2:10 pm • Enhanced Power Calculator for Droop Control in Single-Phase Systems
Gustavo M. S. Azevedo, Marcelo C. Cavalcanti, Fabricio Bradascia, Pedro Rodriguez, Joan Rocabet and Francisco A. S. Neves, Federal University of Pernambuco, Brazil; Technical University of Catalonia, Spain

1:20 pm • A Practical Control Strategy to Improve Unloading Transient Response Performance for Buck Converters
Liang Jia, Zhiyuan Hu, Yan-fei Liu and Paresh C. Sen, Queen’s University, Canada

1:45 pm • A Small Signal Model for Average Current Mode Control Based On Describing Function Approach
Feng Yu, Fred C. Lee and Paolo Mattavelli, CPES, Virginia Tech, USA

2:10 pm • A Novel Control Method for Light-Loaded Multiphase Boost Converter with Voltage Multiplier Used as a Front-End of a Grid-Connected Fuel-Cell Generation
Xiaotian Wu, Longlong Zhang, Guoqiao Shen, Dehong Xu and Adrian Ioinovici, Zhejiang University, China; Holon Institute of Technology, Israel

2:35 pm • Asymmetrical Bridge Double-Input DC-DC Converters Adopting Pulsating Voltage Source Cells
Fuxin Liu, Yunyu Mao, Zhicheng Wang and Xinbo Ruan, Nanjing University of Aeronautics and Astronautics, China

S17 Voltage Source Inverters

Russell
Chairs: Jin Wang, Ohio State University, USA, and Yasuyuki Nishida, Chiba Institute of Technology, Japan

1:20 pm • Inter-Phase Interleaving for Three-Phase Voltage Source Converter Operated with Low Non-Triple Carrier Ratio
Di Zhang, Fred Wang, Rolando Burgos, Xuning Zhang and Dushan Boroyevich, GE Global Research Center, USA; University of Tennessee and ONR, USA; ABB Corporate Research Center Raleigh, USA; Center for Power Electronics System, USA

1:45 pm • Model Predictive-Based Voltage Regulation of an Islanded Distributed Generation Unit
Behrooz Bahrami and Alfred Rufer, Swiss Federal Institute of Technology, Lausanne, Switzerland

2:10 pm • Reduction of Voltage Harmonics for Parallel-Operated Inverters
Qing-Chang Zhong, Frede Blaabjerg, Josep M. Guerrero and Tomas Hornik, Loughborough University, UK; Aalborg University, Denmark; Universitat Politecnica de Catalunya, Spain; University of Liverpool, UK

2:35 pm • Generalized Closed-Loop Control (GCC) Schemes with Embedded Virtual Impedances for Voltage Source Converters
Jinwei He and Yun Wei Li, University of Alberta, Canada

S18 DC-DC Converters for Solar PV Systems I

Sundance
Chairs: Ahmed Elasser, GE Global Research Center, USA, and Dehong Xu, Zhejiang University, China

1:20 pm • Current-Fed Quadratic Full-Bridge Buck Converter for PV Systems Interfacing: Dynamic Characterization
Juha Huusari and Teuvo Suntio, Tampere University of Technology, Finland

1:45 pm • Photovoltaic Microinverter using Single-Stage Isolated High-Frequency Link Series Resonant Topology
Harsharan Krishnaswami, University of Texas at San Antonio, USA

2:10 pm • Three-Port Flyback-Type Micro-Inverter with an Active Power Decoupling Circuit
Yaow-Ming Chen and Chien-Yao Liao, National Taiwan University, Taiwan

S19 Indirect AC-AC Converters II

Borein
Chairs: Lixiang Wei, Rockwell Automation, USA, and Vietson Nguyen, Hamilton Sundstrand, United Technologies, USA

1:20 pm • Active AC Snubber for Direct AC-AC Power Converters
Anish Prasai and Deepak Divan, Georgia Institute of Technology, USA

1:45 pm • Comparison of Boost Chopper and Active Buffer as Single-to Three-Phase Converter
Ohnuma Yoshiya and Itoh Jun-ichi, Nagaoka University of Technology, Japan

2:10 pm • Control of Single-Phase to Three-Phase Matrix Converters for PM Synchronous Motor Drive
Takaharu Takahata and Tomomi Yamashita, Nagoya Institute of Technology, Japan
2:35 pm • Improvement in the Control Range of Matrix Converters  
Luca Zarrì, Olorunfemi Ojo and Michele Mengoni, University of Bologna, Italy; Tennessee Tech University, USA

S20 Transportation Applications: Voltage Converters  
Regency CD  
Chair: Anand Sathyan, Chrysler LLC, USA

1:20 pm • Optimal Design of Multilevel Modular Switched-Capacitor DC-DC Converter  
Dong Cao, Jiang Shuai and Fang Zheng Peng, Michigan State University, USA

1:45 pm • A Double-Wing Multilevel Modular Capacitor-Clamped DC-DC Converter with Reduced Capacitor Voltage Stress  
Dong Cao, Xiaoan Yu, Xi Li, Wei Qian and Fang Zheng Peng, Michigan State University, USA

2:10 pm • Review of High Power Isolated Bi-Directional DC-DC Converters for PHEV/EV DC Charging Infrastructure  
Yu Du, Srdjan Lukic, Boris Jacobson and Alex Huang, FREEDM Systems Center, North Carolina State University, USA; Raytheon Company, USA

SP2 Special Session: Power Supply on Chip  
Regency AB  
Chair: Seth R. Sanders, University of California, Berkeley, USA

1:20 pm • Single Chip Power Converters: Products and Manufacturing Considerations  
Ashraf Lotfi, Empirion, USA

1:45 pm • Developing Single-Chip Offline LED Drivers  
Vivek Mehrotra and Jian Sun, Teledyne Scientific Company, LLC, USA; Rensselaer Polytechnic Institute, USA

2:10 pm • Nanosctructured Scalable Thick-Film Magnetics  
S. Prabhakaran, GE Global Research, USA

2:35 pm • Voltage Scalable Switched Capacitor DC-DC Converters for On-Chip Applications  
Yogesh K. Ramadass and Anantha P. Chandrakasan, Texas Instruments, USA; Massachusetts Institute of Technology, USA

Monday, September 19  
3:20 pm – 5:00 pm

S21 Wind Energy: Power Electronic Converters  
Ellis West  
Chairs: Bogi Bech Jensen, Technical University of Denmark, Denmark, and Ted Breken, Oregon State University, USA

3:20 pm • Three-Level Boost Converter Based Medium Voltage Megawatt PMSG Wind Energy Conversion Systems  
Venkata Yaramasu and Bin Wu, Ryerson University, Canada

3:45 pm • Electro-Thermal Modeling for Junction Temperature Cycling-Based Lifetime Prediction of a Press-Pack IGBT 3L-NPC-VSC Applied to Large Wind Turbines  
Osman S. Senturk, Lars Helle, Stig Munk-Nielsen, Pedro Rodriguez and Remus Teodorescu, Aalborg University, Denmark; Vestas Wind Systems, Denmark; Universitat Politecnica de Catalunya, Spain

4:10 pm • Power Density Investigation on the Press-Pack IGBT 3L-HB-VSCs Applied to Large Wind Turbines  
Osman S. Senturk, Lars Helle, Stig Munk-Nielsen, Pedro Rodriguez and Remus Teodorescu, Aalborg University, Denmark; Vestas Wind Systems, Denmark; Universitat Politecnica de Catalunya, Spain

4:35 pm • A Comparison of Medium Voltage High Power DC-DC Converters with High Step-Up Conversion Ratio for Offshore Wind Energy Systems  
Wu Chen, Alex Huang, Jan Svensson, Jun Li, Zhenyuang Wang and Srdjan Lukic, North Carolina State University, USA; ABB, Sweden; ABB, USA

S22 Magnetic Component Design and Application  
Curtis  
Chair: Braham Ferriera, Delft University of Technology, Netherlands

3:20 pm • Resonant Converter Transformer Design and Optimization  
Garet Gamache and Charles Sullivan, Thayer School of Engineering at Dartmouth, USA

3:45 pm • Novel CCTT Core Integrated Magnetic for High-Power DC-DC Converters  
Kevin Hartnett, Marek Rylko, John Hayes and Michael Egan, University College Cork, Ireland

4:10 pm • Iron Loss Evaluation of Filter Inductor Used in PWM Inverters  
Keisuke Kakazu, Toshihisa Shimizu, Hiroaki Matsumori, Koushi Takano and Hitoshi Ishii, Tokyo Metropolitan University, Japan; Iwatsu Test Instruments Corporation, Japan

4:35 pm • Development and Evaluation of Single Sided Flux Couplers for Contactless Electric Vehicle Charging  
Mickel Budha, Grant Covic, John Boys and Chang-Yu Huang, The University of Auckland, New Zealand

S23 Sensorless Control Issues  
Cassidy  
Chair: Giuseppe Scarcella, University of Catania, Italy

3:20 pm • Secondary Resistive Losses with High-Frequency Injection-Based Self-Sensing in IPM Machines  
Natee Limswan, Takashi Kato, Chen-Yen Yu, Jun Tamura, David Reigosa, Kan Akatsu and Robert Lorenz, University of Wisconsin - Madison, USA; Nissan Motor Co., Ltd., Japan; University of Oviedo, Spain; Shibaura Institute of Technology, Japan

3:45 pm • Analysis of Iron and Magnet Losses in Surface Permanent Magnet Machines Resulting from Injection-Based Self-Sensing Position Estimation  
Shih-Chin Yang and Robert Lorenz, University of Wisconsin-Madison, USA

4:10 pm • The Influence of Magnetic Hysteresis on HF Injection Based Inductance Calculation  
Julien Cordier, Peter Landsmann and Ralph Kennel, Technische Universitaet Muenchen, Germany

4:35 pm • Saliency Based Sensorless Control of Induction Machines at Frequency Overlap of Signal Components  
Mohamed Metwally and Thomas Wolbank, Menoufia University, Egypt; Vienna University of Technology, Austria
Technical Program Schedule

S24 Microgrid Controls

Ellis East
Chairs: Yilmaz Sozer, University of Akron, USA, and Alireza Bakhshai, Queen's University, Canada

3:20 pm • Autonomous Control of Interlinking Converters in Hybrid AC-DC Microgrids with Energy Storages
Poh Chiang Loh, Ding Li and Frede Blaabjerg, Nanyang Technological University, Singapore; Aalborg University, Czech Republic

3:45 pm • Comparison of PV Inverter Controller Configurations for CERTS Microgrid Applications
Micah Erickson, Robert Lasserter and Thomas Jahns, University of Wisconsin - Madison, USA

4:10 pm • Phase Locked Loop Control of Inverters in a Microgrid
Matthew Surprenant, Ian Hiskens and Ian Venkataraman, University of Wisconsin-Madison, USA; University of Michigan, USA

4:35 pm • Enabling High Droop Gain for Improvement of Reactive Power Sharing Accuracy in an Electronically-Interfaced Autonomous Microgrid
Abou Taleb Haddadi, Ali Shojaei and Benoit Boulet, McGill University, Canada

S25 DC-DC Converters: Modeling

Remington
Chairs: Jian Sun, RPI, USA, and Oscar Garcia, Universidad Politécnica de Madrid, Spain

3:20 pm • A New STS Model DC-DC Converter
Fujio Kurokawa, Junya Sakemi, Akihiro Yamanishi and Hiroyuki Osuga, Nagasaki University, Japan; Mitsubishi Electric Corporation, Japan

3:45 pm • Dynamic Modeling of a ZETA Converter in DCM Applied to Low Power Renewable Sources
Renan Caron Viero and Fernando Soares Dos Reis, PUCRS, Brazil

4:10 pm • Simple Large-Signal Model Based on Gyrator for System Level Analysis
Du Weijing, Zhang Yang, Zhang Junming and Qian Zhaoming, Zhejiang University, China

4:35 pm • Modeling of Multiple-Input DC-DC Converters Considering Input-Coupling Effects
Ruichen Zhao, Sheng-Yang Yu and Alexis Kwasinski, The University of Texas at Austin, USA

S26 Thermal Analysis and Losses II

Cowboy Artists
Chairs: Mircea Popescu, Motor Design Ltd, UK, and Andy Knight, University of Alberta, Canada

3:20 pm • Advanced Testing and Modeling of Magnetic Materials Including a New Method of Core Loss Separation for Electrical Machines
Maged Ibrahim and Pragasen Pillay, Concordia University, Canada

3:45 pm • A Nonintrusive Thermal Monitoring Method for Closed-Loop Drive-Fed
Siwei Cheng, Yi Du, Jose Restrepo, Pinjia Zhang and Thomas G. Habetler, Georgia Institute of Technology, USA; Universidad Simon Bolivar, Venezuela; GE Global Research, USA

4:10 pm • Loss Measurement of a 40 kW High-Speed Bearingless PM Synchronous Motor
Gabriel Munteanu, Andreas Binder and Tobias Schneider, Darmstadt University of Technology, Germany; Bosch GmbH, Germany

4:35 pm • Induction Motor Rotor Temperature Estimation Using Superheterodyne Receivers
Zhi Gao, Roy Colby and Larry Turner, Schneider Electric, USA

S27 Inverter Control Techniques

Russell
Chairs: Paolo Mattavelli, Virginia Tech, USA, and Zheng Yu Lv, Zhejiang University, China

3:20 pm • Stability Analysis of Droop Control for Inverter Using Dynamic Phasors Method
Xianwei Wang, Fang Zhuo, Haiping Guo, Liang Meng, Meijuan Yang and Jinjun Liu, Xi’an Jiaotong University, China

3:45 pm • A Grid Synchronization Method for Droop Controlled Distributed Energy Resources Converters
Chia-Tse Lee, Rui-Pei Jiang and Po-Tai Cheng, Department of Electrical Engineering, NTHU, Taiwan

4:10 pm • High Performance AC Current Regulation for Low Pulse Ratio Inverters
Brendan McGrath, Stewart Parker and Grahame Holmes, RMIT University, Australia

4:35 pm • Swinging Bus Inverters: New Requirements in Renewable Power and the Natural Switching Surface
Martin Ordoniez, Simon Fraser University, Canada

S28 DC-DC Converters for Solar PV Systems II

Sundance
Chairs: David A. Torrey, Advanced Energy Conversion, USA, and Adel Nasiri, University of Wisconsin-Milwaukee, USA

3:20 pm • DC-DC Converter Topology Assessment for Large Scale Distributed Photovoltaic Plant Architectures
Mohammed Agamy, Maja Harfman-Todorovic, Ahmed Elasser, Juan Sabate, Robert Steigerwald, Yan Jiang and Essakiappan Somasundaram, GE Global Research Center, USA

3:45 pm • Research on Output Current of Interleaved-Flyback in Boundary Conduction Mode for Photovoltaic AC Module Application
Mingzhi Gao, Min Chen, Qiong Mo, Yuhao Luo and Zhaoming Qian, Zhejiang University, China; Altennergy Power System Inc., China

4:10 pm • Power Control in Three-Phase Grid-Connected Current-Source Boost Inverter
Mahdi Saghaieini and Behrooz Mirafzal, Florida International University, USA; Kansas State University, USA

4:35 pm • A Novel Primary-Side-Assisted Soft-Switching and Fault-Tolerance of a High-Frequency-Link Inverter for Renewable-Energy Systems
Rahnamaee Arash, Sudip Mazumder and Tajfar Alirea, University of Illinois, Chicago, USA
**S29  Modeling and Control of AC-AC Converters**

*Boorein*

*Chairs: Lixiang Wei, Rockwell Automation, USA, and Vietson Nguyen, Hamilton Sundstrand, United Technologies, USA*

*3:20 pm* • Un-Terminated, Low-Frequency Terminal-Behavioral d-q Model of Three-Phase Converters

Igor Cvetkovic, Marko Jaksic, Dushan Boroyevich, Paolo Mattavelli, Fred C. Lee, Zhiyu Shen, Sara Ahmed and Dong Dong, CPES - Virginia Tech, USA

*3:45 pm* • A Four Legs Matrix Converter Based Ground Power Unit with Selective Harmonic Control

Wesam Rohouma, Lee Empiringham, Pericle Zanchetta and Patrick Wheeler, University of Nottingham, UK

*4:10 pm* • Study of the Bi-Directional Power Flow in Back-to-Back Converters by Using Linear and Nonlinear Control Strategies

Janeth Alcala, Victor Cardenas, Adrian Ramirez and Jorge Gudino, Universidad Autonoma de San Luis Potosi, Mexico; Universidad de Colima, Mexico

*4:35 pm* • An Integrated Filter and Controller Design for Direct Matrix Converter

Anindya Dasgupta and Parthasarathi Sensarma, Indian Institute of Technology, Kanpur, India

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**S30  Transportation Applications: Infrastructures**

*Regency CD*

*Chair: Srdjan Lukic, North Carolina State University, USA*

*3:20 pm* • A Study of Sectional Tracks in Roadway Inductive Power Transfer System

Wei Zhang, Siu-Chung Wong, Chi K. Tse and Qianhong Chen, The Hong Kong Polytechnic University, Hong Kong; Nanjing University of Aeronautics and Astronautics, China

*3:45 pm* • Cost Benefits and Vehicle-to-Grid Regulation Services of Unidirectional Charging of Electric Vehicles

Mcdavis Fasugba and Philip Krein, University of Illinois at Urbana-Champaign, USA

*4:10 pm* • Mitigating Distribution Transformer Lifetime Degradation Caused by Grid-Enabled Vehicle (GEV) Charging

Rohit Moghe, Frank Kreikebaum, Jorge Hernandez, Rajendra P. Kandula and Deepak Divan, Georgia Institute of Technology, USA

*4:35 pm* • A Study on Receiver Circuit Topology of a Cordless Battery Charger for Electric Vehicles

Kraisorn Throngnuchchai, Toshihiro Kai and Yuusuke Minagawa, Nissan Motor Co., Ltd., Japan

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**SP3  Special Session: PEV Infrastructure and Technologies**

*Regency AB*

*Chair: Theodore P. Bohn, Argonne National Laboratories, USA*

*3:20 pm* • The EV Project and EV Charging Infrastructure Challenges

Kevin Morrow, ETEC, USA

*3:45 pm* • Technologies for Bi-Directional EV Battery Charging

Thomas Jahns, University of Wisconsin-Madison, USA

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**Tuesday, September 20** 10:30 am – 12:00 pm

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**Plenary Poster Session: Poster Session I**

Phoenix Convention Center West Hall 1

*Chairs: Avoki Omekanda, General Motors, USA, and Rolando Burgos, ABB, USA*

**P101** • Assessment of Inertial Potential of Variable-Speed Wind Turbines

Samer EL Itani and Geza Joos, McGill University, Canada

**P102** • Neural MPPT of Variable Pitch Wind Generators with Induction Machines in a Wide Wind Speed Range

Maurizio Cirrincione, Marcello Pucci and Gianpalo Vitale, UTBM, France; ISSIA-CNR, Italy

**P103** • A Generalized Method for Wind Inverter Control Under Unbalanced Operating Conditions

Shuang Wu and Ana Stankovic, Cleveland State University, USA

**P104** • Megawatt Wind Energy Conversion System with Diode Rectifier and Multilevel Current Source Inverter

Jiacheng Wang, Jingya Dai, Bin Wu, Dewei Xu and Navid Zargari, Ryerson University, Canada; Rockwell Automation, Canada

**P105** • Diagnosis of the Open-Circuit Fault in Three-Parallel Voltage-Source Converter for a High-Power Wind Turbine

Youngjong Ko, Hae-Gwang Jeong, Dong-Choon Lee and Jang-Mak Kim, Ajou University, Republic of Korea; Yeungnam University, Republic of Korea; Pusan National University, Republic of Korea

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Hani Alhamed Aldwaihi and Emmanuelle Delaleau, ISEN-Brest, France

**P107** • Self-Starting DC-DC Boost Converter for Low-Power and Low-Voltage Microbial Electric Generators

Nicolas Degrenne, Bruno Allard, Francois Buret, Zaoui Abderrahime, Florent Morel, Adami Salah-Eddine and Denis Labrousse, Universite de Lyon, Laboratoire Ampere, France

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Lars Eitzen, Christian Graf and Juergen Maas, Hochschule Ostwestfalen-Lippe, Germany

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Ali Tofighi and Mohsen Kalantar, Iran University of Science and Technology, Iran

**P110** • Comparison of Cascaded H-Bridge and Modular Multilevel Converters for BESS Application

Lennart Baruschka and Axel Mertens, Leibniz University of Hannover, Germany

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Zijun Luo, Mary Kaye, Chris Diduch and Luchien Chang, University of New Brunswick, Canada
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Ali Esmaili and Adel Nasiri, University of Wisconsin-Milwaukee, USA

P113 • A New Architecture for Battery Charge Equalization
Bo Dong and Han Yehui, Tsinghua University, China; University of Wisconsin-Madison, USA

P114 • Optimal Transient Control of Microgrids Using a Game Theoretic Approach
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Nishantha Ekneligoda and Wayne Weaver, Michigan Technological University, USA

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Glenn Platt, David Cornforth, Tim Moore and Adam Berry, CSIRO Energy Technology, Australia

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Sunjae Yoon, Hyeongmin Oh and Seowan Choi, LS Industrial System, Republic of Korea; Seoul Tech, Republic of Korea

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Luis Arnedo, Suman Dwari, Vladimir Blasko and Albert Kroeber, United Technologies Research Center, USA; RWTH Aachen University, Germany

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Alex Brissette, Andy Hoke, Dragan Maksimovic and Annabelle Pratt, University of Colorado, USA; Intel Labs, USA

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Akshay Kumar Rathore, National University of Singapore, Singapore

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Nishida Katsumi, Nakaoka Mutsuo and Ahmed Tarek, Ube National College of Technology, Japan; Kyungnam University, Japan; Assuit University, Egypt

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Lari Nousiainen and Teuvo Suntio, Tampere University of Technology, Finland

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P130 • An Effective PV Power Generation Control System Using Quasi-Z Source Inverter with Battery
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Byeong-Mun Song, Yonggrok Kim, Hanju Cha and Hakju Lee, Baylor University, USA; Chungnam National University, Republic of Korea; Korea Electric Power Research Institute, Republic of Korea

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Christopher Lohmeier, Jianwu Zeng, Wei Qiao, Liyan Qu and Jerry Hudgins, University of Nebraska-Lincoln, USA

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Shimon Limor and Doron Shmilovitz, PowerSines LTD., Israel; Tel Aviv University, Israel

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Males Tomlinson, Dewald Abrie and Toit Mouton, Universiteit Stellenbosch, South Africa

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Yi Fei Wang and Yun Wei Li, University of Alberta, Canada

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Zhong Chen, Miao Chen, Yingpeng Luo and Lei Shi, Nanjing University of Aeronautics and Astronautics, China
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Yi Hao, Zhuo Fang, Sun Xinxin and Liu Jinjun, Xi’an Jiaotong University, China

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Hamid Karshenas, Iman Aminoroaya, Alireza Bakhsai and Praveen Jain, Queen’s University, Canada; Isfahan University of Technology, Iran

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Jose Alvarez, Rodolfo Echarvarria and Armando Flores, Universidad Politecnica de Victoria, Mexico

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Amgad El-Deib, Francis Dawson and Georges Zissis, University of Toronto, Canada; Universite de Toulouse, France

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P146 • A Cascaded Shunt Active Power Filter with High Performance for Aircraft Electric Power System
Yingpeng Luo, Zhong Chen, Miao Chen and Jianxia Li, Nanjing University of Aeronautics and Astronautics, China

P147 • Grid Synchronization PLL Robust to Frequency Variation, Unbalanced and Distorted Voltage
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Ahmad Mousavi, Pritam Das, Majid Pahlavaninezhad and Praveen Jain, University of Western Ontario, Canada; Queen’s University, Canada

P152 • Adaptive Current Source Drivers for Efficiency Optimization of High Frequency Synchronous Buck Converters
Zhiliang Zhang, Pengcheng Xu, Yan-Fei Liu and Paresh C. Sen, Nanjing University of Aeronautics and Astronautics, China; Queen’s University, Canada

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Sriram Yarlagadda, Tom Hartley and Iqbal Husain, The University of Akron, USA

P154 • Adaptive Current Source Drivers to Achieve Efficiency Improvement in Wide Load Range
Zhiliang Zhang, Wei Cai and Pengcheng Xu, Nanjing University of Aeronautics and Astronautics, China

P155 • A Novel Feedback-Clamped Magnetically Coupled Bi-Directional Optimal Battery Charging System
Rajeev Kumar Singh and Santanu Kumar Mishra, Indian Institute of Technology Kanpur, India

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Dejana Cucak, Miroslav Vasic, Oscar Garcia, Jesus Oliver and Pedro Alou, Universidad Politecnica de Madrid, Spain

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Xavier Branca, Bruno Allard, David Chesneau and Xuefeng Lin-shi, IEEE, France; STEricsson, France

P159 • A 10 MHz Mixed-Signal CPM Controlled DC-DC Converter IC with Novel Gate Swing Circuit and Instantaneous Efficiency Optimization
Amir Parayandehe, Behzad Mahdvikhah, Sm Ahsanuzzaman, Aleksandar Radic and Aleksandar Prodic, University of Toronto, Canada

P160 • A Small Signal Model for V2 Control with Composite Output Capacitors Based On Describing Function Approach
Feng Yu, Fred C. Lee and Paolo Mattavelli, CPES, Virginia Tech, USA

P161 • A Novel Ripple-Based Constant On-Time Control with Virtual Inductance and Offset Cancellation for DC Power Converters
Yu-Cheng Lin, Ching-Jan Chen, Dan Chen and Brian Wang, National Taiwan University, Taiwan; Richtek Technology Corporation, Taiwan

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Victor Cheung and Henry Chung, City University of Hong Kong, Hong Kong

P163 • Transient Mitigation of DC-DC Converters Using an Auxiliary Switching Circuit
Zhenyu Shan, Siew-Chong Tan and Chi K. Tse, Hong Kong Polytechnic University, Hong Kong; EPGC, ICES, A*STAR, Singapore

P164 • Energy and Impedance State Modeling of Power Electronic Converters
Gregory Vosters and Wayne Weaver, Michigan Technological University, USA

P165 • DC-DC Boost Converter with Network Model for Photovoltaic System
Saichol Chudjarueen, Juan Jimenez, Sachi Jayasuriya, Chika Nwankpa, Karen Miu and Anawach Sangswang, Drexel University and KMUTT (Thailand), Thailand; Drexel University, USA; King Mongkut’s University of Technology Thonburi, Thailand
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Jonathan Mayo-Maldonado, Julio Rosas-Caro, Jesus Valdez-Resendiz, Ruben Salas-Cabra, Eduardo Nacu Salas-Cabra and Hermenegildo Cisneros-Villegas, Instituto Tecnologico de Ciudad Madero, Mexico

P168 • A Zero-Current-Switching Multilevel Switched Capacitor DC-DC Converter
Matthew Gebben, Jorge G. Cintron-Rivera, Wei Qian, Dong Cao, Xuejun Pei and Fang Z. Peng, Michigan State University, USA

P169 • Optimizing Dual Half Bridge Converter for Full Range Soft Switching and High Efficiency
Hamid Daneshpajooh, Alireza Bakhshai and Praveen Jain, Queen’s University, Canada

P170 • A Novel A-D Conversion for Digital Control Switching Power Supply
Fujio Kurokawa, Ryuya Yoshida, Yuki Maeda, Tsukasa Takahashi, Kouta Bansho, Toru Tanaka and Keiichi Hirose, Nagasaki University, Japan; NTT-Facilities, Japan

P171 • Digital Current Sharing Method for Multiphase DC-DC Converters Using the Peak Input Voltage
Suyong Chae, Yujin Song, Sukin Park and Hakeun Jeong, Korea Institute of Energy Research, Republic of Korea

P172 • A High Step-Up Current Fed Multi-Resonant Converter with Coupled Inductor
Donghao Li, Bo Liu, Bo Yuan, Yang Xu, Duan Jason and Zhai Jerry, Xi’an Jiaotong University, China; Analog Devices, Inc., China

P173 • Inductor Optimization Procedure for Power Supply in Package and Power Supply on Chip
Toke M. Andersen, Claudia M. Zingerli, Florian Krismer, Johann W. Kolar and Gian O’Mathuna, Power Electronic Systems Laboratory, ETH Zurich, Switzerland; Tyndall National Institute, Cork, Ireland

P174 • Diagnosis and Fault-Tolerant Control of Three-Phase AC-DC PWM Converter System
Won-Sang Im, Jang-Mok Kim, Dong-Choon Lee and Kyo-Beum Lee, Pusan National University, Republic of Korea; Youngnam University, Republic of Korea; Ajou University, Republic of Korea

P175 • A New Control Scheme for Boost PFC Converters for Both CCM and DCM Operations
Chung-Ping Ku, Sheng-Hsien Lin and Dan Chen, National Taiwan University, Taiwan; Delta Electronics Inc., Taiwan

P176 • Three-Phase Z-Source Power Supply Design and Dynamic Modeling
Giovanni Lo Calzo, Alessandro Lidozzi, Luca Solero and Fabio Crescimbini, University Roma Tre - DIMI, Italy

P177 • Adaptive Discontinuous Current Source Driver to Achieve Switching Loss Reduction for MHz PFC Applications
Pengcheng Xu, Zhihui Zhang, Yan-Fei Liu and P.C. Sen, Nanjing University of Aeronautics and Astronautics, China; Queen’s University, Canada

P178 • Analysis and Design of a Three-Phase Reduced Switch Buck-Boost AC-DC Converter
Dunisha Wijeratne and Gerry Moschopoulos, University of Western Ontario, Canada

P179 • One-Cycle Controlled Three-Switch Buck-type Rectifier
Shao Zhang and King Jet Tseng, Nanyang Technological University, Singapore

P180 • Six Switches Solution for Single-Phase AC-DC-AC Converter with Capability of Second-Order Power Mitigation in DC-Link Capacitor
Xiong Liu, Peng Wang, Poh Chiang Loh, Frede Blaabjerg and Mingyu Xue, EEE, Nanyang Technological University, Singapore; Institute of Energy Technology, Aalborg Univers, Denmark; Huazhong University of Science and Technology, China

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Sung Min Park, Yong Duk Lee and Sung Yeul Park, University of Connecticut, USA

P182 • Catastrophic Bifurcation in Three-Phase Boost Rectifiers
Meng Huang, Siu-Chung Wong, Chi K. Tse and Xibo Ruan, The Hong Kong Polytechnic University, Hong Kong; Huazhong University of Science and Technology, China

P183 • A Control Method to Reduce a Surge Voltage of Indirect Matrix Converter by Using Zero Current and Zero Voltage Switching Jun-ichi Itoh, Yoshifumi Hinata and Koji Kato, Nagaoka University of Technology, Japan

P184 • High Power Density High Efficiency DC-DC Converter
Daocheng Huang, David Gilham, Weiyi Feng, Pengju Kong, Dianbo Fu and Fred. C. Lee, Virginia Tech, USA; Intersil Corporation, USA; Huawei Technologies Co., Ltd., USA

P185 • A Bi-Directional Single-Phase Soft-Switched AC-AC Converter
Alireza Safaee, Davood Yazdani, Alireza Bakhshai and Praveen Jain, Queen’s University, Canada; ReDriven Power Inc., Canada

P186 • A Sense Winding Based Synchronization Technique for Bi-Directional IPT Pick-Ups
Duleepa J. Thrimawithana, Udaya K. Madawala, Michael Neath and Tobias Geyer, The University of Auckland, New Zealand

P187 • A Single Stage Micro-Inverter Based on a Three-Port Flyback with Power Decoupling Capability
Haibing Hu, Qian Zhang, Xiang Fang, John Shen and Issa Batarseh, University of Central Florida, USA

P188 • Novel Family of Quasi-Z Source AC-AC Converter with Safe-Commutation
He Liangzong, Peng Fangzheng and Duan Shanxu, Huazhong University of Science and Technology, China; Michigan State University, USA
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Plenary Poster Session: Poster Session II

Phoenix Convention Center West Hall 1
Chairs: Jian Sun, Rensselaer Polytechnic Institute, USA, and Subhashish Bhattacharya, North Carolina State University, USA

P301 • Design and Force Control of Slotted Tubular Linear Motor for Active Pedal
Bon-Gwan Gu, Young-Kyoung Kim, In-Soung Jung, Jeongyeol An and Jongsang Noh, KETI, Republic of Korea; DH Holdings Co., Republic of Korea

P302 • Modeling, Implementation and Analysis of a Li-Ion Battery Powered Electric Truck
Prasanna Mantravadi, Igbal Husain and Yilmaz Sozer, University of Akron, USA

P303 • Analytical Model of PMSM Designed for High-Frequency Operation 'Machine and Inverter Sizing Compromise'
Mohand Sough, Daniel Depernet, Frederic Dubas, Christophe Espanet and Benali Boualem, ALSTOM Transport, France; University of Technology of Belfort-Montbéliard, France; University of Franche-Comté, France

P304 • Benefits of Cascaded Inverter for Electrical Vehicles' Drives-Trains
Benoit Sarrazin, Nicolas Rouger, Jean-Paul Ferriex and Yvan Avenas, G2Elab, CNRS, Grenoble University, France

P305 • Lithium-Ion Cell Modeling from Impedance Spectroscopy for EV Applications
Akram Eddahech, Olivier Briat, Ramzi Chaari, Nicolas Bertrand, Herve Henry and Jean-Michel Vinassa, IMS laboratory, France

P306 • Design and Analysis of Three-Port DC-DC Converters for Satellite Platform Power System
Zhijun Qian, Osama Abdel-Rahman, Kejiu Zhang, Haibing Hu, John Shen and Issa Batarseh, Linear Technology, USA; Advanced Power Electronics Corporation, USA; DELL, USA; University of Central Florida, USA

P307 • Control Strategy for Electric Starter Generators Embedded in a Gas Turbine Engine for Aerospace Applications
Bikramjit Bhangou and Rajashekar Kaushik, Rolls-Royce, Singapore; Rolls-Royce, USA

P308 • Low Frequency Ripple Current Compensation with DC Active Filter for the Single-Phase Aeronautic Static Inverter
Zhong Chen, Miao Chen, Yingpeng Luo and Changyou Wang, Nanjing University of Aeronautics and Astronautics, China

P309 • Effects of Electrical Power Off-Take on Finite Inertia Mechanical Systems
Rebecca Todd, Frank Bryan, Andrew Forsyth, Chengwei Gan and James Bassard, The University of Manchester, UK; Rolls-Royce, UK

P310 • Multi-Sampled Carrier-Based PWM for Multilevel Active Shunt Power Filters for Aerospace Applications
Milijana Odavic, Veronica Biagini, Mark Sumner, Pericle Zanchetta and Marco Degano, The University of Nottingham, UK

P311 • A New Battery Parameter Identification Considering Current, SOC and Peukert's Effect for Hybrid Electric Vehicles
Jongkyung Lee, Youngroc Kim and Hanju Cha, Chungnam National University, Republic of Korea

P312 • Power and Efficiency Measurements and Design Improvement of a 50kW Switched Reluctance Motor for Hybrid Electric Vehicles
Motoki Takeno, Akira Chiba, Nobukazu Hoshi, Masatsugu Takemoto and Satoshi Ogasawara, Tokyo University of Science, Japan; Tokyo Institute of Technology, Japan; Hokkaido University, Japan

P313 • Analysis and Mitigation of Torsional Vibration of PM Brushless DC Drives with Direct Torque Controller
Z.Q. Zhu and J.H. Leong, University of Sheffield, UK

P314 • Design for Self-Sensing of a Linear Actuator
Joel Maridor, Miroslav Markovic and Yves Perriard, EPFL IMT LAI, Switzerland

P315 • Independent Speed Control of Two Induction Motors Fed by a Five-Leg Inverter with Space Vector Modulation
Atsushi Hara, Hiroyuki Enokijima and Kouki Matsuse, Meiji University, Japan

P316 • Homopolar Machines for Power Generation: A Review
Claudio Bianchini, Fabio Immovilli, Alberto Bellini, Emilio Lorenzani and Carlo Concarì, DISMI University of Modena and Reggio E., Italy; DII University of Parma, Italy

P317 • Effect of Stator and Rotor Saturation on Sensorless Rotor Position Detection
Emanuele Fornasiero, Nicola Bianchi and Silverio Bolognani, University of Padova, Italy

P318 • Weight Optimization of a Surface Mount Permanent Magnet Synchronous Motor Using Genetic Algorithms and a Combined Electromagnetic-Thermal Co-Simulation Environment
Mohand ou Ramdane Hamit, Chris Gerada and Michael Rottach, The University of Nottingham, UK

P319 • Optimization of the Winding Arrangement to Increase the Leakage Inductance of a Synchronous Machine with Multi-Functional Converter Drive
Thomas Hackner and Johannes Pförrl, University of Applied Sciences Ingolstadt, Germany

P320 • Mitigation of Voltage Regulation Problem in Flux Reversal Machine
Vandana Rallabandi and Fernandes B.G., Indian Institute of Technology Bombay, India

P321 • Mechanically Commutated Self Control of PM-Synchronous Machines
Tobias Roesmann and Stefan Soter, Moog Unna, Germany; University of Wuppertal, Germany

P322 • Reduction of Magnetic Saturation by Using Additional Permanent Magnets in Synchronous Machines
Katsumi Yamazaki, Tamiya Shuichi, Kazuo Shima and Tadashi Fukami, Chiba Institute of Technology, Japan; Kanazawa Institute of Technology, Japan

P323 • A Geometrical Interpretation of Current Space Vector Components Due to Induction Machines Rotor Faults
Carlo Concarì, Giovanni Franceschini, Carla Tassoni and Andrea Toscani, Università `degli Studi di Parma, Italy

P324 • Analysis of Two-Part Rotor, Axial Flux Permanent Magnet Machines
Gianmaria Pellegrino, Paolo Giangrande, Francesco Cupertino, Davide Ronchetto, Mark Sumner and Chris Gerada, Politecnico di Torino, Italy; Politecnico di Bari, Italy; University of Nottingham, UK

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P325 • The Effect of Magnetic Saturation on Sensorless Control of a Brushless Permanent Magnet Motor under AC and DC Excitation
Antonio Grillo, Rafal Wrobel, Philip Mellor, Derrick Holiday and Parminder Sangha, University of Bristol, UK; University of Strathclyde, UK; Goodrich Corporation, UK

P326 • Performance Comparison between Unipolar and Bipolar Excitations in Switched Reluctance Machine with Sinusoidal and Rectangular Waveforms
Xu Liu, Z.Q. Zhu, Masahiko Hasegawa, Rajesh Deodhar and Adam Pride, University of Sheffield, UK; IMRA Europe SAS, UK Research Centre, UK

P327 • DC-Link Capacitance Requirement and Noise and Vibration Reduction in 6/4 Switched Reluctance Machine with Sinusoidal Bipolar Excitation
Xu Liu, Z.Q. Zhu, Masahiko Hasegawa, Adam Pride and Rajesh Deodhar, University of Sheffield, UK; IMRA Europe SAS, UK Research Centre, UK

P328 • Impact of the Rotor Back-Iron Resistivity on the Rotor Eddy-Current Losses in Fractional-Slot Concentrated Windings PM Machines
Andrea Cavagnino, Mario Lazzari, Alessio Miotto, Alberto Tenconi and Silvio Vascchetto, Politecnico di Torino, Italy

P329 • Damper Windings in Induction Machines for Reduction of Unbalanced Magnetic Pull and Bearing Wear
David Dorrell, Jonathan Shek, Min-Fu Hseih and Markus Mueller, University of Technology Sydney, Australia; University of Edinburgh, UK; National Cheng Kung University, Taiwan

P330 • Comparison of Air-Cored and Iron-Cored Non-Overlap Winding Radial Flux Permanent Magnet Direct Drive Wind Generators
Maarten Kamper, Johannes Potgieter, Abraham Stegmann and Pieter Bouwer, Stellenbosch University, South Africa

P331 • Design of a Sustainable Wind Generator System using Redundant Materials
Hartmut Jagau, Azeem Khan and Paul Barendse, University of Cape Town, South Africa

P332 • Modeling, Construction and Testing of a Simple HTS Machine Demonstrator
Bogi Jensen and Asger Abrahamsen, Technical University of Denmark, Denmark

Mina Rahimian, Seung Choi and Karen Butler-Purry, Texas A and M University, USA; Toshiba, USA

P334 • Levitation Performance of Two Opposed Permanent Magnet Pole-Pair Separated Conical Bearingless Motors
Peter Kascak, Jansen Ralph, Dever Timothy, Nagorny Aleksandr and Loparo Kenneth, NASA Glenn Research Center, USA; ResMed Motor Technologies, USA; Case Western Reserve University, USA

P335 • Switched Reluctance Motor without Torque Ripple or Electrolytic Capacitors
Ethan Swint and Jason Lai, Virginia Tech, USA

P336 • Capacitive Power Transfer for Slip Ring Replacement in Wound Field Synchronous Machines
Daniel Ludois, Kyle Hanson and Justin Reed, University of Wisconsin-Madison, USA

P337 • Scalability Investigation of Proximity Losses in Fractional-Slot Concentrated Winding Surface PM Machines During High-Speed Operation
Patel Reddy and Thomas Jahns, GE Global Research Center, Niskayuna, USA; University of Wisconsin-Madison, USA

P338 • Maximum Torque Per Ampere Control of Phase Advance Modulation of a SPM Wind Generator
Mehanathan Pathmanathan, Wen Soong and Nesimi Ertugrul, The University of Adelaide, Australia

P339 • Modeling and Control of Three-Phase PMSMs under Open-Phase Fault
Alberto Gaeta, Giacomo Scelba and Alfio Consoli, University of Catania, Italy

P340 • Modeling the Dynamic Suspension Behavior of an Eddy Current Device
Jonathan Bird, Nirmal Paudel, Subhra Paul and Bobbha Dheeraj, University of North Carolina at Charlotte, USA

P341 • An Accurate Rotor Time Constant Estimation Method for Self-Commissioning of Multi-Scale Induction Motor Drives
Shuang Sheng, Xiaomeng Cheng, Haifeng Lu, Wenlong Qu and Yituo Li, Tsinghua University, China

P342 • Research on Optimized Control Technique of Electric Vehicles Propulsion System with Dual PMSM Connection
Jian Zhang, Xuhui Wen and Youlong Wang, Institute of Electrical Engineering, CAS, China

P343 • Speed Control of Electrical Drives Using Classical Control Methods
Lennart Harnefors, Seppo Saarakkala and Marko Hinkkanen, ABB Power Systems - HVDC, Sweden; Aalto University, Finland

P344 • Adaptive Wide Angle PWM Control Strategy of BLDC Motor Drive for Efficiency Optimization and Wide Speed Control Range
Kai-Sheng Kan and Ying-Yu Tzou, National Chiao Tung University, Taiwan

P345 • Transformer-Isolated Gate Drive Design for SiC JFET Phase-Leg Module
Ruxi Wang, Milisav Danilovic, Zheng Chen and Dushan Boroyevich, Virginia Tech, CPES, USA

P346 • Optimal Torque Trajectories Minimizing Loss of Induction Motor Under Given Condition of Rotational Angle
Kaoru Inoue, Keito Kotera and Toshihji Kato, Doshisha University, Japan

P347 • A Novel Single Phase Hybrid Switched Reluctance Motor Drive System
Jianing Liang, Guoqing Xu, Linni Jian, Jakobsen Uffe and Jin-Woo Ahn, Shenzhen Institutes of Advanced Technology, China; The Chinese University of Hong Kong, China; Aalborg University, Denmark; Kyungsung University, Republic of Korea

P348 • Experimental Methods for Synchronous Machines Evaluation by an Accurate Magnetic Model Identification
Paolo Guglielmi, Eric Armando, Justin Radu Bojoi, Gianmario Pellegino and Michele Pastorelli, Politecnico di Torino, Italy

P349 • Electromechanical Regeneration Actuator with Fault Tolerance Capability for Automotive Chassis Applications
Lei Hao and Chandra Namuduri, General Motors RD Center, USA

P350 • A New High Frequency Injection Method for Sensorless Control at Doubly-Fed Induction Machines
Longya Xu, Ernesto Inoa, Yu Liu and Bo Guan, The Ohio State University, USA
P351 • MRAS Speed Observer for High Performance Linear Induction Motor Drives Based on Linear Neural Networks
Angelo Accetta, Maurizio Cirrincione, Marcello Pucci and Gianpaolo Vitale, University of Palermo, Italy; UTBM, France; ISSIA-CNRI, Italy

P352 • Optimum Torque Control Algorithm for Wide Speed Range and Four Quadrant Operation of Stator Flux Oriented Induction Machine Drive without Regenerative Unit
Valeriu Olarescu, Sorin Musuroi, Ciprian Sorandaru, Martin Weinmann and Stefan Zeh, Diehl AKO Stftung, Germany; University “Politehnica” of Timisoara, Romania

P353 • Rotor Position Measurement for a Magnetically Levitated 500000 rpm Permanent Magnet Machine
Claudius Martin Zingerli, Imoberdorf Philipp, Thomas Nussbaumer and Johann Walter Kolar, ETH Zurich, Switzerland; Levitronix, Switzerland

P354 • Innovative Measuring System for Wear-Out Indication of High Power IGBT Modules
Jens Due, Stig Munk-Nielsen and Rasmus Nielsen, Institute of Energy Technology - Aalborg University, Denmark

P355 • Resonant Power Shoes for Humanoid Robots
Lee Byunghun, Kim Hyunjae, Lee Sung Woo, Park Chang Byung and Rim Chun Taek, KAIST, Republic of Korea

P356 • Loss Evaluation of an AC-AC Direct Converter with a New GaN HEMT SPICE Model
Okamoto Masayuki, Toyota Genki, Hiraki Eiji, Tanaka Toshihiko and Hashizume Tamotsu, Yamaguchi University, Japan; Hokkaido University, Japan

P357 • A New High Frequency Inductor Loss Measurement Method
Mingkai Mu and Lee Fred, CPES, Virginia Tech, USA

P358 • Optimal Design Method for Interleaved Single-Phase PFC Converter with Coupled Inductor
Jun Imaoka, Yuki Ishikura, Takahiro Kawashima and Masayoshi Yamamoto, Shimane University, Japan

P359 • Lithium-Ion Supercapacitors for Pulsed Power Applications
Raymond Sepe, Anton Steyerl and Steven Bastien, Electro Standards Laboratories, USA

P360 • Zero Voltage Switching Performance of 1200V SiC MOSFET, 1200V Silicon IGBT and 900V CoolMOS MOSFET
Arun Kadavelugu, Vinay Baliga, Subhashish Bhattacharya, Mrinal Das and Anant Agarwal, North Carolina State University, USA; Cree, Inc., USA

P361 • Novel Silicon-Embedded Coreless Coupled Inductors for High Efficiency On-Chip DC-DC Conversion
Rongxiang Wu and Johnny K.O. Sin, Hong Kong University of Science and Technology, Hong Kong

P362 • A Bipolar Primary Pad Topology for EV Stationary Charging and High Power by Inductive Coupling
Grant Covic, Michael Kissin, Dariusz Kacprzak, Niels Clausen and Hao Hao, The University of Auckland, New Zealand

P363 • Integrated Magnetic Design of Small Planar Transformers for LLC Resonant Converters
Samuel Robert Cove, Martin Ordonez, Federico Luchino and John Quaicoe, Memorial University of Newfoundland, Canada; Simon Fraser University, Canada

P364 • Microfabricated V-Groove Power Inductors Using Multilayer Co-Zr-O Thin Films for Very-High-Frequency DC-DC Converters
Di Yao, Christopher Levey and Charles Sullivan, Maxim Integrated Products, USA; Thayer School of Engineering at Dartmouth, USA

P365 • Boundary-Dependent Circuit Model for the Transient Behavior of a Thermal Stack in Power Modules
Xiao Cao, Guo-Quan Lu and Khai Ngo, Virginia Tech, USA

P366 • A Comprehensive Design for High Power Density CM EMI Inductor
Luo Fang, Boroyevich Dushan, Mattavelli Paolo and Nicolas Gazel, CPES, Virginia Tech, USA; SAFRAN Group, France

P367 • Analysis of Impact of Self-Power Function on Emitter Turn-Off Thyristor
Qian Chen and Alex Huang, North Carolina State University, USA

P368 • Analytical Modeling of a Medium-Voltage and High-Frequency Resonant Coupled-Mode Power Transformer for a Solid State Transformer Application
Seunghun Baek and Subhashish Bhattacharya, North Carolina State University, USA

P369 • PWM Method’s Influence on the Common-Mode Choke of Motor Drives
Dong Jiang, Fei Wang and Jing Xue, the University of Tennessee, USA

P370 • A New Compact, Isolated and Integrated Gate Driver Using High Frequency Transformer for Interleaved Boost Converter
The Van Nguyen, Pierre-Olivier Jeannin, Jean-Christophe Crobier and Jean-Luc Schanen, Grenoble Electrical Engineering Laboratory, France

P371 • Doubly Fed Induction Machine Drive Distance Learning Laboratory for Wind Power and Electric Ship Propulsion Applications
Giovanna Oriti, Alexander Julian and Dan Zulaica, Naval Postgraduate School, USA

P372 • Teaching Digital Control of Switch Mode Power Supplies
Oscar Garcia, Jesus Oliver, Daniel Diaz, Benoit Duret, Pedro Alou and Jose Cobos, Universidad Politecnica de Madrid, Spain

P373 • EMC Modeling of Drives for Aircraft Applications: Modeling Process, EMI Filter Optimization and Technological Choice
Baidy Toure, Jean-Luc Schanen, Laurent Gerbard, Thierry Meynard and Jean-Pierre Carayon, Liebherr Aerospace, France; G2Elab, France; Laplace, France

P374 • MOSFET Power Loss Characterization: Evolving into Multivariate Response Surface
Federico Luchino, Martin Ordonez, German Oggier and John Quaicoe, Simon Fraser University, Canada; Universidad Nacional de Rio Cuarto, Argentina; Memorial University of Newfoundland, Canada

P375 • Performance Evaluation of Full SiC Switching Cell in an Interleaved Boost Converter for PV Applications
Carl N.M. Ho, Francisco Canales, Sami Pettersson, Gerardo Escobar, Antonio Coccia and Nikolaos Oikonomou, ABB Switzerland Ltd., Switzerland

P376 • Impact of Power Factor Correction and Harmonic Compensation by STATCOM on Converter Temperature and Reliability
Lakshmi GopiReddy, Leon Tolbert, Burak Ozpineci, Yan Xu and Tom Ritz, University of Tennessee, USA; Oak Ridge National Laboratory, USA

P377 • PEEC Based Virtual Design of EMI Input Filters
Ivana Kovacevic, Thomas Friedli, Andreas Muesing and Johann Kolar, Power Electronic Systems Laboratory, ETH Zurich, Switzerland

P378 • A Waveform-Based Power Estimator for Variable Power Loads
Warit Wichakool, Zachary N. Remscrim, Uzoma A. Orji and Steven B. Leeb, Massachusetts Institute of Technology, USA
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<td>Evaluation of Point Field Sensing in IGBT Modules for High Bandwidth Current Measurement</td>
<td>Patrick Schneider and Robert Lorenz, University of Wisconsin-Madison, USA</td>
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<td>P380</td>
<td>An Efficient Resonant Gate Drive Scheme for High Frequency Applications</td>
<td>Mahesa Swamy, Tsunewo Kume and Noriyuki Takada, Yaskawa America Incorporated, USA; Yaskawa Electric Corporation, Japan</td>
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<td>P381</td>
<td>Innovation of a Large Capacity 5-level IGBT Inverter for Oil and Gas Industry</td>
<td>Mostafa Al Mamun, Masahiko Tsukakoshi, Kazunori Hashimura, Hiromi Hosoda and Steven C. Peak, Toshiba Mitsubishi Electric Industrial Sys. Co., Japan; TM GE Automation Systems LLC, USA</td>
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<td>Constant Common Mode Voltage Modulation Strategy for the FB10 Power Converter</td>
<td>Pedro Rodriguez, Raúl S. Munoz-Aguilar, Gerardo Vazquez, Ignacio Candela and Remus Teodorescu, Universitat Politècnica de Catalunya, Spain; Aalborg University, Denmark</td>
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<td>PWM Technique to Extend Current Reconstruction Range and Reduce Common-Mode Voltage for Three-Phase Inverter Using DC-Link Current Sensor Only</td>
<td>Yong-Kai Lin and Yen-Shin Lai, Industrial Technology Research Institute, Taiwan; National Taiwan University of Technology, Taiwan</td>
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<td>An Inrush Current Reduction Technique for Multiple Inverter-Fed Transformers</td>
<td>Yu-Hsing Chen, Ming-Yang Yeh, Po-Tai Cheng, Steven Liao and Charles Tsai, National Tsing Hua University, Taiwan; Delta Electronics, Taiwan</td>
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<td>Transition Control Strategy Between Standalone and Grid Connected Operation of the Voltage Source Inverters</td>
<td>Nayeem Arafat, Shreeshaiah Palle, Iqbal Hussain and Yilmaz Sozer, University of Akron, USA</td>
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<td>Pulse Energy Modulation of a Buck-Boost Inverter</td>
<td>Abraham Tareke Woldegiorgis, Yonggao Zhang and Liuchen Chang, University of New Brunswick, Canada</td>
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<td>P387</td>
<td>Compensation of DC Link Oscillation in Single-Phase VSI and CSI Converters for Photovoltaic Grid Connection</td>
<td>Montie Vitorino and Mauricio Correa, Federal University of Campina Grande, Brazil</td>
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<td>P388</td>
<td>Modeling and Analysis of a DC Current Compensator in Distribution Power Lines</td>
<td>Giampaolo Buticchi, Luca Consolini, Emilio Lorenzani and Carlo Concari, University of Parma, Italy; University of Modena and Reggio Emilia, Italy</td>
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<td>P389</td>
<td>Investigating a H-Infinite Control Method Considering Frequency Uncertainty for CLC Type Inductively Coupled Power Transfer System</td>
<td>Xin Dai, Aiguo Patrick Hu, Chunsen Tang, Yue Sun and Zhihui Wang, Chongqing University, China; The Auckland University, New Zealand</td>
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<td>Robustness Analysis of Active Damping Methods for a Grid Connected Inverter with an LCL filter</td>
<td>Ricchiuto Domenico, Liserre Marco, Kerekex Tamas, Teodorescu Remus and Blaabjerg Frede, Politecnico di Bari, Denmark; Aalborg University, Denmark</td>
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<td>Switching-Sequence Based Global Stability and Control of Standalone and Interactive Power Converters</td>
<td>Sudip Mazumder, University of Illinois, Chicago, USA</td>
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<td>Design and Performance of a SiC High Frequency Inverter</td>
<td>Miaosen Shen, Shashank Krishnamurthy and Mihir Mudholkar, United Technologies Research Center, USA; University of Arkansas, USA</td>
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<td>Core-Loss Analysis in AC Inductors for a Single-Phase Pulse-Width Modulated Solar Power Conditioner</td>
<td>Hideaki Fujita, Tokyo Institute of Technology, Japan</td>
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<td>Proposal of a Series Configuration Hybrid AC Power Source</td>
<td>Rafael Concato Beltrame, Mathaus Iensen Desconzi, Mario Lucio da Silva Martins, Cassiano Rech and Helio Leaes Hey, Federal University of Santa Maria - UFSC, Brazil; Federal University of Technology - Parana, Brazil</td>
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<td>P395</td>
<td>A New Single-Phase Five-Level Inverter with No Problem of Voltage Balancing</td>
<td>Zixin Li, Ping Wang, Yaohua Li and Gao Fanqiang, Chinese Academy of Sciences, China</td>
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<td>P396</td>
<td>Voltage Fluctuation Suppression Method of Floating Capacitors in a New Modular Multilevel Inverter</td>
<td>Kui Wang, Yongdong Li, Zedong Zheng and Lie Xu, Tsinghua University, China</td>
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<td>Theoretical Analysis of Self-Balancing Function of Capacitor Voltages in Flying Capacitor Multi-Level Converters</td>
<td>Hidemine Obara and Yukihiko Sato, Chiba University, Japan</td>
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<td>Neutral-Point Current Modeling and Control for Neutral-Point Clamped Three-Level Converter Drive with Small DC-Link Capacitors</td>
<td>Ramkrishan Maheshwari, Stig Munk-Nielsen and Sergio Busquets-Monge, Aalborg University, Denmark; Technical University of Catalonia, Spain</td>
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<td>P399</td>
<td>Improved Interleaved Discontinuous Carrier-Based PWM Strategy for Three-Level Coupled Inductor Inverters</td>
<td>Behzad Vafakhat, Androw M. Knight and Salmon John, Ford Motor Company, USA; University of Alberta, Canada</td>
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<td>P400</td>
<td>Control and Design Principle of a Soft-Switching Boost DC to AC Converter without Smoothing Capacitor Using a MERS Pulse Link Concept</td>
<td>Yohei Otani, Takanori Isobe and Ryuichi Shimada, Tokyo Institute of Technology, Japan</td>
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**Wednesday, September 21**

8:00 am – 9:40 am

**S31 Wind Energy: Grid Connection and System Integration**

Ellis West  
Chairs: Yilmaz Sozer, University of Akron, USA, and Waqas Arshad, ABB Inc. Corporate Research, USA

8:00 am • Modeling and Mitigation of Harmonic Resonance Between Wind Turbines and the Grid | Mauricio Cespedes and Jian Sun, Rensselaer Polytechnic Institute, USA

8:25 am • Thermal Analysis of Multilevel Grid Side Converters for 10 MW Wind Turbines Under Low Voltage Ride Through | Ke Ma, Frede Blaabjerg and Marco Liserre, Aalborg University, Denmark; Polytechnic of Bari, Italy

8:50 am • Power Capacity Specification for Energy Storage in Wind Application Using Probability-Based Method | Wenzhong Gao, Xiaoyu Wang and Eduard Muljadi, University of Denver, USA; National Renewable Energy Laboratory, USA
# Technical Program Schedule

## S32 Magnetics

**Chair:** Charlie Sullivan, Dartmouth University, USA

### 8:00 am • Magnetic Characterization of Low Temperature Co-Fired Ceramic (LTCC) Ferrite Materials for High Frequency Power Converters

Mingkai Mu, Yipeng Su, Qiang Li and Fred Lee, CPES, Virginia Tech, USA

### 8:25 am • Predicting Inductance Roll-Off with DC Excitations

Jennifer D. Pollock, Weyman Lundquist and Charles R. Sullivan, Thayer School of Engineering at Dartmouth, USA; West Coast Magnetics, USA

### 8:50 am • High Frequency Inductor Design and Comparison for High Efficiency High Density POLs with GaN Device

Yipeng Su, Qiang Li, Mingkai Mu and Fred C. Lee, Virginia Tech, USA

## S33 Drive Issues I

**Chair:** Tony O’Gorman, PESC, Inc., USA

### 8:00 am • Influence of High-Frequency Leakage Current on Motor Position Control in PWM Inverter-Fed Servo Drives

Kotaro Tagami and Satoshi Ogasawara, NSK Ltd., Japan; Hokkaido University, Japan

### 8:25 am • A Review of Mitigation Methods for Overvoltage in Long-Cable-Fed PWM AC Drives

Jiangbiao He, Gennadi Sizov, Peng Zhang and Nabeel Demerdash, Marquette University, USA

### 8:50 am • Investigation of Voltage Stresses Inside Adjustable Speed Drives

Lixiang Wei, Zhijun Liu and Gary Skibinski, Rockwell Automation, USA

### 9:15 am • Identifying Ground Fault Location in High Resistance Grounded Systems using Adjustable Speed Drive

Lixiang Wei, Liu Zhijun, Russ Kerkman and Gary Skibinski, Rockwell Automation, USA

## S34 Transient Behavior in Grid Connected and Stand Alone Systems

**Chair:** Francisco Canales, ABB Corporate Research, Switzerland, and Tom Jahns, University of Wisconsin-Madison, USA

### 8:00 am • Active Islanding Detection Using High Frequency Signal Injection

David Reigosa, Fernando Briz, Christian Blanco, Pablo Garcia and Juan Manuel Guerrero, University of Oviedo, Spain

### 8:25 am • Safe Transient Operation of Microgrids Based on Master-Slave Configuration

Gustavo M. S. Azevedo, Joan Rocabert, Pedro Rodriguez, Fabio Bradaschia, Marcelo C. Cavalcanti and Francisco A. S. Neves, Federal University of Pernambuco, Brazil; Technical University of Catalonia, Spain

### 8:50 am • Droop-Controlled Inverters with Seamless Transition Between Islanding and Grid-Connected Operations

Shang-Hung Hu, Chun-Yi Kuo, Tsung-Lin Lee and Josep M. Guerrero, National Sun Yat-sen University, Taiwan; Aalborg University, Denmark

### 9:15 am • Engine Generator Efficiency and Transient Characteristics Improvement Using a Series Compensator Named MERS

Kouhei Kashiwagi, Takanori Isobe and Ryuichi Shimada, Tokyo Institute of Technology, Japan

## S35 Resonant DC-DC Converters I

**Chairs:** Praveen Jain, Queen’s University, Canada, and Xu Yang, Xi An Jiaotong University, China

### 8:00 am • A New DC-DC Converter with Wide-Range ZVS and Zero Circulating Current

Mehdi Narimani and Gerry Moschopoulos, University of Western Ontario, Canada

### 8:25 am • Zero Voltage Switching Technique for Bi-Directional DC-DC Converters

Luca Corradini, Daniel Seltzer, Douglas Bloomquist, Regan Zane, Dragan Maksimovic and Boris Jacobson, University of Colorado at Boulder, USA; Raytheon Company, USA

### 8:50 am • Soft Switching Chopper with Tail Loss Cancel Circuit

Yukinori Tsuruta and Atsuo Kawamura, Yokohama National University, Japan

### 9:15 am • The Resonant LLC vs. LCC Converter — Comparing Two Optimized Prototypes

Alexander Pawellek, Christian Oeder, Juergen Stahl and Duerbaum Thomas, University of Erlangen-Nuremberg, Germany

## S36 Fractional Slot Machines

**Chairs:** Nicola Bianchi, University of Padova, and Tom Jahns, University of Wisconsin-Madison, USA

### 8:00 am • Design, Analysis and Loss Minimization of a Fractional-Slot Concentrated Winding Interior Permanent Magnet Machine for Traction Applications

Jagadeesh Tangudu, Thomas Jahns and Theodore Bohn, University of Wisconsin-Madison, USA; Argonne National Laboratory, USA

### 8:25 am • Influence of Alternate Slot Openings on Torque-Speed Characteristics and Cogging Torque of Fractional Slot IPM Brushless AC Machines

Ziad Azar, Z.Q. Zhu and Grzegorz Ombach, University of Sheffield, UK; BROSE FAHRZEUGTEILE GmbH and Co, Germany

### 8:50 am • Comparison of Interior and Surface PM Machines Equipped with Fractional-Slot Concentrated-Windings for Hybrid Traction Applications

Ayman EL-Refaie, Patel Reddy, Kum-Kang Huh, Jagadeesh Tangudu and Thomas Jahns, GE Global Research, USA; University of Wisconsin-Madison, USA
S37  Z-Source Inverters

Russell
Chair: Hideaki Fujita, Tokyo Institute of Technology, Japan

8:00 am • Single-Phase Z-Source Inverter: Analysis and Low-Frequency Harmonics Elimination Pulse Width Modulation
Yifan Yu, Qianfan Zhang, Bin Liang and Shumei Cui, Harbin Institute of Technology, China

8:25 am • Stability Analysis of Reduced Leakage Current Modulation Techniques for Z-Source Inverters in Transformerless Photovoltaic Applications
Fabricio Bradaschia, Marcelo C. Cavalcanti, Pedro E. P. Ferraz, Gustavo M. S. Azevedo, Francisco A. S. Neves and Euzeli C. dos Santos Jr., Federal University of Pernambuco, Brazil; Federal University of Campina Grande, Brazil

8:50 am • High Step-Up Continuous Input Current LCCT-Z-Source Inverters for Fuel Cells
Marek Adamowicz, Jaroslaw Guzinski, Fang Zheng Peng, Ryszard Strzelecki and Haitham Abu-Rub, Gdansk University of Technology, Poland; Michigan State University, USA; Gynia Maritime University, Poland; Texas A and M University at Qatar, Qatar

9:15 am • Transient Modeling Of Current-fed Quasi-Z-Source Inverter
Qin Lei, Fangzheng Peng and Ge Baoming, USA

S38  LED Drivers I

Sundance
Chair: Yehui Han, University of Wisconsin-Madison, USA

8:00 am • A Universal-Input High-Power-Factor PFC Pre-Regulator without Electrolytic Capacitor for PWM Dimming LED Lighting Application
Hongbo Ma, Jih-Sheng Lai, Wensong Yu, Quanyuan Feng, Cong Zheng and Bo-yuan Chen, Virginia Tech, USA; Southwest Jiaotong University, China

8:25 am • A Novel High Efficiency and Low-Cost Current Balancing Method for Multi-LED Driver
Jianfeng Wang, Junming Zhang, Xinke Wu, Yangyu Shi and Zhaoming Qian, Electrical Engineering of Zhe-Jiang University, China

8:50 am • Off-Line LED Driver with Bi-Directional Second Stage for Reducing Energy Storage
Qingcong Hu and Regan Zane, University of Colorado at Boulder, USA

9:15 am • A Novel SEPIC-Derived PFC Pre-Regulator without Electrolytic Capacitor for PWM Dimming LED Lighting Application Based on Valley Fill Circuit
Hongbo Ma, Jih-Sheng Lai, Wensong Yu, Cong Zheng and Quanyuan Feng, Virginia Tech, USA; Southwest Jiaotong University, China

S39  AC-DC Rectifiers: Design and Analysis

Borein
Chairs: Rolando Burgos, ABB Corporate Research, USA, and Sung- Yeul Park, University of Connecticut, USA

8:00 am • A Flicker-Free Electrolytic Capacitor-Less AC-DC LED Driver
Shu Wang, Xibo Ruan, Kai Yao and Zhihong Ye, Nanjing University of Aeronautics and Astronautics, China; Lite-on Technology Corp., China

8:25 am • An AC-DC Single-Stage Full-Bridge Converter with Buck-Boost Input Section
Navid Golbon and Gerry Moschopoulos, University of Western Ontario, Canada

8:50 am • Class E Rectifier Using Switch-Controlled Capacitor
Kazuaki Fukui and Hirotaka Koizumi, Tokyo University of Science, Japan

9:15 am • MHz Power Factor Correction with Adaptive Current Source Drivers
Pengcheng Xu, Zhihong Zhang, Wei Cai, Yan-fei Liu and Paresh C. Sen, Nanjing University of Aeronautics and Astronautics, China; Queen’s University, Canada

S40  Transportation Applications: Electric Drivetrain

Regency D
Chair: Syed Hossain, Globe Motors, USA

8:00 am • Design and Analysis of a 55-kW Air Cooled Automotive Traction Drive Inverter
Madhu Sudhan Chinthavalli, Tawfik Jonathan and Rao Arimilli, Oak Ridge National Laboratory, USA; University of Tennessee, USA

8:25 am • Back to Back Z-Source Inverter Topology for the Series Hybrid Electric Bus
Craig Rogers and Fang Peng, Michigan State University, USA

8:50 am • A Novel Current Angle Control of a Current Source Inverter Fed Permanent Magnet Synchronous Motor Drive for Automotive Applications
Lixin Tang and Gui-Jia Su, Oak Ridge National Laboratory, USA

SP4  Special Session: Power Magnetics for Smart Grid Applications

Regency AB
Chairs: Ahmed Zobaa, Brunel University, UK, and Subhashish Bhattacharya, North Carolina State University, USA

8:00 am • Magnetic Components for High Voltage DC Transmission Converters and Static Var Compensators
Sarath B. Tennakoon, Staffordshire University, UK

8:25 am • Magnetic Components in Electric Circuits — Understanding Thermal Behaviour and Stress
Peter R. Wilson, University of Southampton, UK

8:50 am • Transformer Construction and its Affect on Transformer Stability
Kevin McGivern, Bicron Electronics, USA

9:15 am • Design, Development, and Testing of a 1 MVA, 13.8 kV/465 V Solid-State Transformer with 10 kV Silicon Carbide Switches
Ravisekhar N. Raju, GE Global Research, USA
### Technical Program Schedule

**Wednesday, September 21**  
10:00 am – 11:40 am

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<td><strong>Wind Energy: Generators and Controls</strong></td>
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Chair: Annette von Jouanne, Oregon State University, USA, and Eduard Muljadi, National Renewable Energy Lab, USA  
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10:00 am • **Vector Control of Multite Module Transverse Flux PM Generator for Large-Scale Direct-Drive Wind Turbines**  
Seon-Hwan Hwang, Hui Li, Je-Wook Park, Jang-Mok Kim and Deok-Je Bang, Florida State University, USA; Pusan National University, Republic of Korea; Delft University of Technology, Netherlands  
---  
10:25 am • **Direct Grid Connection of a Slip-Permanent Magnet Wind Turbine Generator**  
Ulwin Hoffmann, Pieter Bouwer and Maarten Kamper, University of Stellenbosch, South Africa  
---  
10:50 am • **Predictive Direct Control of Doubly Fed Induction Generator for Grid Synchronization in Wind Power Generation**  
Jiefeng Hu, Jianguo Zhu, Yongchang Zhang, Glenn Platt and David Dorrell, University of Technology, Sydney, Australia; CSIRO Energy Centre, Australia  
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11:15 am • **Feed-Forward Transient Compensation Control for DFIG Wind Generators During Both Balanced and Unbalanced Grid Disturbances**  
Jiaqi Liang and Ronald Harley, Georgia Institute of Technology, USA  

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Chair: Fred Wang, University of Tennessee, USA  
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10:00 am • **Investigation of Si IGBT Operation at 200 Degree Centigrade for Traction Application**  
Zhuxian Xu, Ming Li, Fred Wang and Zhenxian Liang, University of Tennessee, USA; Oak Ridge National Laboratory, USA  
---  
10:25 am • **Characterization of a High Temperature Multichip SiC JFET-Based Module**  
Fan Xu, Dong Jiang, Jing Wang, Fred Wang, Leon M. Tolbert, Timothy Junghen and Sung Joon Kim, The University of Tennessee, USA; Global Power Electronics, Inc., USA  
---  
10:50 am • **Development of a 10 kW High Temperature High Power Density Three-Phase AC-DC-AC SiC Converter**  
Puqi Ning, Di Zhang, Rixin Lai, Jiang Dong, Fred Wang, Boroyevich Dushan, Ngo Khai, Burgos Rolando, Karimi Kamiar, Immanuel Vikram and Solodovnik Eugene, Oak Ridge National Lab, USA; General Electric, USA; The University of Tennessee, USA; Virginia Tech, USA; ABB, USA; Boeing, USA  
---  
11:15 am • **Design Comparison of High Power Medium-Voltage Converters Based on 6.5kV Si-IGBT/Si-PiN Diode, 6.5kV Si-IGBT/SiC-JBS Diode, and 10kV SiC MOSFET/SiC-JBS Diode**  
Hasam Mirzaee, De Ankan, Tripathi Awneesh and Bhattacharya Subhashish, North Carolina State University, USA  

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Cassidy  
Chair: Jul-Ki Seok, YeungNam University, Republic of Korea  
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10:00 am • **Magnet Temperature Estimation in Surface PM Machines During Six-Step Operation**  
David Reigosa, Fernando Briz, Michael W. Degner, Pablo Garcia and Juan Manuel Guerrero, University of Oviedo, Spain; Ford Motor Company, USA  
---  
10:25 am • **Adaptive Flux-Weakening Controller for IPMSM Drives**  
Silverio Bolognani, Sandro Calligaro and Roberto Petrella, DIE - University of Padova, Italy; DIEGM - University of Udine, Italy  
---  
10:50 am • **Voltage Disturbance State-Filter Design for Precise Torque-Controlled Interior PM Synchronous Motors**  
Kim SeHwan, Choi Chan-Hee and Seok Jul-Ki, YeungNam University, Republic of Korea  
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11:15 am • **Torque Ripple Control for Synchronous Motors Using Instantaneous Torque Estimation**  
Noriya Nakao and Kan Akatsu, Shibaura Institute of Technology, Japan  

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<td><strong>Grid Interactive Solar PV Systems I</strong></td>
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Ellis East  
Chair: Behroz Mirafzal, Florida International University, USA, and Vladimir Blasko, United Technologies Research Center, USA  
---  
10:00 am • **Leakage Current Analysis of Grid Connected Transformerless Solar Inverters with Zero Vector Isolation**  
Ziya Ozkam and Ahmet Hava, Middle East Technical University, Turkey  
---  
10:25 am • **Towards Next Generation Photovoltaic Inverters**  
Yaosuo Xue, Divya Kurfthakoti Chandrashekhar, Gerd Griepentrog, Liviu Mihalache, Sindhu Suresh and Madhav Manijrekar, Siemens Corporate Research, USA; Corporate Technology, Siemens AG, Germany; Siemens Energy Inc., USA  
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10:50 am • **Single-Stage Grid-Connected Forward Microinverter with Boundary Mode Control**  
David Menezes, Oscar Garcia, Pedro Alou, Jesus Angel Oliver and Roberto Prieto, Universidad Politecnica de Madrid, Spain  
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11:15 am • **Research on a Non-Complementary Active Clamp Flyback Converter with Unfolding DC-AC Inverter for Decentralized Grid-Connected PV Systems**  
Qiong Mo, Min Chen, Zhe Zhang, Mingzhi Gao and Zhaoming Qian, Zhejiang University, China  

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<td>S45</td>
<td><strong>DC-DC Converters: Topologies II</strong></td>
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Remington  
Chair: Javier Sebastian, Universidad de Oviedo, Spain, and Wilson Eberle, University of British Columbia, Canada  
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10:00 am • **Serial or Parallel Linear-Assisted Switching Converter as Envelope Amplifier: Optimization and Comparison**  
Miroslav Vasic, Oscar Garcia, Jesus Angel Oliver, Pedro Alou and Jose Antonio Cobos, Universidad Politecnica de Madrid, Spain  
---  
10:25 am • **A Large DC-Gain Highly Efficient Hybrid Switched-Capacitor-Boost Converter for Renewable Energy Systems**  
Dazhong Gu, Dariusz Czarkowski and Adrian Ioinovici, Polytechnic Institute of New York University, USA; Holon Academic Institute of Technology, Israel  

10:50 am • A Gallium-Nitride Switched-Capacitor Circuit Using Synchronous Rectification
Mark J Scott, Ke Zou, Jin Wang, Chingchi Chen, Ming Su and Lihua Chen, The Ohio State University, USA; Ford Motor Company, USA

11:15 am • A Novel Push-Pull Forward Converter for High Reliability and High Input Voltage Applications
Yanbing Xia, Hongfei Wu, Wei Liu, Yan Xing and Xudong Ma, Nanjing University of Aeronautics and Astronautics, China; Southeast University, China

S46 Faults and Diagnostics
Cowboy Artists
Chair: Gerald Capolino, University of Picardy “Jules Verne,” France, and Bin Lu, Eaton Corporation, China

10:00 am • Detection and Classification of Rotor Demagnetization and Eccentricity Faults for PM Synchronous Motors
Jongman Hong, Doosoo Hyun, Tae-june Kang, Sang Bin Lee, Christian Kral and Anton Haummer, Korea University, Republic of Korea; Austrian Institute of Technology, Austria

10:25 am • Detection of Inter-Coil Short Circuits in the Stator Winding of a PM Machine by Using Saliency Tracking Schemes
Jesus Arellano-Padilla, Mark Sumner, Chris Gerada and Gary Buckley, University of Nottingham, UK

10:50 am • Bearing Fault Detection Capability of Frequency Response Measurement in Speed-Sensorless Operated Two-Mass-Systems
Henning Zoubek and Mario Pacas, Universitaet Giessen, Germany

11:15 am • A Low Conductivity Composite Rotor for Fractional Pitch Concentrated Winding Machines
Johan Wolmarans, Martin Van der Geest, Henk Polinder, Bram Ferreira and Dennis Zeilstra, Delft University of Technology, Netherlands; Aeronamic BV, Netherlands

S47 Modeling and Control of Single-Phase Inverters
Russell
Chair: Pedro Rodriguez, Catalonia Polytechnic University, Spain

10:00 am • Fast Current-Tracking Control for Grid-Connected Inverter with an LCL Filter by Sinusoidal Compensation
Toshihi Kato, Kaoru Inoue and Yoshihisa Donomoto, Doshisha University, Japan

10:25 am • Wide Bandwidth System Identification of AC System Impedances by Applying Perturbations to an Existing Converter
Daniel Martin, Adam Barkley and Enrico Santi, University of South Carolina, USA

10:50 am • A Frequency Adaptive Resonant Controller for Fixed Point Digital Implementation at High Sampling Frequency
Sayed Ali Khajehoddin, Masoud Karimi-Ghartemani, Praveen Jain and Alireza Bakhshai, Queen’s University, Canada

11:15 am • Current Mode with RMS Voltage and Offset Control Loops for a Single-Phase Aircraft Inverter Suitable for Parallel and Three-Phase Operation Modes
Pablo Varela Fraile, David Meneses Herrera, Oscar Garcia Suarez, Jesus Angel Oliver Ramirez and Pedro Alou Cervera, Universidad Politecnica de Madrid, Spain

S48 LED Drivers II

Sundeep
Chair: Raylee Lin, National Cheng Kung University, Taiwan, and Brad Lehman, Northeastern University, USA

10:00 am • Multi-Channel Constant Current (MC3) LLC Resonant LED Driver
Haoran Wu, Shu Ji, Fred C. Lee and Xinke Wu, CPES, Virginia Tech, USA; Zhejiang University, China

10:25 am • An Energy Conservation Based High-Efficiency Dimmable Multi-Channel LED Driver
April (Yang) Zhao and Wai Tung Ng, University of Toronto, Canada

10:50 am • Analysis of the Asymmetrical Half-Bridge for Street LED-Lighting Applications
Manuel Arias, Diego Lamar, Aitor Vazquez, Javier Sebastian, Didier Balocco and Almadidi Diallo, Universidad de Oviedo, Spain; AEG Power Solutions, France

11:15 am • Single Switch Three-Level Boost Converter for PWM Dimming LED Lighting
Cong Zheng, Jih-Sheng Lai, Wensong Yu and Hongbo Ma, Virginia Tech, USA

S49 High Performance Power Factor Correction

Borein
Chair: Toshihisa Shimizu, Tokyo Metropolitan University, Japan

10:00 am • Boundary Control of Boost-Derived PFCs Using the Natural Switching Surface: Derivation and Enhanced Properties
Juan Galvez and Martin Ordenez, Simon Fraser University, Canada

10:25 am • Digital Primary-Side Sensing and PFC Control of a Flyback Converter
Chih-Wei Lin and Ying-Yu Tzou, National Chiao Tung University, Taiwan

10:50 am • A Snubber Cell for Single-Stage PFC with a Boost Type Input Current Shaper and Isolated DC-DC Converter
Qian Zhang, John Shen, Issa Batarseh, Haibing Hu and Osama Abdel-Rahman, University of Central Florida, USA

11:15 am • The Input EMI Filter Design of Interleaved Critical Conduction Mode Boost PFC Converter with Coupled Inductor
Fei Yang, Xinbo Ruan, Qing Ji and Zhihong Ye, Nanjing University of Aeronautics and Astronautics, China; Lite-On Technology Power SBG ATD-NJ RD Center, China

S50 Transportation Applications: Battery Modeling and Charging

Regency D
Chair: Ashish Arora, Exponent, USA

10:00 am • Battery Modeling Based on the Coupling of Electrical Circuit and Computational Fluid Dynamics
Shaohua Lin, Scott Stanton, Wenyu Lian and Thomas Wu, ANSYS, USA; General Motor Company, USA; University of Central Florida, USA

10:25 am • Improved Nonlinear Model for Electrode Voltage-Current Relationship for More Consistent Online Battery System Identification
Larry Juang, Phillip Kollmeyer, Thomas Jahns and Robert Lorenz, University of Wisconsin-Madison, USA
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<td>10:50 am</td>
<td>A Transient-Based Approach for Estimating the Parameters of a Lithium-Ion Battery Model</td>
<td>Lalit Mandal and Robert Cox, University of North Carolina-Charlotte, USA</td>
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<td>11:15 am</td>
<td>A Three-Phase High Frequency Semi-Controlled Battery Charging Power Converter for Plug-In Hybrid Electric Vehicles</td>
<td>Mahmoud Amin and Osama Mohammed, Florida International University, USA</td>
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<td><strong>SP5 Special Session: Superconducting Machines</strong></td>
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<td><strong>Regency AB</strong></td>
<td><strong>Chair:</strong> Konrad Weeber, GE Global Research Center, USA</td>
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<td>10:00 am</td>
<td>Towards Commercial Application of HTS Rotating Machines</td>
<td>Clive Lewis, Converte UK Ltd, UK</td>
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<td>10:25 am</td>
<td>Fault Current Limiting HTS Power Transformer</td>
<td>Shirish Mehta, Waukesha Electric Systems, USA</td>
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<td>10:50 am</td>
<td>Overview on the Development of High-Temperature Superconducting (HTS) Machines at Siemens</td>
<td>Joern Grundmann, Siemens, Germany</td>
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<td>11:15 am</td>
<td>Design Considerations for Large Direct Drive Wind Turbine Generators with Superconductor Field Windings</td>
<td>Greg Snitchler, Bruce Gamble and Peter Winn, American Superconductor Corporation, USA</td>
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<td>Wednesday, September 21</td>
<td><strong>S51 Wind Energy: Control Techniques</strong></td>
<td><strong>Chair:</strong> Kevin Lee, Eaton Corporation, USA</td>
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<td>1:30 pm</td>
<td>Control of Power Converters in Distributed Generation Applications Under Grid Fault Conditions</td>
<td>Alvaro Luna, Raul Munoz, Pedro Rodriguez, Felipe Corcoles, Frede Blaabjerg and Teodorescu Remus, UPC, Spain; AAU, Denmark</td>
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<td>1:55 pm</td>
<td>The Steady-State Interaction of a Grid-Connected Doubly-Fed Induction Generator and the Wind Turbine</td>
<td>Kennedy Aganah, Joseph Ojo and Bijaya Pokharel, Tennessee Technological University, USA</td>
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<td>2:20 pm</td>
<td>An Adaptive Approximation Method for Maximum Power Point Tracking (MPPT) in Wind Energy Systems</td>
<td>Joanne Hui, Alireza Bakhshai and Praveen Jain, Queen’s University, Canada</td>
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<td>2:45 pm</td>
<td>Design of a Novel Simulation Platform for the EMS-MG Based on MAS</td>
<td>Meiqin Mao, Wei Dong and Liuchen Chang, Hefei University of Technology, China; University of New Brunswick, Canada</td>
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<td><strong>S52 Power Semiconductors: Wide Bandgap Devices</strong></td>
<td><strong>Regency C</strong></td>
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<td><strong>Chair:</strong> Jerry Hudgins, University of Nebraska, USA</td>
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<td>1:30 pm</td>
<td>Switching Characteristics of Diamond-Based m-i-p+ Diodes in Power Electronic Applications</td>
<td>Arie Nawawi, King Ket Tseng, Rusli Rusli and Gehan A.J. Amaratunga, Nanyang Technological University, Singapore; University of Cambridge, UK</td>
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<td>2:20 pm</td>
<td>10 kV, 120 A SiC Half H-Bridge Power MOSFET Modules Suitable for High Frequency, Medium Voltage Applications</td>
<td>Mrinal Das, Craig Capell, David Grider, Scott Leslie, Ravi Raju, Michael Schutten, Jeffrey Nasadoski and Allen Hefner, Cree, Inc., USA; Powerex, USA; General Electric, USA; NIST, USA</td>
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<td>2:45 pm</td>
<td>Optimal Stray Magnetic Couplings for EMC Filters</td>
<td>Thomas De Oliveira, Jean-Luc Schanen, Jean-Michel Guichon and Laurent Gerbaut, G2Elab, France</td>
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<td><strong>S53 Sensorless Control I</strong></td>
<td><strong>Cassidy</strong></td>
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<td><strong>Chair:</strong> Kevin Lee, Eaton Corporation, USA</td>
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<td>1:30 pm</td>
<td>Comparison of Resistance-Based and Inductance-Based Self-Sensing Control for Surface Permanent Magnet Machine Using High Frequency Signal Injection</td>
<td>Shih-Chin Yang and Robert Lorenz, University of Wisconsin-Madison, USA</td>
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<td>1:55 pm</td>
<td>Sensorless Control of Surface Permanent Magnet Synchronous Machines Using the High Frequency Resistance</td>
<td>Pablo Garcia, David Reigosa, Fernando Briz, Christian Blanco and Juan M. Guerrero, University of Oviedo, Spain</td>
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<td>2:20 pm</td>
<td>High-Resolution Sensorless Position Estimation Using Delta-Sigma-Modulated Current Measurement</td>
<td>Wolfgang Hammel and Ralph Kennel, SEW-Eurodrive GmbH, Germany; Technische Universitaet Muenchen, Germany</td>
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<td>2:45 pm</td>
<td>High Frequency Injection Assisted “Active Flux” Based Sensorless Vector Control of Reluctance Synchronous Motors, with Experiments from Zero Speed</td>
<td>Sorin-Cristian Agarita, Ion Boldea and Frede Blaabjerg, Politehnica University of Timisoara, Romania; Institute of Energy Technology, Aalborg, Denmark</td>
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<td><strong>S54 Grid Interactive Solar PV Systems II</strong></td>
<td><strong>Ellis East</strong></td>
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<td><strong>Chair:</strong> Remus Teodorescu, Aalborg University, Denmark, and Behrooz Mirafzal, Florida International University, USA</td>
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<td>1:30 pm</td>
<td>Single-Phase Cascaded H-Bridge Multilevel Inverter with Nonactive Power Compensation for Grid-Connected Photovoltaic Generators</td>
<td>Bailu Xiao, Faete Filho and Leon Tolbert, University of Tennessee, USA</td>
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</table>
1:55 pm • 1 MHz Cascaded Z-Source Inverters for Scalable Grid-Interactive Photovoltaic (PV) Applications Using GaN Device
Liming Liu, Hui Li, John Shen, Yi Zhao and Xiangning He, Florida State University, USA; University of Central Florida, USA; Zhejiang University, China

2:20 pm • Low Frequency Current Reduction Using a Quasi-Notch Filter Operated in Two-Stage DC-DC-AC Grid-Connected Systems
Hong-Ju Jung, Keun-Soo Ha, Byeong-Mun Song, Jih-Sheng Lai, Dong-Seok Hyun and Rae-Young Kim, Hanyang University, Republic of Korea; LG Electronics Inc., Republic of Korea; Baylor University, USA; Virginia Tech, USA

2:45 pm • Multi-String Single-Stage Grid-Connected Inverter for PV System
Yaow-Ming Chen, Kuo-Yuan Lo and Yung-Ruei Chang, National Taiwan University, Taiwan; Institute of Nuclear Energy Research, Taiwan

S55 Resonant DC-DC Converters II

Technical Program Schedule 2011 IEEE Energy Conversion Congress & Exposition® • 53

1:30 pm • Small Signal Phasor Modeling of Dual Active Bridge Series Resonant DC-DC Converters with Multi-Angle Phase Shift
Daniel Seltzer, Luca Corradini, Bloomquist Doug, Regan Zane and Dragan Maksimovic, University of Colorado at Boulder, USA

1:55 pm • Research on Key Application Issues of Smart Synchronous Rectifier Driver IC in LLC Resonant Converter
Jianfeng Wang, Junming Zhang, Guoxing Zhang, Ming Xu and Zhaoming Qian, Zhejiang University, China; fsp-powerland.Ltd, China

2:20 pm • Analysis and Design Considerations of LLCC Resonant DC-DC Converter with Precise Current Sharing for Two-Channel LED Driver
Yue Chen, Xinke Wu and Zhaoming Qian, Zhejiang University, China

2:45 pm • A Novel Two-stage Electronic Ballast for MH Lamp with Frequency Modulation Control
Co-Hang Chiang, Tsorng-Juu Liang, Jia-You Lee, Hsueh-Ko Liao, Chun-An Cheng and Kuan-Hsien Chou, National Cheng-Kung University, Taiwan; I-Shou University, Taiwan

S56 Electric Traction Machines

Technical Program Schedule 2011 IEEE Energy Conversion Congress & Exposition® • 53

1:30 pm • Influence of Winding Design on Losses in Brushless AC IPM Propulsion Motors
Philip Mellor, Rafal Wrobel, Adrian Mlot, Tony Horseman and Dave Staton, University of Bristol, UK; Motor Design Ltd, UK

1:55 pm • Design of a Ferrite Magnet Vernier Machine for an In-Wheel Machine
Ryota Hosoya, Hiroyuki Shimada and Shoji Shimomura, Shibaura Institute of Technology, Japan

2:20 pm • Feasibility and Electromagnetic Design of Direct Drive Wheel Actuator for Green Taxiing
Tsarafidy Raminosoa, Mohand Hamiti, Michael Galea and Chris Gerada, GE Global Research - Niskayuna, USA; The University of Nottingham, UK

2:45 pm • Fundamental Characteristics of a Ferrite Permanent Magnet Axial Gap Motor with Segmented Rotor Structure for the Hybrid Electric Vehicle
Shinji Chino, Takahiko Miura, Masatsugu Takemoto, Satoshi Ogawara and Akira Chiba, Hokkaido University, Japan; Tokyo Institute of Technology, Japan

S57 Modeling and Control of Three-Phase Inverters

Russell
Chair: Bin Lu, Eaton Corporation, USA

1:30 pm • Power Synchronization Control for Capacitor Minimization in Solid State Transformers (SST)
Tiefu Zhao, Gangyao Wang, Xu She, Fai Wang and Subhashish Bhattacharya, Eaton Corp Innovation Center, USA; NCSU, USA

1:55 pm • Low THD, Fast Transient and Cost-Effective Synchronous-Frame Repetitive Controller for Three-Phase UPS Inverters
Shuai Jiang, Dong Cao, Yuan Li, Jianfeng Liu and Fang Z. Peng, Michigan State University, USA; Sichuan University, China; Central South University, China

2:20 pm • Control and Elimination of Sinusoidal Harmonics in Power Electronics Equipment: A System Approach
Vladimir Blaska, Luis Arnedo, Parag Kshirsagar and Suman Dwari, United Technologies Research Center, USA

2:45 pm • Active Filter Under Constant-Frequency Hysteresis Control Based on a Synchronous Reference Frame
Claudio A. Molina, Jose R. Espinoza, Felipe A. Villarroel, Eduardo E. Espinosa and Pedro E. Melin, Concepcion University, Chile

S58 Lighting Applications

Sundance
Chair: Huang-Jen Chiu, National Taiwan University of Science and Technology, Taiwan, and Annabelle Pratt, Intel, USA

1:30 pm • A Series Tuned High Power IFT Stage Lighting Controller
Jason James, Alex Chu, Almas Sabitov, Daniel Robertson and Grant Covic, The University of Auckland, New Zealand

1:55 pm • A Multi-Functional Digital Controller for a High Power Factor Electronic Ballast Dimmable with Standard Phase-Cut Dimmers
John Lam, Joanne Hui and Praveen K Jain, Queen’s University, Canada

2:20 pm • Collective Dimming of Discharge Lamps with Improved Input Power Factor Using MERS-PFC Converter
Cheng Miao-miao, Mustapha Ilhami Bin, Isobe Takanori and Shimada Ryuchi, Tokyo Institute of Technology, Japan

2:45 pm • Proposing Measures of Flicker in the Low Frequencies for Lighting Applications
Brad Lehman, Arnold Wilkins, Berman Sam, Poplawski Michael and Naomi Johnson Miller, Northeastern University, USA; University of Essex, UK; Lawrence Berkeley National Laboratory Emeritus, USA; Pacific Northwest National Laboratory, USA
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| **S59** | AC-DC Rectifiers: Control I | Borain Chair: Min Chen, National Semiconductor Corporation, USA, and Sudip K. Mazumder, University of Illinois, USA  
1:30 pm • An Optimal Lyapunov-Based Control Strategy for Digital-Mode Controlled Single-Phase Power Factor Correction AC-DC Converters  
Majid Pahlavaninazhad, Pritam Das, Alireza Safaei, Praveen Jain, Alireza Bakhshi and Garry Moschopoulos, Queen’s University, Canada; University of Western Ontario, Canada  
1:55 pm • Bridgeless Isolated PFC Rectifier Using Bi-Directional Switch and Dual Output Windings  
Jong-Won Shin, Jong-Bok Baek and Bo-Hyung Cho, Seoul National University, Republic of Korea |
| **S60** | Transportation Applications: Batteries, Ultracapacitors and Fuel Cells | Regency D Chair: Abraham Gebregergis, Nexteer Automotive, USA  
1:30 pm • Sizing Considerations for Ultra-Capacitors in Hybrid Energy Storage Systems  
Valentin Bolborici, Francis Dawson and Keryn Lian, University of Toronto, Canada  
1:55 pm • A Modular Balancing Bridge for Series Connected Li-Ion Batteries  
Jeffrey Ewanchuk, Dominic Yague and John Salmon, University of Alberta, Canada  
2:20 pm • Optimal Power Flow for Hybrid Ultracapacitor Systems in Light Electric Vehicles  
Omar Laldin, Mazhar Moshirvaziri and Olivier Trescases, University of Toronto, Canada  
2:45 pm • A Parallel Energy-Sharing Control for a Fuel Cell-Battery-Ultracapacitor Hybrid Vehicles  
Jenn Hwa Wong, Nik Rumzi Nik Idris, Makbul Anwari and Taufik Taufik, Universiti Teknologi Malaysia, Malaysia; University of Umm Al-Qura, Saudi Arabia; Cal Poly State University, USA |
| **S61** | DC-DC Converters: Digital Control | Regency A Chair: A. Prodic, University of Toronto, Canada  
1:30 pm • Digital Control Implementation to Reduce the Cost and Improve the Performance of the Control Stage of an Industrial Switch-Mode Power Supply  
Daniel Diaz, Oscar Garcia, Jesus Angel Oliver, Pedro Alou and Felix Moreno, Universidad Politecnica de Madrid, Spain  
1:55 pm • Novel Random Switching PWM Technique with Constant Sampling Frequency and Constant Inductor Average Current for Digital-Controlled Converter  
Ye-Then Chang, Bo-Yuan Chen and Yin-Shin Lai, National Taipei University of Technology, Taiwan  
2:20 pm • Small-Signal Model Analysis and Design of Constant On-Time V2 Control for Low-ESR Caps with External Ramp Compensation  
Shuili Tian, KuangYao Cheng, Fred Lee and Paolo Mattavelli, CPES, Virginia Tech, USA; Texas Instruments, USA  
2:45 pm • Dynamic Resonse Improvement of Power Converter Using an Adaptive Frequency Control Law  
Vara Prasad Arikatla and Jaber Abu Qahouq, The University of Alabama, USA |

**Wednesday, September 21**  
3:30 pm – 5:10 pm

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<td>Energy Storage I</td>
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3:30 pm • Testing and Modeling of Lithium-Ion Ultracapacitors  
Emad Manla, Goran Mandic and Adel Nasiri, University of Wisconsin-Milwaukee, USA  
3:55 pm • An Analysis on the Possibility of Using Flying Capacitors of a Three-Level Capacitor Clamped Inverter as Power Smoothing Elements for Wind Power Systems  
Gamini Jayasinghe, Don Mahinda Vilathgamuwa and Udaya Madawala, Nanyang Technological University, Singapore; The University of Auckland, New Zealand  
4:20 pm • A Modular Hybrid Fuel Cell System with Energy Storage  
Prasad Enjeti, Somasundaram Essakinappan and Joshua Hawke, IEEE, USA  
4:45 pm • Power Oscillation Damping Controller by Static Synchronous Compensator with Energy Storage  
Mebtu Beza and Massimo Bongiorno, Chalmers University of Technology, Sweden |
| **S63** | Power Devices: Parallel and Series Operation | Regency C Chair: Enrico Santi, University of South Carolina, USA  
3:30 pm • Series Connection of Power Switches in High Input Voltage with Wide Range Power Supply for Gate Driving Application  
Filippo Chimento, Salvatore Tomarchio, Angelo Raciti, Simone Buonuomo and Antonino Gaito, ABB Corporate Research, Sweden; University of Catania, Italy; ST Microelectronics, Italy  
3:55 pm • Digital Adaptive Driving Strategies for High-Voltage IGBTs  
Axel Mertens, Harald Kuhn and Lan Dang, Leibniz University Hannover, Germany  
4:20 pm • A New Delay Time Compensation Principle for Parallel Connected IGBTs  
Rodrigo Alvarez and Steffen Bernet, Technische Universität Dresden, Germany  
4:45 pm • The Voltage Sharing of Commercial IGBTS in Series with Passive Components  
Sheng Zheng, Yousheng Wang, Xinke Wu, Zhaoming Qian and FZ. Peng, Zhejiang University, China; Michigan State University, USA |
S64  Sensorless Control II  

**Cassidy**  
Chair: Mahesh Swamy, Yaskawa America Inc., USA  

3:30 pm • Encoderless Servo Drive with Adequately Designed IPMSM for Pulse Voltage Injection Based Position Detection  
Soji Murakami, Masaki Hisatsune, Takayuki Shiota, Motomichi Ohto and Kozo Ide, Yaskawa Electric Corporation, Japan  

3:55 pm • PWM Switching Frequency Signal Injection Sensorless Method in IPMSM  
Songmin Kim, Jung-Ik Ha and Seung-Ki Sul, Seoul National University, Republic of Korea  

4:20 pm • Position Self-Sensing Evaluation of a FI-IPMSM Based on High Frequency Signal Injection Methods  
Chen-Yen Yu, Jun Tamura, David Reigosa and Robert Lorenz, University of Wisconsin-Madison, USA; Nissan Motor Co., Ltd., Japan; University of Oviedo, Spain  

4:45 pm • Sensorless Rotor Position Detection Capability of a Dual Three-Phase Fractional-Slot IPM Machine  
Massimo Barcaro, Adriano Faggion, Nicola Bianchi and Silverio Bolognani, University of Padova, Italy  

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S65  Impact of Renewable Energy Systems on Utility Grid  

**Ellis East**  
Chairs: Burak Ozpineci, Oak Ridge National Laboratory, USA, and Sudip Mazumder, University of Illinois, Chicago, USA  

3:30 pm • A Review on Fundamental Grid-Voltage Detection Methods Under Highly Distorted Conditions in Distributed Power-Generation Networks  
Nils Hoffmann, Ralf Lohde, Lucian Asiminoaei, Friedrich W. Fuchs and Paul B. Theegersen, Christian-Albrechts-University of Kiel, Germany; Danfoss Drives A/S, Denmark; KK-Electronic A/S, Denmark  

3:55 pm • Two Methods for Addressing DC Component in Phase-Locked Loop (PLL) Systems  
Masoud Karimi-Ghartemani, Sayed Ali Khajehoddin, Praveen Jain and Alireza Bakhshai, Queen’s University, Canada  

4:20 pm • Monte Carlo Analysis of the Impacts of High Renewable Power Penetration  
Douglas Halamay and Ted Breken, Oregon State University, USA  

4:45 pm • Online Grid-Adaptive Control and Active-Filter Functionality of PWM-Converters to Mitigate Voltage-Unbalances and Voltage-Harmonics — A Control Concept Based on Grid-Impedance Measurement  
Nils Hoffmann, Lucian Asiminoaei and Friedrich W. Fuchs, Christian-Albrechts-University of Kiel, Germany; Danfoss Drives A/S, Denmark  

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S66  Resonant DC-DC Converters III  

**Remington**  
Chairs: Paolo Mattavelli, Virginia Tech, USA, and Alireza Bakhshai, Queen’s University, Canada  

3:30 pm • A Resonant Bi-Directional DC-DC Converter for Aerospace Applications  
Alireza Safaee, Alireza Bakhshai and Praveen Jain, Queen’s University, Canada  

3:55 pm • Hybrid Half- and Full-Bridge Converter with High Efficiency and Full Soft-Switching Range  
Wensong Yu, Jih-Sheng Lai, Wei-Han Lai and Hongmei Wan, Virginia Tech, USA  

4:20 pm • Practical Performance Evaluations of a Soft Switching PWM Boost DC-DC Converter with High Efficiency and High Scalability Edge Resonant Switched Capacitor Modular  
Tomokazu Mishima, Yujiro Takeuchi and Mutsuo Nakaoka, Kobe University, Japan; Kyungnam University and Yamaguchi University, Japan  

4:45 pm • Optimal Design Considerations for a Modified LLC Converter with Wide Input Voltage Range Capability Suitable for PV Applications  
Haibing Hu, Xiang Fang, Qian Zhang, John Shen and Issa Batarseh, University of Central Florida, USA  

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S67  Advanced Electric Machine Design I  

**Cowboy Artists**  
Chairs: David Dorrell, University of Technology, Australia, and Chris Gerada, University of Nottingham, UK  

3:30 pm • Induction Motor Design Methodology Based on Rotor Diameter Progressive Growth  
Aldo Boglietti, Andrea Cavagnino, Mario Lazzari, Alessio Miotto and Silvio Vascotto, Politecnico di Torino, Italy  

3:55 pm • Theory and Design of Fractional-Slot Multilayer Winding  
Luigi Alberti and Nicola Bianchi, University of Padova, Italy  

4:20 pm • Integer-Slot vs Fractional-Slot Concentrated-Winding Axial-Flux Permanent Magnet Machines: Comparative Design, FEA and Experimental Tests  
Giulio De Donato, Fabio Giulii Capponi, Antonio Rivellini and Federico Caricchi, University of Rome “La Sapienza”, Italy  

4:45 pm • Design and Analysis of Brushless Doubly Fed Reluctance Machines  
Andrew Knight, Robert Betz and David Dorrell, University of Alberta, Canada; University of Newcastle, Australia; University of Technology Sydney, Australia  

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S68  High Power Inverters  

**Russell**  
Chair: Toshihisa Shimizu, Tokyo Metropolitan University, Japan  

3:30 pm • Common-Mode Voltage Reduction Methods for Medium-Voltage Current Source Inverter-Fed Drives  
Ning Zhu, Bin Wu, Dewei Xu, Navid R. Zargari and Mehrdad Kazerni, Ryerson University, Canada; Rockwell Automation Canada Company, Canada; University of Waterloo, Canada  

3:55 pm • Implementation of a Fully Integrated High Density 50 kW Inverter Using a SiC JFET Based Six-Pack Power Module  
Timothy Junhee Han, Jim Nagashima, Sung Joon Kim, Srikanth Kulkarni and Fred Barlow, Global Power Electronics, Inc., USA; University of Idaho, USA  

4:20 pm • A Transformerless D-StatCom Based on a Multi-Voltage Cascade Converter Requiring No DC Sources  
Kenichiro Sano and Masahiro Takasaki, CRIEPI, Japan
4:45 pm • Optimization of Switching Losses and Harmonic Performance Using Model Predictive Control of a Cascaded H-Bridge Multi-Level StatCom
Chris Townsend, Terry Summers and Robert Betz, University of Newcastle, Australia

S69 Uninterruptible Power Supplies

Sundance
Chair: Ahmet Hava, Middle East Technical University, Turkey

3:30 pm • A Cascaded Online Uninterruptible Power Supply Using Reduced Semiconductor
Lei Zhang, Poh Chiang Loh, Feng Gao and Frede Blaabjerg, Nanyang Technological University, Singapore; Shandong University, China; Aalborg University, Denmark

3:55 pm • Comparisons of Different Control Strategies for 20kVA Solid State Transformer
Gangyao Wang, Xu She, Fei Wang, Arun Kadavelugu, Tiefu Zhao, Alex Huang and Wenxi Yao, North Carolina State University, USA; Zhejiang University, China

4:20 pm • On Single-Phase UPS Topologies
Edison Da Silva, Welffen Santos, Cursino Jacobina and Alexandre Cunha, Federal University of Campina Grande, Brazil

S70 Single Phase AC-DC Rectifier: Control and Analysis

Borein
Chairs: Yaow-Ming Chen, National Taiwan University, Taiwan, and Mohamed Orabi, South Valley University, Egypt

3:30 pm • Digital Control Strategy for Multi-Phase Interleaved Boundary Mode and DCM Boost PFC Converters
Tobias Grote, Frank Schafmeister, Heiko Figge, Norbert Froehleke and Joachim Boecker, University of Paderborn, Germany; DELTA Energy Systems GmbH, Germany

3:55 pm • The Effect of Ripple Steering on Control Loop Stability for a CCM PFC Boost Converter
Fariborz Musavi, Murray Edington, Wilson Eberle and William G. Dunford, Delta-Q Technologies Corp., Canada; University of British Columbia, Canada

4:20 pm • Model Predictive-Based Control Method for Cascaded H-Bridge Multilevel Active Rectifiers
Michail Vasiladiotis, Konstantinos Pavlou, Stefanos Manias and Alfred Rufer, Ecole Polytechnique Federale de Lausanne (EPFL), Switzerland; National Technical University of Athens (NTUA), Greece

S71 Rail, Aerospace and Marine

Regency D
Chair: Mahesh Krishnamurthy, Illinois Institute of Technology, USA

3:30 pm • Diode Rectification of Multiphase Synchronous Generators for Aircraft Applications
Steven Jordan and Judith Apsley, University of Manchester, UK

3:55 pm • Self Healing for a DC Zonal Distribution Architecture Using Active Impedance Estimation
Mark Sumner, Edward Christopher, David Thomas and Frans de Wildt, University of Nottingham, UK; MOD UK, UK

4:20 pm • An Algorithm and Implementation System for Measuring Impedance in the D-Q Domain
Francis Gerald, Burgos Rolando, Boroyevich Dushan, Wang Fred and Karimi Kamiar, The Boeing Co., USA; ABB Corporate Research, USA; Virginia Tech - CPES, USA; University of Tennessee, USA

S72 Integrated DC-DC Converters

Regency A
Chairs: Cian Ó Mathúna, Tyndall University, Ireland, and Francesco Caraboliante, Qualcomm, USA

3:30 pm • A Single-Inductor Bipolar-Output Converter with 5 mV Positive Voltage Ripple for Active Matrix OLED
Chen Wei-Chung, Chiu Chao-Chang, Hsieh Chun-Yu, Huang Tzu-Chi and Lee Yu-Huei, ECE, NCTU, Taiwan

3:55 pm • A 1.65W Fully Integrated 90nm Bulk CMOS Intrinsic Charge Recycling Capacitive DC-DC Converter
Hans Meyvaert, Tom Van Breussegem and Michiel Steyaert, Katholieke Universiteit Leuven ESAT-MICAS, Belgium

4:20 pm • Non-Isolated Flyback Switching Capacitor Voltage Regulator
Wenjing Cao, Ke Jin and Xinbo Ruan, Nanjing University of Aeronautics and Astronautics, China

Thursday, September 22 8:00 am – 9:40 am

S73 Energy Storage II

Ellis West
Chairs: Madhav Manjrekar, Siemens Energy Inc., USA, and Satish Rajagopalan, EPRI, USA

8:00 am • Interleaved Smart Burp PV Charger for Lead Acid Batteries with Incremental Conductance MPPT
Guan-Chyun Hsieh, Shih-Wei Chen and Cheng-Yuan Tsai, Chyun Yuan Christian University, Taiwan; National Taiwan University of Science and Technology, Taiwan

8:25 am • Design and Implementation of a Bi-Directional Isolated DAB-Based DC-DC Converter in Home Area Networks
Sheng-Chieh Lo, Yen-Chun Wu and Tzung-Lin Lee, National Sun Yat-sen University, Taiwan

8:50 am • Power Control Strategy of a CSC Based Wind Energy Conversion System with Superconducting Magnetic Energy Storage System in DC Side
Zheng Wang, Yongqiang Lang, Ming Cheng and Jiacheng Wang, Southeast University, China; Delta Electronics, Nanjing, China; Department of Electrical and Computer Engineering, Canada

9:15 am • Lithium-Based Energy Storage Management for DC Distributed Renewable Energy System
Wei Zhang, Dong Dong, Igor Cvetkovic, Fred C. Lee and Boroyevich Dushan, Virginia Polytechnic Institute and State University, USA
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<thead>
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<th>Session</th>
<th>Title</th>
<th>Chair(s)</th>
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<td>S74</td>
<td>Electric Machine Modeling</td>
<td>Curtis A, Chairs: David Dorrell, University of Technology, Australia, and Rafal Wrobel, University of Bristol, UK</td>
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<tr>
<td>8:00 am</td>
<td>Modeling and Effects of In-Situ Magnetization of Isotropic Ferrite Magnet Motors</td>
<td>Min-Fu Hsieh, Ching-Kuo Lin, David Dorrell and Peter Wung, National Cheng Kung University, Taiwan; University of Technology, Sydney, Australia; A. O. Smith Corporation, USA</td>
</tr>
<tr>
<td>8:25 am</td>
<td>A Basic Study of MATRIX Motor</td>
<td>Hiroki Hijikata and Kan Akatsu, Shibaura Institute of Technology, Japan</td>
</tr>
<tr>
<td>8:50 am</td>
<td>Influence of Slot and Pole Number Combinations on Unbalanced Magnetic Force in Permanent Magnet Machines</td>
<td>Z. Q. Zhu, M. L. Mohd Jamil and L. J. Wu, University of Sheffield, UK</td>
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<tr>
<td>S75</td>
<td>Modulation Techniques</td>
<td>Cassidy, Chair: Tim Alt, Rolls-Royce, USA</td>
</tr>
<tr>
<td>8:00 am</td>
<td>PWM Scheme to Reduce the Common-Mode Current Generated by an AC Drive at Low Modulation Index</td>
<td>Rangarajan Tallam, David Leggate, David Kirschnik and Richard Lukaszewski, Rockwell Automation, USA</td>
</tr>
<tr>
<td>8:25 am</td>
<td>Model Predictive Pulse Pattern Control</td>
<td>Tobias Geyer, Nikolaos Okonomou, Georgios Papaioiipou and Frederick Kieferndorf, The University of Auckland, New Zealand; ABB Corporate Research, Switzerland</td>
</tr>
<tr>
<td>8:50 am</td>
<td>Quantitative Power Quality and Characteristic Analysis of Multilevel Pulse Width Modulation Methods in Medium Voltage High Power Industrial AC Drives</td>
<td>Kevin Lee and Geraldo Nojima, Eaton Corporation, USA</td>
</tr>
<tr>
<td>S76</td>
<td>DC-DC Converters for Renewable Energy Systems</td>
<td>Ellis East, Chairs: Burak Ozpineci, Oak Ridge National Laboratory, USA, and Sudip Mazumder, University of Illinois, Chicago, USA</td>
</tr>
<tr>
<td>8:00 am</td>
<td>Bi-Directional Converter with Low Input/Output Current Ripple for Renewable Energy Applications</td>
<td>Abbas Fardoun, Esam Ismail, Ahmad Sabzali and Mustafa Al-Saffar, UAE University, United Arab Emirates; College of Technological Studies, Kuwait</td>
</tr>
<tr>
<td>8:25 am</td>
<td>Swinging Bus Technique for Ripple Current Elimination in Fuel Cell Power Conversion</td>
<td>Martin Ordonez, Simon Fraser University, Canada</td>
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<tr>
<td>8:50 am</td>
<td>Characteristic Analysis and Modeling on PEMFC Degradation Associated with Low Frequency Ripple Current Effects</td>
<td>Jonghoon Kim, Minho Jang, Yongsung Tak and Bohyung Cho, Seoul National University, Republic of Korea; Inha University, Republic of Korea</td>
</tr>
<tr>
<td>9:15 am</td>
<td>A Three-Port Half-Bridge Converter with Synchronous Rectification for Renewable Energy Application</td>
<td>Hongfai Wu, Yan Xing, Runruo Chen, Junjun Zhang, Kai Sun and Hongjuan Ge, Nanjing University of Aeronautics and Astronautics, China; Tsinghua University, China</td>
</tr>
<tr>
<td>S77</td>
<td>DC-DC Converters: Controls II</td>
<td>Remington, Chairs: Dragan Maksimovic, University of Colorado at Boulder, USA, and Jaber Abu-Gahouq, Arizona University, USA</td>
</tr>
<tr>
<td>8:00 am</td>
<td>Analysis and Implementation of Output Voltage Regulation in Multi-Phase Switched Capacitor Converters</td>
<td>Sam Ben-Yaakov and Alexander Kushnerov, Ben-Gurion University of the Negev, Israel</td>
</tr>
<tr>
<td>8:25 am</td>
<td>Flyback Transformer Based Transient Suppression Method for Digitally Controlled Buck Converters</td>
<td>Jing Wang, Aleksandar Prodic and Wai Tung Ng, University of Toronto, Canada</td>
</tr>
<tr>
<td>8:50 am</td>
<td>Improvements in Boundary Control of Boost Converters Using the Natural Switching Surface</td>
<td>Juan Galvez, Martin Ordonez, Federico Luchino and John Quaicoe, Simon Fraser University, Canada; Memorial University of Newfoundland, Canada</td>
</tr>
<tr>
<td>9:15 am</td>
<td>A Family of Switching Capacitor Regulators</td>
<td>Ling Gu, Wenjing Cao, Ke Jin and Xinbo Ruan, Nanjing University of Aeronautics and Astronautics, China</td>
</tr>
<tr>
<td>S78</td>
<td>Advanced Electric Machine Design II</td>
<td>Cowboy Artists, Chairs: Yves Perriard, Ecole Polytechnique Federale de Lausanne, Switzerland, and Andreas Binder, Darmstadt University of Technology, Germany</td>
</tr>
<tr>
<td>8:00 am</td>
<td>Design Study for Exterior Rotor Bearless Permanent Magnet Machines</td>
<td>Thomas Reichert, Thomas Nussbaumer and Johann W. Kolar, Power Electronic Systems Laboratory, ETH Zurich, Switzerland; Levitonix GmbH, Switzerland</td>
</tr>
<tr>
<td>8:25 am</td>
<td>A Novel Technique for Minimizing Torque Ripple in Axial Flux Segmented Rotor SRM</td>
<td>Madhavan Ramanujam and Ferrandes B.G., Indian Institute of Technology Bombay, India</td>
</tr>
<tr>
<td>8:50 am</td>
<td>Core Axial Lengthening as Effective Solution to Improve the Induction Motor Efficiency Classes</td>
<td>Luigi Alberti, Nicola Bianchi, Aldo Boglietti and Andrea Cavagnino, Universita' di Padova, Italy; Politecnico di Torino, Italy</td>
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<tr>
<td>9:15 am</td>
<td>Characterization of Noise and Vibration in Permanent Magnet Synchronous Motors Using Electromagnetic and Structural Analyses</td>
<td>Mohammad Islam, Rakib Islam and Tomy Sebastian, Nexteer Automotive, USA</td>
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<tr>
<td>S79</td>
<td>Multilevel Converters II</td>
<td>Russell, Chair: Yong Kang, Huazhong University of Science and Technology, China</td>
</tr>
<tr>
<td>8:00 am</td>
<td>Optimal Pulsewidth Modulation of a Dual Three-Level Inverter System Operated from a Single DC Link</td>
<td>Till Boller, Joachim Holtz and Akshay Rathore, University of Wuppertal, Germany; National University of Singapore, Singapore</td>
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</table>
8:25 am • Fault-Tolerance Capacity of the Multilevel Active Clamped Topology
Joan Nicolas-Apruzzese, Sergio Busquets-Monge, Josep Bordonau, Salvador Alepuz and Alejandro Calle-Prado, Technical University of Catalonia (UPC), Spain

8:50 am • A Neutral Point Balancing Controller for Three-Level Inverter with Full Power-Factor Range and Low Distortions
Jie Shen, Stefan Schroeder, Duro Basic and Robert Roesner, GE Global Research, Germany; GE Energy, Germany

9:15 am • Equalization of DC Bus Voltage in Three-Level NPC-HB Inverters for PV Applications by Even Harmonics Injection or Fundamental Phase Modulation
Roberto Petrella, Nicola Buonocunto, Alessandro Revelant and Piero Stocco, DIEGM - University of Udine, Italy; MetaSystem Energy s.r.l., Italy

S80 Medium Voltage Industrial Drives

Sundae
Chairs: Sewon Choi, Seoul National University, Republic of Korea, and Jason Lai, Virginia Tech, USA

8:00 am • Transformerless Multi-Level Converter Based Medium Voltage Drives
Peter Steimer and Manfred Winkelkemper, ABB Ltd., Switzerland

8:25 am • Quantitative System Compatibility and Characteristics Analysis of Two-Level and Three-Level Low Voltage Industrial Drives
Kevin Lee and Wenxi Yao, Eaton Corporation, USA; Zhejiang University, China

8:50 am • Regenerative Energy Saving in Multi-Axis Servo-Motor-Drives
Ali Kashefi Kaviani, Brian Hadley and Behrooz Mirazfai, Florida International University, USA; Kansas State University, USA

S81 Single Phase AC-DC Rectifier: Topology

Borein
Chairs: Tsorng-Juu (Peter) Liang, National Cheng Kung University, Taiwan, and Dylan Lu, University of Sydney, Australia

8:00 am • A Transformerless Single-Stage AC-DC Converter with Low Output Voltage
Shu Kong Ki and Dylan Dah-Chuan Lu, The University of Sydney, Australia

8:25 am • Novel Bi-Directional AC-DC MOSFET Converter for Energy Storage System Applications
Hao Qian, Jih-Sheng Lai and Wensong Yu, Virginia Tech, USA

8:50 am • Dynamic Behavior of Single-Phase Full-Wave Rectifiers with Instantaneous Constant-Power Loads
Chimaobi Onwuchekwa and Alexis Kwasinski, The University of Texas at Austin, USA

S82 Contactless Power Transfer

Curtis B
Chair: Fang Peng, Michigan State University, USA

8:00 am • Free Positioning for Inductive Wireless Power System
Eberhard Waffenschmidt, Philips Research, Germany

8:25 am • A Contactless Power Transfer System with Capacitively Coupled Matrix Pad
Chao Liu, Patrick Aiguo Hu and Xin Dai, The University of Auckland, New Zealand; Chongqing University, China

9:15 am • A Design Methodology for Multi-kW, Large Airgap, MHz Frequency, Wireless Power Transfer Systems
Seung-Hwan Lee and Robert D. Lorenz, University of Wisconsin-Madison, USA

S83 Inverter Applications

Phoenix
Chair: Burak Ozpineci, Oak Ridge National Lab, USA

8:00 am • High Performance Gradient Driver for Magnetic Resonance Imaging System
Rixin Lai, Juan Sabate, Song Chi and Wesley Skeffington, GE Global Research Center, USA

8:25 am • High Performance Pulsed Power Resonant Converter for Radio Frequency Applications
Chao Ji, Pericle Zanchetta, Fabio Carastro and Jon Clare, University of Nottingham, UK

8:50 am • H5TM Inverter with Constant-Frequency Asynchronous Sigma-Delta Modulation
Yaow-Ming Chen, Chia-Hsi Chang and Yung-Ruei Chang, National Taiwan University, Taiwan; Institute of Nuclear Energy Research, Taiwan

9:15 am • Variable Sampling Frequency in Iterative Learning Current Control for Shunt Active Filter in Aircraft Power Systems
Pericle Zanchetta, Jun Yi Liu, Marco Degano and Paolo Mattavelli, University of Nottingham, UK; Virginia Tech, USA

Thursday, September 22
10:00 am – 11:40 am

S84 Energy Storage: Batteries

Ellis West
Chairs: Madhav Manjrekar, Siemens Energy Inc., USA, and Raju Ravisekhar, GE Global Research, USA

10:00 am • Battery Ripple Current Reduction in a Three-Phase Interleaved DC-DC Converter for 5kW Battery Charger
Wujong Lee, Byung-Moon Han and Hanju Cha, Chungnam National University, Republic of Korea; Myongji University, Republic of Korea

10:25 am • Empirical Battery Model Characterizing a Utility-Scale Carbon-Enhanced VRLA Battery
Daniel Fregosi, Subhashish Bhattacharya and Stanley Atcitty, North Carolina State University, USA; Sandia National Laboratories, USA

10:50 am • Self-Reconfigurable Multicell Batteries
Taesik Kim, Wei Qiao and Liyan Qu, University of Nebraska-Lincoln, USA

11:15 am • Evaluating the Application of Energy Storage and Day-Ahead Solar Forecasting to Firm the Output of a Photovoltaic Plant
Frank Kreikebaum, Rohit Moghe, Anish Prasai and Deepak Divan, Georgia Institute of Technology, USA
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<td>S85</td>
<td><strong>Switched Reluctance Machines</strong></td>
<td>Curtis A, Chairs: Avoki Omekanda, General Motors, USA, and Yilmaz Sozer, University of Akron, USA</td>
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<tr>
<td></td>
<td>10:00 am • Design of Switched Reluctance Motor Competitive to 60 kW IPMSM in Third Generation Hybrid Electric Vehicle</td>
<td>Kyohei Kiyota and Akira Chiba, Tokyo Institute of Technology, Japan</td>
</tr>
<tr>
<td></td>
<td>10:25 am • Torque Ripple Minimization of Switched Reluctance Machines Through Current Profiling</td>
<td>Rajib Mikail, Yilmaz Sozer, Iqbal Hussein, Mohammad Islam and Tomy Sebastian, University of Akron, USA, Nexteer Automotive, USA</td>
</tr>
<tr>
<td></td>
<td>10:50 am • Switched Reluctance Generator Controls for Optimal Power Generation and Battery Charging</td>
<td>Sandeep Narla, Yilmaz Sozer and Iqbal Hussein, University of Akron, USA</td>
</tr>
<tr>
<td></td>
<td>11:15 am • Characteristics of Axial Type Switched Reluctance Motor</td>
<td>Hiromu Arihara and Kan Akatsu, Shibaura Institute of Technology, Japan</td>
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<td>S86</td>
<td><strong>Drive Control</strong></td>
<td>Cassidy, Chair: Gui-Jia Su, Oak Ridge National Laboratory, USA</td>
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<td></td>
<td>10:00 am • Control of Induction Machine with Extended Range of Maximum Torque Capability for Traction Drives</td>
<td>Bin Gu and JiH-Sheng Lai, Virginia Tech, USA</td>
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<tr>
<td></td>
<td>10:25 am • Application of One-Cycle Control to Stator Field-Oriented Control</td>
<td>Alberto Soto-Lock, Edison Da Silva, Malik Elbuluk and Cursino Jacobina, Federal University of Campina Grande, Brazil; University of Akron, USA</td>
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<td></td>
<td>10:50 am • Zero-Speed Operation of CSI-Fed Induction Motor Drive</td>
<td>Fangrui Liu, Bin Wu, Manish Pande and Navid Zargari, Ryerson University, Canada; Rockwell Automation, Canada</td>
</tr>
<tr>
<td></td>
<td>11:15 am • Input Power Factor Compensation for PWM-CSC Based High-Power Synchronous Motor Drives</td>
<td>Jingya Dai, Manish Pande and Navid Zargari, Rockwell Automation, Canada</td>
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<tr>
<td>S87</td>
<td><strong>Solar PV System Design and Architecture</strong></td>
<td>Ellis East, Chairs: Adel Nasiri, University of Wisconsin, Milwaukee, USA, and Vladimir Blasko, United Technologies Research Center, USA</td>
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<td></td>
<td>10:00 am • Development of an Autonomous Distributed Maximum Power Point Tracking PV System</td>
<td>Yaow-Ming Chen, Cheng-Wei Chen and Yang-Lin Chen, National Taiwan University, Taiwan</td>
</tr>
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<td></td>
<td>10:25 am • Progressive Smooth Transition for Four-Switch Buck-Boost Converter in Photovoltaic Applications</td>
<td>Yaow-Ming Chen, Yang-Lin Chen and Cheng-Wei Chen, National Taiwan University, Taiwan</td>
</tr>
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<td>10:50 am • Photovoltaic-Wind Hybrid System with Battery Back-Up Optimized for Apartment Complexes and other Community Living Environments</td>
<td>Mohammad Bagher Shadmand, Murali Pasupuleti and Robert Balog, Texas A and M University, USA</td>
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<tr>
<td>S88</td>
<td><strong>DC-DC Converters: Controls III</strong></td>
<td>Remington, Chairs: Regan Zane, University of Colorado at Boulder, USA, and Pritam Das, Queen’s University, Canada</td>
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<tr>
<td></td>
<td>10:00 am • Seamless Boost Converter Control in Critical Boundary Condition for Fuel Cell Power Conditioning System</td>
<td>Tai-Sik Hwang and Sung-Yeul Park, University of Connecticut, USA</td>
</tr>
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<td></td>
<td>10:25 am • Enhanced Load Step Response for a Bi-Directional DC-DC Converter</td>
<td>Dinesh Sekhar Segaran, Grahame Holmes and Brendan McGrath, RMIT University, Australia</td>
</tr>
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<td></td>
<td>10:50 am • A Switching Strategy for Multiple-Input Converters</td>
<td>Chimaobi Omuchekwa and Alexis Kwasinski, The University of Texas at Austin, USA</td>
</tr>
<tr>
<td></td>
<td>11:15 am • Sliding-Mode Control of Quasi-Z-Source Inverter with Battery for Renewable Energy System</td>
<td>Jianfeng Liu, Shuai Jiang, Dong Cao, Xi Lu and Fangzheng Peng, Central South University, China; Michigan State University, USA</td>
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<tr>
<td>S89</td>
<td><strong>Permanent Magnet Machine Optimization</strong></td>
<td>Cowboy Artists, Chairs: Hamid Toliyat, Texas A and M University, USA, and Francesco Cupertino, Politecnico di Bari, Italy</td>
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<td></td>
<td>10:00 am • Automated Bi-Objective Design Optimization of Multi-MW Direct-Drive PM Machines Using CE-FEA and Differential Evolution</td>
<td>Gennadi Sizov, Peng Zhang, Dan Ionel, Demerdash Nabeel and Marius Rosu, Marquette University, USA; ANSYS, USA</td>
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<td></td>
<td>10:25 am • Fast Optimization of an IPMSM with Space Mapping Technique</td>
<td>Stephane Vivier, Didier Lemoine and Guy Friedrich, Universite de Technologie de Compiegne, France</td>
</tr>
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<td></td>
<td>10:50 am • Minimization of Cogging Torque in a Small Axial-Flux PMSG with a Parallel-Teeth Stator</td>
<td>John Wanjiku, Hartmut Jagau, Azeem Khan and Paul Barendse, University of Cape Town, South Africa</td>
</tr>
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<td></td>
<td>11:15 am • A Review of Recent Developments in Electrical Machine Design Optimization Methods with a Permanent Magnet Synchronous Motor Benchmark Study</td>
<td>Yao Duan and Dan Ionel, Vestas Technology R&amp;D Americas, Inc., USA</td>
</tr>
<tr>
<td>S90</td>
<td><strong>Inverter PWM Techniques</strong></td>
<td>Russell, Chair: Xinbo Ruan, Huazhong University of Science and Technology, China</td>
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<tr>
<td></td>
<td>10:00 am • A Novel Switching Loss Minimized PWM Method for a High Switching Frequency Three-Level Inverter with a SiC Clamp Diode</td>
<td>Nam-Joon Ku, Hong-Ju Jung, Rae-Young Kim and Dong-Suk Hyun, Hanyang University, Republic of Korea</td>
</tr>
<tr>
<td></td>
<td>10:25 am • SDRE Control of Single Phase PWM Inverter Using FPGA Based Hardware Controller</td>
<td>Takeaki Fujimoto, Hiroki Uchida and Yokoyama Tomoki, Tokyo Denki University, Japan</td>
</tr>
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</table>
10:50 am • Introducing the Elliptical Carrier for PWM Inverters: Derivation and Properties for Phase-Shift Compensation
Lucas Sinopoli and Martin Ordonez, Memorial University of Newfoundland, Canada; Simon Fraser University, Canada

11:15 am • A New Three-Phase Hybrid Five-Level Inverter with Reduced Number of High-Frequency Switching Devices
Liviu Mihalache and Yaosuo Xue, Siemens Corporate Research, USA

S91 STATCOM Controls

Sundance
Chairs: Yongsug Suh, Chonbuk National University, Korea, and Pericle Zanchetta, University of Nottingham, UK

10:00 am • Negative-Sequence Reactive-Power Control by a PWM STATCOM Based on a Modular Multilevel Cascade Converter (MMCC-SDBC)
Makoto Hagiwara, Ryo Maeda and Hirofumi Akagi, Tokyo Institute of Technology, Japan

10:25 am • A Unified Modular Transformer Converter (MTC) System with Advanced Angle Control Structure
Babak Parkhizdeh and Subhashish Bhattacharya, North Carolina State University, USA

10:50 am • A DSTATCOM with ADALINE Algorithm for Current Compensation in Distributed Generation Systems
Yin-Ching Wang, Shou-Fu Li and Tsung-Lin Lee, National Sun Yat-sen University, Taiwan

11:15 am • Instantaneous Phase-Locked Loop for Performance Improvement of System with STATCOM Under Single-Line to Ground Fault
Xi Zhengping, Babak Parkhizdeh and Subhashish Bhattacharya, North Carolina State University, USA

S92 AC-DC Rectifiers: Control II

Borein
Chairs: Yasuyuki Nishida, Chiba Institute of Technology, Japan, and Yan Xing, Nanjing University of Aeronautics and Astronautics, China

10:00 am • AC Stability of High Power Factor Multi-Pulse Rectifiers
Rolando Burgos, Dushan Boroyevich, Fred Wang, Karimi Kamiar and Francis Gerald, ABB Corporate Research, USA; Virginia Tech, CPES, USA; University of Tennessee, USA; The Boeing Co., USA

10:25 am • Multiloop Interleaved Control for Two-Switch Two-Capacitor Three-Level SMR without Capacitor Voltage Balancing Loop
Jhen-Yu Liao and Hung-Chi Chen, National Chiao Tung University, Taiwan

10:50 am • HF Voltage Generation in a Multi-State Switching Cells-Based Single-Phase Multilevel PFC Rectifier
Marcio Ortman, Samir Mussa and Marcelo Heldwein, Federal University of Santa Catarina - EEL/INEP, Brazil

11:15 am • Low-Frequency Leakage Current Reduction Using Active Control of Single-Phase PWM Rectifier
Dong Dong, Dushan Boroyevich and Paolo Mattavelli, Virginia Tech, USA

S93 DC-DC Converters: Passive Components

Curtis B
Chairs: Mat Wilkowski, Empirion, USA, and Braham Ferreira, Delft University of Technology, Netherlands

10:00 am • A Novel Winding Layout Strategy for Planar Transformer Applicable to High Frequency High Power DC-DC Converters
Majid Pahlavaninezhad, Pritam Das, Josef Drobnik, Praveen Jain, Alireza Bakhshai and Gerry Moschopoulos, Queen’s University, Canada; Freescale Semiconductors Inc., USA; University of Western Ontario, Canada

10:25 am • Proposal and Validation of a Medium-Frequency Power Transformer Design Methodology
Irma Villar, Asier Garcia-Bediaga, Unai Viscarret, Ion Etxeberria-Otadui and Alfred Rufer, IKERLAN-IK4 Technology Research Centre, Spain; Industrial Electronics Laboratory, EPFL, Switzerland

10:50 am • Novel Concepts for High Frequency High Efficiency Transformer Design
Dianbo Fu and Shuo Wang, Huawei Technologies, USA; University of Texas at San Antonio, USA

11:15 am • A Novel Integrated Multi-Elements Resonant Converter
Daocheng Huang, Pengju Kong, Fred. C. Lee and Dianbo Fu, Virginia Tech, USA; Intersil Corporation, USA; Huawei Technologies Co., Ltd., USA

S94 General Inverter Technologies

Phoenix
Chairs: Yan Xing, Nanjing University of Aeronautics and Astronautics, China, and Jon Clare, University of Nottingham, UK

10:00 am • An Improved Virtual Resistance Damping Method for Grid-Connected Inverters with LCL Filters
Ye Li, Zhengming Zhao, Fanbo He, Sizhao Lu and Lu Yin, Tsinghua University, China

10:25 am • Modeling and Digital Control of LLC Resonant Inverter with Varying Load
Scott Jensen, Luca Corradini, Miguel Rodriguez and Dragan Maksimovic, University of Colorado at Boulder, USA

10:50 am • Analysis and Characterization of DC Bus Ripple Current of Two-Level Inverters Using the Equivalent Centered Harmonic Approach
Ufuk Ayhan and Ahmet Hava, Middle East Technical University, Turkey

11:15 am • Model Predictive Control of Z-Source Neutral Point Clamped Inverter
Wei Mo, Poh Chiang Loh and Fred Bjaalberg, Nanyang Technological University, Singapore; Aalborg University, Denmark

Thursday, September 22
1:40 pm – 3:20 pm

S95 Ocean and Wave Energy Harvesting I

Ellis West
Chairs: Dehong Xu, Zhejiang University, China, and David Dorrell, University of Technology Sydney, Australia

1:40 pm • Wave Energy Converter with Wideband Power Absorption
Timothy Lewis, Annette von Jouanne and Ted Brekken, Oregon State University, USA
### Technical Program Schedule

**2:05 pm • Efficient Energy Harvester for Microbial Fuel Cells Using DC-DC Converters**
Jae-Do Park and Zhiyong Ren, University of Colorado Denver, USA

**2:30 pm • Universal Power Management IC for Small-Scale Energy Harvesting with Adaptive Impedance Matching**
Na Kong, T. Shaver Deyerle IV and Dong Sam Ha, Virginia Tech, USA

**2:55 pm • Design and Experiments of Linear Tubular Generators for the Inertial Sea Wave Energy Converter**
Giovanni Bracco, Ermano Giorelli, Giuliana Mattiazzo, Ciro Attaianese and Silvio Carbone, Politecnico di Torino, Italy; University of Cassino, Italy

### S96 Power Devices: Measurement and Characterisation

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<tr>
<td>2:05 pm</td>
<td>Can Power Devices’ Sensitivity to Mechanical Stresses Be Used as a Sensor for Power Assembly Health Monitoring?</td>
<td>Florence Capy, Stephane Azzopardi, Kamal El Boubkari, Yassine Belmehdi and Jean-Yves Deletage, IMS Laboratory, France</td>
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<tr>
<td>2:30 pm</td>
<td>High-Bandwidth, High-Fidelity In-Circuit Measurement of Power Electronic Switching Waveforms for EMI Generation Analysis</td>
<td>Niall Oswald, Bernard Stark, Neville McNeill and Derrick Holiday, University of Bristol, UK</td>
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<td>2:55 pm</td>
<td>Experimental Study of Power Module with SiC Devices</td>
<td>Dong Jiang, Fan Xu, Fei Wang, Timothy Junghae Han and Leon Tolbert, University of Tennessee, USA; Global Power Electronics, USA</td>
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### S97 Drive Issues II

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<td>1:40 pm</td>
<td>Control of PWM Voltage Source Inverter in the Pulse Dropping Region to Reduce Reflected Wave Motor Over-Voltage</td>
<td>Rangarajan Tallam and David Leggate, Rockwell Automation, USA</td>
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<tr>
<td>2:05 pm</td>
<td>Embedded-Friendly Online Dead-Time Compensation Using PWM Timer</td>
<td>Takahiro Suzuki, Kiyoji Sakamoto, Toshihiro Takeuchi and Yasuo Notohara, Hitachi, Ltd., Japan; Hitachi Information and Control Solutions, Ltd., Japan</td>
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<td>2:30 pm</td>
<td>Feedforward Control for SPMSM with Final State Control Based on Voltage Limit Circle with Transient Term</td>
<td>Takayuki Miyajima, Hiroshi Fujimoto and Masami Fujitsu, The University of Tokyo, Japan; DENSO Corporation, Japan</td>
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<td>2:55 pm</td>
<td>On-Line Condition Monitoring for MOSFET and IGBT Switches in Digitally Controlled Drives</td>
<td>Jason Anderson and Robert Cox, UNC Charlotte, USA</td>
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### S98 Grid Interactive Renewable Energy Systems

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<td>1:40 pm</td>
<td>Utility Grid Impact with High Penetration PV Micro-Inverters Operating Under Burst Mode Using Simplified Simulation Model</td>
<td>Zheng Zhao, Kuan-Hung Wu, Jih-Sheng Lai and Wensong Yu, Virginia Tech, USA; National Taiwan University of Science and Technology, Taiwan</td>
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<td>2:05 pm</td>
<td>Energy Capture Improvement of a Solar PV System with a Multilevel Inverter</td>
<td>Nayeem Mahmud, Yilmaz Sozer and Iqbal Husain, University of Akron, USA</td>
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<td>2:30 pm</td>
<td>A DC-Link Voltage Control Scheme for Single-Phase Grid-Connected PV Inverters</td>
<td>Fanbo He, Zhengming Zhao, Liqiang Yuan and Sizhao Lu, Tsinghua University, China</td>
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### S99 DC-DC Converters: Topologies III

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<tr>
<td>1:40 pm</td>
<td>Canonical Small-Signal Model of Double-Input Converters Based on H-Bridge Cells</td>
<td>Reza Ahmadi and Mehdi Ferdowsi, Missouri University of Science and Technology, USA</td>
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<tr>
<td>2:05 pm</td>
<td>A Novel Half-Bridge Converter with Current Ripple Reduction</td>
<td>Ching-Shan Leu and Trong Nha Quang, National Taiwan University of Science and Technology, Taiwan</td>
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<td>2:30 pm</td>
<td>Design Considerations of a Multiple-Input Isolated Single Ended Primary Inductor Converter (SEPIC) for Distributed Generation Sources</td>
<td>Sheng-Yang Yu, Ruichen Zhao and Alexis Kwasinski, The University of Texas at Austin, USA</td>
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<td>2:55 pm</td>
<td>A Variable Frequency Soft Switching Controlled Boost-Feedback Converter for High Step-Up Applications</td>
<td>Junjun Zhang, Hongfei Wu, Yan Xing, Kai Sun and Xudong Ma, Nanjing University of Aeronautics and Astronautics, China; Tsinghua University, China; Southeast University, China</td>
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### S100 Special Application Machines

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<td>1:40 pm</td>
<td>Damper Windings for the Magnetic Gear</td>
<td>Siavash Pakdelian, Nicolas Frank and Hamid Toliyat, Texas A and M University, USA; ABB US Corporate Research Center, USA</td>
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<td>2:05 pm</td>
<td>Experimental Evaluation of a Motor Integrated Permanent Magnet Gear</td>
<td>Peter Rasmussen, Kasper Koetter, Tommy Frandsen and Kenneth Jessen, Aalborg University, Denmark; Danfoss Drives, Denmark</td>
</tr>
</tbody>
</table>
2:30 pm • A Line-Fed Permanent Magnet Motor Solution for Drum-Motor and Conveyor-Roller Applications
Mircea Popescu, David Staton, Steven Jennings, Thomas Barucki and Joachim Schnuettgen, Motor Design Ltd., UK; Interroll, Germany; Adapted Solutions GmbH, Germany

2:55 pm • Design Study of a Three-Phase Brushless Exciter for Aircraft Starter/Generator
Antonio Griffio, Rafal Wrobel, Adrian Miot, Jason Von and Phil Mellor, University of Bristol, UK

S101 Modular Multilevel Converters
Russell
Chairs: Sudip K. Mazumder, University of Illinois, USA, and Wuhua Li, Zhejiang University, China

1:40 pm • A New Three-Phase AC-AC Modular Multilevel Converter with Six Hexagonally Arranged Branches
Lennart Baruschka and Axel Mertens, Leibniz University of Hannover, Germany

2:05 pm • Complex Phasor Modeling and Control of Modular Multilevel Inverters
Justin Reed, Giri Venkataramanan and Francisco Martinez, University of Wisconsin-Madison, USA; Technical University of Madrid, Spain

2:30 pm • Continuous Model of Modular Multilevel Converter and Experimental Verification
Steffen Rohner, Jens Weber and Steffen Bernet, Dresden University of Technology, Germany

2:55 pm • Capacitor Voltage Balancing Control Based on CPS-PWM of Modular Multilevel Converter
Xiaojian Li, Qiang Song, Jianguo Li and Wenhua Liu, Tsinghua University, China

S102 Active Filters Applications
Sundance
Chairs: Toshihisa Shimizu, Tokyo Metropolitan University, Japan, and Tony O’Gorman, Continental Automotive, USA

1:40 pm • Design and Testing of a Medium Voltage Controllable Network Transformer Prototype with an Integrated Hybrid Active Filter
Debrup Das, Javier Munoz, Rajendra Prasad Kandula, Ron Harley, Deepak Divan and Joe Schatz, Georgia Institute of Technology, USA; University of Concepcion, USA; Southern Company, USA

2:05 pm • A High Power Medium-Voltage DC Amplifier System
Hesam Mirzaee, Subhashish Bhattacharya and Sandeep Bala, North Carolina State University, USA; ABB Corporate Research Center, USA

2:30 pm • Study of a New Technique to Reduce the DC-Link Capacitor in a Power Electronic System by Using a Series Voltage Compensator
Huai Wang and Henry Chung, City University of Hong Kong, Hong Kong

2:55 pm • Directional Triplen Hybrid Active Filter for Radial Systems
Rajendra Prasad Kandula, Jorge E. Hernandez and Deepak Divan, Georgia Institute of Technology, USA

S103 Three-Phase AC-DC Rectifiers
Borein
Chairs: Keiji Wada, Tokyo Metropolitan University, Japan, and Fujio Kurokawa, Nagasaki University, Japan

1:40 pm • Selective Harmonic Compensation (SHC) PWM for Grid-Interfacing High-Power Converters
Hua Zhou, Yun Wei Li, Navid R. Zargari and Zhongyuan Cheng, Rockwell Automation Canada, Canada; University of Alberta, Canada

2:05 pm • Development of an All SiC High Power Density Three-Phase Rectifier with Interleaving
Di Zhang, Puqi Ning, Fred Wang, Dushan Boroyevich, Rolando Burgos, Kamiar Karimi, Vikram Immanuel and Solodovnik Eugene, GE, Global Research Center, USA; University of Tennessee, USA; Oak Ridge National Lab, USA; Virginia Tech, CPES, USA; ABB, USA; Boeing Company, USA

2:30 pm • A Multi-Carrier PWM for Parallel Three-Phase Active Front-End Converters
Chung-Chuan Hou, Chung Hua University, Taiwan

2:55 pm • New Considerations in the Input Filter Design of a Three-Phase Buck-Type PWM Rectifier for Aircraft Applications
Marcelo Silva, Nico Hensgens, Jesus Oliver, Pedro Alou, Oscar Garcia and Jose A Cobos, Universidad Politecnica de Madrid, Spain

S104 Soft-Switching Inverters
Phoenix
Chair: Ichiro Omura, Kyushu Institute of Technology, Japan

1:40 pm • Dynamic Analysis and Control of a Zone-Control Induction Heating System
Ngoc Ha Pham, Hideaki Fujita, Kazuhiro Ozaki and Naoki Uchida, Tokyo Institute of Technology, Japan; Mitsui Engineering and Shipbuilding Co., LTD., Japan

2:05 pm • 1/3 Weight Core of a Capacitor-Less ARCP Method Three-Phase Voltage Source Soft-Switching Inverter Suitable for EV
Hirota Koda and Masayoshi Yamamoto, Shimane University, Japan

2:30 pm • Switching Control Strategy to Extend the ZVS Operating Range of a Dual Active Bridge AC-DC Converter
Jordi Everts, Jeroen Van den Keybus and Johan Driesen, Catholic University of Leuven, Belgium; Triphase, Belgium

Thursday, September 22
3:40 pm – 5:00 pm

S105 Ocean and Wave Energy Harvesting II
Ellis West
Chairs: Dehong Xu, Zhejiang University, China, and David Dorrel, University of Technology Sydney, Australia

3:40 pm • Experimental Evaluation of a Doubly-Fed Linear Generator for Ocean Wave Energy Applications
Jennifer Vining, Giri Venkataramanan and Thomas Lipo, University of Wisconsin-Madison, USA

4:05 pm • Per-Unit Wave Energy Converter System Analysis
Timothy Lewis, Annette von Jouanne and Ted Brekken, Oregon State University, USA
### Technical Program Schedule

#### S106 IGBT Modules

**Curriculum A**

Chair: Alex Huang, North Carolina State University, USA

- **3:40 pm** • Diagnostic Characterization of High-Power IGBTs with Field Instrumentation: Pitfalls in Using Curve Tracers Only and Improvements by Oscilloscopes
  - Pierluigi Tenca and Filippo Chimento, ABB Corporate Research, Sweden

- **4:05 pm** • Characterization of a 6.5 kV / 500 A IGBT Module in a Series Resonant Converter
  - Lars Lindenmueller, Steffen Bernet, Rodrigo Alvarez and Philipp Kleinichen, Technische Universität Dresden, Germany

- **4:30 pm** • Turn-On Loss vs. Free-Wheel Diode Recovery DV/DT in IGBT Modules
  - John Donlan, Eric Motto, Marco Honsberg, Thomas Radke and Toru Matsuoka, Powerex, Inc., USA; Mitsubishi Electric Europe BV, Germany; Mitsubishi Electric Corp., Japan

#### S107 DC Microgrids

**Ellis East**

Chairs: Liuchen Chang, University of New Brunswick, Canada, and Erkan Mese, Yildiz Technical University, Turkey

- **3:40 pm** • Game Theoretic Bus Selection in DC Power Systems
  - Nishantha Ekneligoda and Wayne Weaver, Michigan Technological University, USA

- **4:05 pm** • Control of Parallel-Connected Bi-Directional AC-DC Converters in Stationary Frame for Microgrid Applications
  - Xiaonian Lu, Josep Guerrero, Remus Teodorescu, Tamas Kerekes and Kai Sun, Tsinghua University, China; Technical University of Catalonia, Spain; Aalborg University, Denmark

- **4:30 pm** • DC-Bus Voltage Regulation and Power Compensation with Bi-Directional Inverter in DC-Microgrid Applications
  - Tsai-Fu Wu, Chia-Ling Kuo, Kun-Han Sun and Yuan-Chih Chang, EPARC, National Chung Cheng University, Taiwan

#### S108 Multiphase DC-DC Converters

**Remington**

Chairs: Luca Corradini, University of Colorado at Boulder, USA, and Zhiliang Zhang, Nanjing University of Aeronautics and Astronautics, China

- **3:40 pm** • Impact of Input and Output Voltage Perturbation on the Behavior of Automotive Multi-Phase Converters with Coupled Inductors
  - Sebastian Utz and Johannes Pförr, University of Applied Sciences Ingolstadt, Germany

- **4:05 pm** • H2-Optimal Thermal Management for Multi-Phase Current Mode Buck Converters
  - Mohammad Shawkat Zaman, Pearl Ke Cao, Olivier Trescases and Wai Tung Ng, University of Toronto, Canada

- **4:30 pm** • Design and Characterization of a Three-Phase Dual Active Bridge DC-DC Converter in Wye-Delta Connection for a High Frequency and High Power Applications
  - Seunghun Baek, Sumit Dutta and Bhattacharya Subhashish, North Carolina State University, USA

#### S109 Synchronous Reluctance Machines

**Cowboy Artists**

Chairs: Gianmario Pellegrino, Politecnico di Torino, Italy, and Daniel Saban, Danotek Motion Technologies, USA

- **3:40 pm** • Rotor Structure for Reducing Demagnetization of Magnet in a PMASynRM with Ferrite Permanent Magnet and its Characteristics
  - Masayuki Sanada, Yukinori Inoue and Shigeo Morimoto, Osaka Prefecture University, Japan

- **4:05 pm** • Performance Evaluation of a High Power Density PMASynRM with Ferrite Magnets
  - Shohei Ooi, Shigeo Morimoto, Masayuki Sanada and Yukinori Inoue, Osaka Prefecture University, Japan

- **4:30 pm** • Magnet Minimization in IPM-PMASR Motor Design for Wide Speed Range Application
  - Paolo Guglielmi, Barbara Boazzo, Gianmario Pellegrino, Eric Armando and Alfredo Vagati, Politecnico di Torino, Italy

#### S110 Boost Inverters

**Russell**

Chairs: Enrico Santi, University of South Carolina, USA, and Zhengyu Lv, Zhejiang University, China

- **3:40 pm** • Switched-Boost Inverter based on Inverse Watkins-Johnson Topology
  - Santanu Mishra, Ravindranath Adda and Avinash Joshi, Indian Institute of Technology Kanpur, India

- **4:05 pm** • High Voltage Gain Boost Converter Topology for Grid Connected Systems
  - Mohamed Orabi, Moustafa Mousa, Mahrous Ahmed and Mohamed Youssef, APEARC, South Valley University, Egypt; Bombardier Transportation, Canada

- **4:30 pm** • High Step-Up Single-Stage Boost Inverter
  - Yufei Zhou, Wenxin Huang, Jianwu Zhao and Ping Zhao, Nanjing University of Aeronautics and Astronautics, China

#### S111 Utility Applications

**Sundance**

Chairs: Kevin Lee, Eaton Corporation, USA, and Friedrich Wilhelm Fuchs, University of Kiel, Germany

- **3:40 pm** • Transformer-Less Intelligent Power Substation Design with 15kV SiC IGBT for Grid Interconnection
  - Kamalesh Hatua, Sumit Dutta, Awnneesha Tripathi, Seunghun Baek, Giti Karimi and Subhashish Bhattacharya, North Carolina State University, USA

- **4:05 pm** • A Half-Bridge Inverter Based Current Balancer with the Reduced DC Capacitors in Single-Phase Three-Wire Distribution Feeders
  - Yusuke Baba, Masayuki Okamoto, Eiji Hiraki and Toshihiko Tanaka, Yamaguchi University, Japan

- **4:30 pm** • Design Aspects of a Square-Wave Series Voltage Compensator
  - Igor A. Pires, Braz de J. Cardoso Filho and Sidelmo M. Silva, Universidade Federal de Minas Gerais, Brazil

- **4:55 pm** • Series Connected IGBT Based Three-Level Neutral Point Clamped Voltage Source Inverter Pole for High Power Converters
  - Subhashish Bhattacharya and Saman Babaie, North Carolina State University, USA
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<td>JIAM Division, JSOL Corporation and Powersys, Inc</td>
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<td>FSU Center for Advance Power Systems</td>
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<td>IEEE ECCE 2012 Organizing Committee</td>
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</tbody>
</table>
Canadian Electronics

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lijun.peng@canadian-electronics.com
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5S Components is a leading distributor of components for power electronics systems. Major product lines are ABB’s semiconductors, voltage sensors and current sensors; ICAR power film capacitors; and CT-Concept IGBT Gate Drivers.

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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.

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GRAPES (Grid-Connected Advanced Power Electronics Systems) is an NSF Industry/University Cooperative Research Center led by a partnership between the University of Arkansas (lead institute) and the University of South Carolina. GRAPES conducts research on design, development, evaluation, control and standardization of grid-connected power electronic equipment on both the supply and load side of power systems.

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This free power electronics portal is the engineer’s first stop for technical information on all aspects of power conversion. It features the How2Power Design Guide (a unique article search tool), the How2Power Today Newsletter, the Consultants Corner directory, the Power Electronics Bookstore, and the Power Around the Web directory of power-related websites.
The Fourth IEEE Energy Conversion Congress and Exposition will be held from September 16-20, 2012 at the brand new Raleigh Convention Center, located near the newly renovated Fayetteville Street in the heart of downtown Raleigh. The downtown Raleigh Marriott is our selected conference hotel. For details, please visit www.ecce2012.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.

The Power Electronics Society (PELS) is one of the technical societies of the Institute of Electrical and Electronics Engineers (IEEE). For over 20 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.
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pbaldassari@magneforcess.com
www.magneforcess.com

MagneForce Software Systems produces 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 associated drive/load circuitry allows MagneForce to produce both steady-state and transient results. MagneForce simulators compute directly machine performance parameters such as voltages, currents, torque, power and efficiency as well as the entire set of machine magnetic parameters. This is all done in an easy to learn and use environment.

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<td>81 Parker Road, Barre, VT 05641</td>
<td>+1 802-661-3450</td>
<td>+1 802-661-3504</td>
<td><a href="mailto:EdwardS@SBElectronics.com">EdwardS@SBElectronics.com</a></td>
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<td><strong>Sidelinesoft LLC</strong></td>
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<td>Tooh Dineh Industries, Inc is the largest contract electronics manufacturing company in Northern Arizona. Our core business remains electronic assembly of printed circuit boards, complete systems build and test. Additional capabilities include cable and harness assembly and fulfillment activities. Customer design capability support is provided through strategic alliances.</td>
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<td><strong>United Technologies Research Center</strong></td>
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<td>+1 860-622-0474</td>
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<td>United Technologies Research Center (UTRC) develops the world’s most advanced technologies and processes to help ensure the products delivered to market by the UTC businesses are the best available. The challenges undertaken at UTRC require the best minds working together to generate ideas, test theories, challenge assumptions and ultimately deliver solutions.</td>
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<td><strong>University of Sheffield</strong></td>
<td>409</td>
<td>Mappin Street, Sheffield, South Yorkshire S1 3JD, UK</td>
<td>+44 1142225854</td>
<td>+44 1142225196</td>
<td><a href="mailto:z.q.zhu@sheffield.ac.uk">z.q.zhu@sheffield.ac.uk</a></td>
<td><a href="http://www.sheffield.ac.uk/eee/research/emd">www.sheffield.ac.uk/eee/research/emd</a></td>
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<td>The Electrical Machines and Drives group at the University of Sheffield, UK, headed by Professor Z.Q. Zhu, comprises &gt;80 academic/research personnel. It has long-standing and extensive research activities with automotive, aerospace and renewable energy sectors, hosting Rolls-Royce University-Technology-Centre on “Advanced Electrical Machines and Drives” and “Sheffield-Siemens Wind Power Research Centre (S2WP)”. It is particularly well-known for its innovative research on permanent-magnet brushless machines and controls, supported by extensive on-site testing and fabrication facilities.</td>
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In this event, 9 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.

The demos are listed below:

### A DC Link Module for Reducing the DC Link Capacitance in a Capacitor-Supported System

Demonstrator: Wang Huai (student)  
University: City University of Hong Kong  
Advisor: Dr. Henry Chung  
email: eeshc@cityu.edu.hk

### A Quad-Active Bridge DC-DC Converter for Solid-State Transformer Applications

Demonstrator: Chenhao Nan (student)  
University: Arizona State University  
Advisor: Dr. Raja Ayyanar  
email: rayyanar@asu.edu

### A Two-Stage Solid-State Transformer Using an Isolated Boost AC-DC Converter

Demonstrator: Youyuan Jiang (student)  
University: Arizona State University  
Advisor: Dr. Raja Ayyanar  
email: rayyanar@asu.edu

### Battery Charger, Grand Prize of IFEC Competition

Demonstrators: Thomas LaBella and Jason Dominic (students)  
University: Virginia Tech  
Advisor: Dr. Jason Lai  
email: laijs@vt.edu

### Doubly Excited Brushless Wind Generator

Demonstrator: Ernesto Inoa (student)  
University: Ohio State University  
Advisor: Dr. Longya Xu  
email: longyaxu@gmail.com

### GaN Based Switched Capacitor Circuit

Demonstrator: Mark Scott (student)  
University: Ohio State University  
Advisor: Dr. Jin Wang  
email: wang@ece.osu.edu

### Power Converters: Essential Components for Top Solar Boat Performance

Demonstrator: Andrew Koch (student)  
University: Cedarville University  
Advisors: Dr. Gerald Brown (attending), Dr. Timothy Dewhurst  
emails: gbrown@cedarville.edu  
dewhurst@cedarville.edu

### PWAM and Micro-Inverters

Demonstrators: Dong Cao and Qin Lei (students)  
University: Michigan State University  
Advisor: Dr. F. Peng  
email: fzpeng@egr.msu.edu

### Regenerative Motor Drive

Demonstrator: Yan Zhou (student)  
University: Florida State University  
Advisor: Dr. Hui Li  
email: hlincaps@gmail.com
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The Fourth Annual IEEE Energy Conversion Congress & Exposition® (ECCE 2012) will be held in Raleigh, North Carolina, on September 16-20, 2012. To be held in Raleigh’s brand new convention center, ECCE 2012 will feature both industry-driven and application-oriented technical sessions, as well as industry exhibitions and seminars. ECCE 2012 will bring together practicing engineers, researchers and other professionals for interactive discussions on the latest advances in various areas related to Energy Conversion. Technical papers are solicited on any subject pertaining to the scope of the conference that includes, but is not limited to, the following major topics:

Energy Conversion Systems
► Renewable and alternative 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, energy harvesting and system architectures
► Transportation applications — electric and hybrid vehicles, infrastructure, traction, marine and aerospace
► Power conversion systems stability and power quality

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

Important Dates

January 15, 2012
Digest of proposed papers due (to be submitted via ECCE 2012 website)

May 1, 2012
Notification to authors of acceptance/rejection of papers

July 1, 2012
Final papers with IEEE copyright forms due

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. 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. Refer to the conference web page for a detailed list of technical topics and the digest submission method.

Close to the Research Triangle Park, Raleigh is the Smart Grid Hub, home to many global companies leader in energy efficiency and smart grid technology, as well as world class universities. Less than two hours away from the North Carolina seashore, and one hour from the Blue Ridge Mountains, there is simply too much to see and do in the Raleigh area. We are looking forward to seeing you in September 2012.

For more information, please visit www.ecce2012.org or contact the ECCE 2012 Technical Program Chairs at ecce2012tpc@gmail.com. For more information on the Expo or becoming an exhibitor at ECCE 2012, please contact the conference Exhibition Chairs at ecce2012exhibit@gmail.com. For information about Raleigh and its surrounding areas, you can visit www.visitraleigh.com.

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