IEEE ENERGY CONVERSION CONGRESS & EXPO

VIRTUAL CONFERENCE PROGRAM

OCTOBER 11-15

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Welcome from General Chair

It is a great pleasure for me to welcome you to the 12th Annual IEEE Energy Conversion Congress & Exposition (ECCE 2020), from October 11 to October 15, 2020. ECCE is IEEE's flagship conference on energy conversion systems and technologies and is sponsored by the **IEEE Industrial Application Society (IAS)** and **IEEE Power Electronics Society (PELS)**.

Acclaimed for its top-quality content, ECCE is the world's leading technical conference and exposition for energy conversion solutions. Each year, we bring together a multi-disciplinary group of researchers, engineers, and scientists from all over the world to present and exchange breakthrough ideas. ECCE is unique in its emphasis on integrated systems, presenting the best in applied integrated systems research together with innovations in individual energy conversion components.

2020 has been a very challenging year due to the COVID-19 pandemic. With the safety and wellbeing of our participants as our top priority, ECCE 2020—originally planned to be held in Detroit, Michigan, USA—has been converted to a fully virtual conference. To provide maximum flexibility for the participants, the ECCE 2020 virtual conference program includes video-on-demand tutorials and technical presentations as well as live plenary sessions and special panel sessions. Virtual exhibitions at ECCE also showcase state-of-the-art technologies, products, and solutions. This virtual format allows us to still come together to learn, share ideas, and gain insight into the latest innovations within the energy conversion field while ensuring that the current landscape does not hinder anyone's ability to participate.

ECCE 2020 features four plenary talks on the challenges in the energy conversion industry, from Dr. Anna Stefanopoulou, Energy Institute Director, University of Michigan, Ann Arbor; Dr. John A. Cavolowsky, Director, Transformative Aeronautics Concepts Program, NASA Aeronautics Research Mission Directorate (ARMD); Mr. Rob Del Core, Assistant Vice President, Fuel Cell Power Systems and Hydrogen Infrastructure, Technology and Strategy Group, Ricardo North America; and Mr. Sam Holeman, Vice President, Transmission, System Planning and Operation, Duke Energy. We are extremely fortunate to have these four distinguished leaders from industry and the scientific community to share their wisdom and visions with us.

This year, the ECCE Technical Program Committee (TPC) has made significant effort to completely redesign the traditional ECCE technical program to ensure a pleasant virtual conference experience for everyone. The ECCE 2020 technical program has 62 oral sessions and 36 digital poster sessions, featuring a total of 959 technical papers. All these sessions have on-demand videos of the presentations that will be available to view for a month, as well as a live interactive "meet the authors" component during the conference week. There are also 20 special sessions in ECCE 2020, all live throughout the week. These are strongly oriented towards the latest industry interests and technology trends, as well as the latest collaboration opportunities between industry and academia. In ECCE 2020, two special memorial sessions will be dedicated to Prof. Tom Lipo, who passed away in the past year. ECCE 2020's professional program also includes 14 tutorial sessions that offer in-depth discussions of important and complex technical topics, combining practical application with theory. All the tutorials will be accessible by video-on-demand for a month and will also feature live "meet the presenters" sessions during the week.

I would like to express my utmost gratitude to the members of the ECCE 2020 Organization Committee, the ECCE Steering Committee, SmithBucklin, the IEEE MCE team, as well as the PELS and IAS society staffs, who have made this event possible through their hard work, selfless dedication, and numerous extra hours dealing with the fluid situation of the pandemic. I would like to thank PELS and IAS for their sponsorship and stewardship, and all of our corporate sponsors for their generous support. I would like to thank each and every one of you, whether you are a paper presenter, an attendee, an exhibitor, a volunteer, or any combination of the above, for your contribution and participation.

Once again, I sincerely welcome you to ECCE 2020 and please enjoy the exciting virtual conference program.

Yunwei (Ryan) Li
ECCE 2020 General Chair

Welcome from Technical Program Committee

On behalf of the Technical Program Committee (Emmanuel Agamloh, Navid Zargari, Henry Chung, and Martin Ordonez) it is our great pleasure to welcome you to a fully online edition of the IEEE Energy Conversion Congress & Exposition (ECCE 2020). This year, the program features unlimited on-demand content and exciting live sessions to bring our community together. ECCE is the world's leading conference on energy conversion systems and is sponsored by the IEEE Industry Applications Society (IAS) and IEEE Power Electronics Society (PELS).

The conference offers a multidisciplinary array of topics ranging from machines for transportation, battery chargers, and multilevel converters to topics in wide-bandgap devices and machine diagnosis, to name a few. The content presented is curated to provide in-depth exposure to the latest breakthrough research in the field and to cover energy conversion systems in their entirety. All the high-quality content has been organized in a portal for easy access. Scheduled Q&A sessions will provide opportunities to interact with the presenters and network with community members.

Our program includes peer-reviewed technical presentations, special sessions, interactive Q&A sessions, and tutorials, as well as plenary talks and an exposition with exhibitors and poster presentations. This mixture creates a highly interactive learning and networking environment with a multitude of opportunities for exchanging beyond-state-of-the-art knowledge and ideas on energy conversion systems and technologies. As 2020's ECCE will take place on an entirely virtual platform, we look forward to your participation to ensure we have lively interaction and discussion.

The conference has received a total of 1615 digest submissions from 70 countries. After a rigorous peer review and scheduling process, 959 papers have been scheduled for oral/poster presentation. Special thanks are extended to our 24 track chairs and 182 topic chairs who managed and organized the review process to identify the best papers for ECCE. On average, each digest received over 4 reviews. For the very first time, the ECCE Technical Program Committee had two virtual meetings in April to finalize all paper decisions.

The tutorials co-chairs have received and reviewed 54 proposals, and 14 selected tutorials are offered online this year. Discussion time has been allocated to allow interaction with tutorial presenters. Finally, we have the participation of key industry players to showcase their products and innovations in our virtual exhibitor sessions, creating a dynamic online environment to learn, enjoy great technical conversations, and make high-impact professional connections.

We look forward to virtually welcoming you to ECCE 2020—thank you for helping us making ECCE 2020 an exciting virtual event. ***Stay healthy!***

ECCE 2020 Technical Program Committee

Emmanuel Agamloh

Navid Zargari

Henry Chung

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Vice Chair: Jean-Luc Schanen, *Univ. Grenoble Alpes, G2ELab*

ECCE 2020 Virtual Platform How-To Guide

The ECCE 2020 virtual conference kicks off October 11 with a full lineup of on-demand tutorials, technical presentations, live plenary sessions, special panel sessions and a virtual exhibition. Please review the following information to prepare for this exciting virtual event.

Accessing the Platform

Attendees can access the platform here, or by clicking on the link provided to them via their confirmation email.

Please watch a 6-minute instructional video to familiarize yourself with the virtual platform.

If you already registered for the event, you can start to build your agenda. Be sure to use the email address you used to register for the conference to log in to the virtual event platform. The password is **ECCE2020**.

ALREADY REGISTERED? CLICK HERE TO BUILD YOUR AGENDA

If you are NOT registered for the conference but are interested in attending and viewing all the sessions, click the below button to register. After you register, please allow the system up to 30 minutes to send a confirmation email. Once you receive your confirmation, you will be able to log in, build your agenda and view sessions.

NOT YET REGISTERED? CLICK HERE TO REGISTER FOR THE CONFERENCE

If you are interested in attending the free sessions offered at ECCE 2020, click the below button to register. After you register, please allow the system up to 30 minutes to send a confirmation email. Once you receive your confirmation, you will be able to log in.

NOT YET REGISTERED? CLICK HERE TO REGISTER FOR FREE SESSIONS ONLY

If you have any technical difficulties accessing the platform, please email ecce@iplanitmeetings.com or call +1800.781.1193 ext. 73.

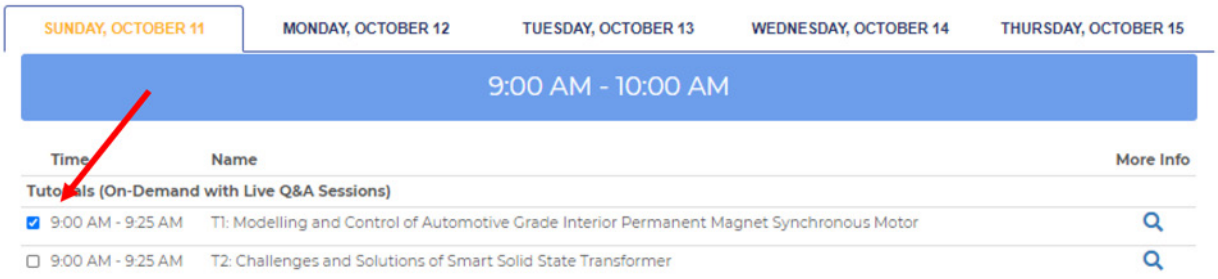
Explore the Platform

Start planning for the sessions you want to attend! Search for sessions by session type and day. Click on the Once you are logged into the platform, start planning for the sessions you want to attend! Each session falls into one of the following session types. Each session type is listed next to the session in the agenda.

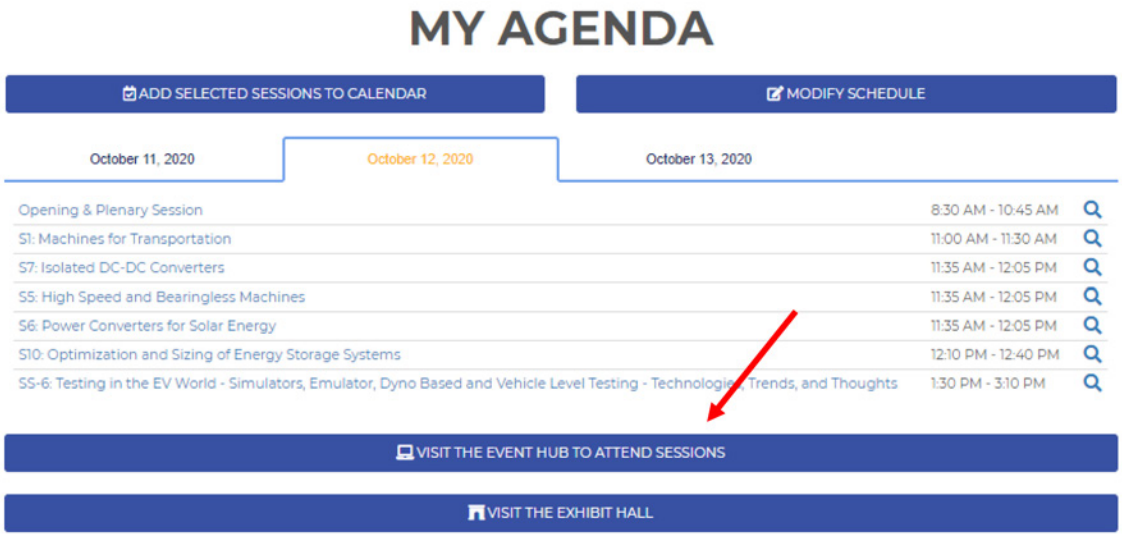
- **Live** – Session happening in real time, similar to attending an in-person session at a live event.
- **Simulive** – A simulive webinar simulates a live webinar by playing a rerecorded event at a specified time.
- **On-demand** – An on-demand webinar is available for viewing at any time. Once the webinar is published, attendees can access it whenever they please.

Building Your Agenda

Interested in a session? Select the box next to the session to add it your agenda. After selecting the sessions you want to attend over the course of the virtual conference, select continue at the bottom of the page.



After selecting continue, you will be brought to the below screen. Select "VISIT THE EVENT HUB TO ATTEND SESSIONS." From here, you will be able to view sessions and join Live Q&A sessions.



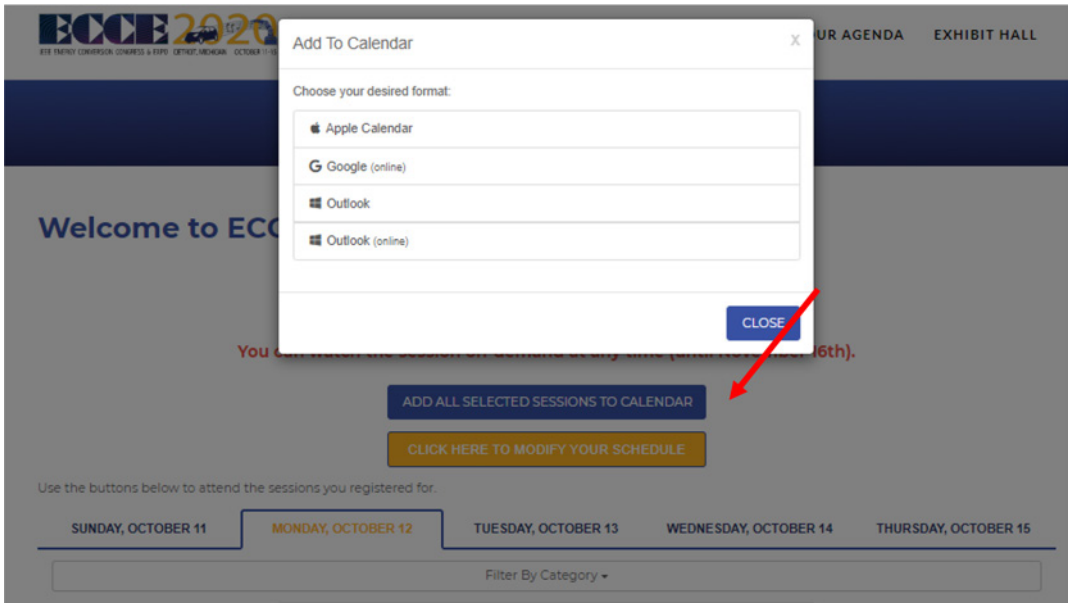
To modify your schedule throughout the event, select **"CLICK HERE TO MODIFY YOUR SCHEDULE."** Follow the above steps to add and remove sessions from your personal agenda.

CLICK HERE TO MODIFY YOUR SCHEDULE

For more information on navigating the virtual platform, please watch the instructional video here.

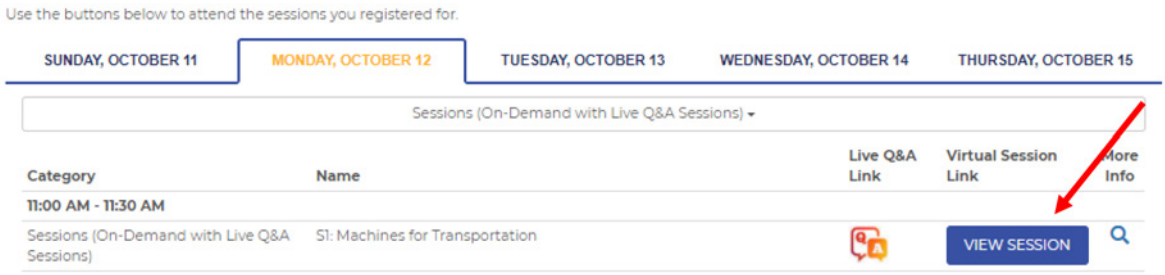
Add Sessions to Your Calendar

Don't forget to add sessions directly to your calendar. If you are interested in attending a session, simply click **"ADD ALL SELECTED SESSIONS TO CALENDAR"** to add to your personal computer. All sessions are in Eastern Daylight Time.

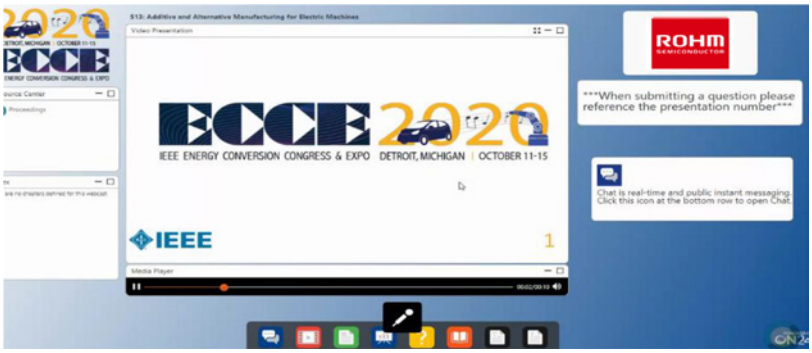


Viewing A Session

To view a session, select **"VIEW SESSION"** within the agenda. When prompted, enter your email address. Please note: This should be the email address you used to register.

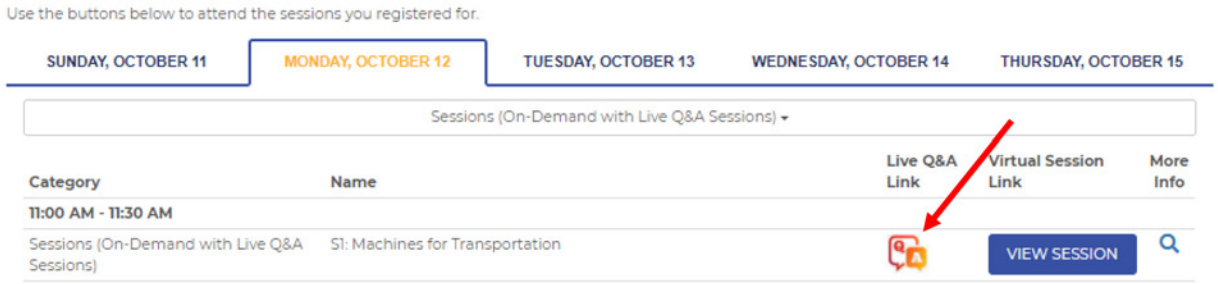


You will be taken to the screen below to view the session video. During the session, you can use the chat feature to interact with the authors and other attendees viewing the session.



Joining a Live Q&A

To create opportunities for interaction between authors and ECCE attendees, we have added an interactive live "meet the authors" component for tutorials, oral, poster and special sessions during the conference week (October 11-15). To join a Q&A session, select the live Q&A link found in the session details. Please note: You will not be able to join the meeting until the session time. If you enter before or after the time of the session, you will be entered into a waiting room. **View the agenda** to check the start time of each session. For more information on the live Q&A sessions, please watch the instructional video **here**.



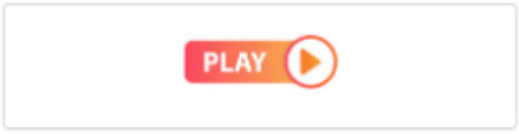
TIP: For the best video viewing experience, we recommend using Google Chrome and enabling Flash Player.

Networking

Your ECCE 2020 experience is not only about education – be sure to take advantage of every opportunity to strike up a conversation with peers and industry experts. Within each session you can connect with attendees using the Chat widget and submit questions to speakers during live sessions using the Q&A widget.

Activities

Compete against fellow attendees throughout the event by participating in the attendee game! Questions will differ each day. Head to the exhibit hall to play or click on the play icon on the moving slide show!



Meet with Exhibitors

Head to an exhibitor's booth during the designated times and meet with our sponsors. Ask questions and learn about state-of-the-art technologies, products and solutions.

Monday, October 12th

- 10:45-11:00 am: Dedicated Product & Service Sessions
- 12:40-1:30 pm: Dedicated Exhibit Hours

Tuesday, October 13th

- 10:40-11:00 am: Dedicated Product & Service Sessions
- 12:40-1:30 pm: Dedicated Exhibit Hours

Wednesday, October 14th

- 10:40-11:00 am: Dedicated Product & Service Sessions
- 12:40-1:30 pm: Dedicated Exhibit Hours

Thursday, October 15th

- 10:40-11:00 am: Dedicated Product & Service Sessions
- 12:40-1:30 pm: Dedicated Exhibit Hours

Explore the Program

This virtual format allows us to come together to learn, share ideas and gain insight into the latest innovations within the energy conversion field, and ensures that the current landscape does not hinder anyone's ability to participate. Here is a brief overview of the program:

Plenary Sessions

ECCE 2020 features four plenary talks on the challenges in the energy conversion industry. The plenary sessions will be live on the morning of Monday, October 12, following the ECCE opening ceremony. Recorded videos of the plenary sessions will be available on the ECCE virtual event platform as video on-demand through November 16, 2020. The plenary sessions are free for everyone this year, but you must be registered to attend. Register **here**.

Tutorials

There are 14 tutorials at ECCE 2020. All tutorials are video on-demand starting October 9 through November 16, 2020. To provide opportunities for interaction with the tutorial instructors, a 25-minute live "meet the instructor" session for each tutorial has also been created. To follow the tradition of ECCE, those live tutorial "meet the instructor" sessions are scheduled on Sunday, October 11. For those watching the tutorial videos in advance, those "meet the instructor" session can serve as Q&A sessions. If you do not have a chance to watch the tutorial videos, the live sessions will be a great opportunity for you to learn more about the tutorials before you watch the videos on your own time..

Technical Paper Sessions

959 papers accepted by ECCE 2020 are grouped into 62 Oral Sessions and 36 digital poster sessions. All these sessions have on-demand videos of the presentations that are available to view until November 16, 2020. Please check the technical program for the schedule of each live "meet the authors" sessions. Technical program registration is required to access the special sessions.

Special Sessions

ECCE 2020 features 20 live or simulive special sessions throughout the conference week, October 11-15, 2020. Those special sessions are strongly oriented towards the latest industrial interests and technology trends, as well as the latest collaboration opportunities between industry and academia. There are two free special memorial sessions dedicated to Prof. Tom Lipo who passed away in 2020.

There are two types of special sessions, 1) panel discussions which are live panel sessions without formal presentations; 2) simulive videos broadcast in real time followed by a live discussions and Q&A. Videos in the simulive sessions will become videos on-demand and are accessible through November 16, 2020. Please check the ECCE program for the special session schedules. Technical program registration is required to access the special sessions.

WIE

ECCE 2020 WIE committee has organized a special session featuring "Dealing with Public Health Emergence: Online Life and Advanced Technologies in Remote Education." The tradition of WIE breakfast talk at ECCE has been converted to two WIE discussion sessions with the topic on "Mentors + Advocates: How to be one + How to find one."

Student Activities

ECCE 2020 features a number of student activities. We continues the tradition of student project demonstration in ECCE 2020. Those around 20 projects will be showcased in ECCE virtual event platform through short videos. The student mentorship round table event will be hosted online this year, too. More details are available at ECCE website.

Award Session

IEEE Power Electronics Society and IEEE Industry Applications Society has organized the annual Award Ceremony this year at ECCE2020 virtual. This Award Session will be video on demand featuring the major IEEE and society awards as well as newly elevated IEEE Fellows from the societies. The Award Session is free to access - please join and congratulate the awardees through the session chat function.

Technical and System Requirements

The following specifications are recommended for an optimal virtual conference experience.

Supported System Configurations

Webcasts

- Windows 10+ (Microsoft Edge, Firefox, or Chrome)
- Apple Mac OS 10.10+ (*Latest Firefox, Safari, or Chrome)
- Android 9+ (Chrome Browser Only)
- Apple iOS 12+ (*Latest Safari Browser)

If you are using an unsupported version of a Windows, Mac, or Linux operating system, you may experience difficulty viewing and/or listening to the event.

We recommend using a laptop or desktop computer while attending virtual conference sessions. While it may be possible to use a tablet or other mobile device, the smaller screen may make it a less than optimal experience.

Internet Browsers

- Microsoft Edge (*Latest)
- Mozilla Firefox (*Latest)
- Safari (*Latest, Mac Only)
- Google Chrome (*Latest)

Internet Connection

Before you access the event, you should ensure that your browser is configured to stream media. For Audio events, we recommend a minimum Internet connection of 128 Kbps. For Video events, a minimum Internet connection of 800 Kbps is recommended for an optimal experience.

Live/Simu-Live Session Schedules

All session times are in Eastern Daylight Time.

Sunday, October 11, 2020
Tutorial – Meet the Instructors

9:00AM-11:25AM	Virtual 1	Virtual 2	Virtual 3
» 9:00AM-9:25AM	T1: Modelling and Control of Automotive Grade Interior Permanent Magnet Synchronous Motor	T2: Challenges and Solutions of Smart Solid State Transformer	T3: GaN-Based Power Converter Ecosystem Design: Magnetics, Gate Driver IC, and Applications
» 9:30AM-9:55AM	T4: Physics-based Modeling and Control of PWM Converters	T5: Grid-forming Inverters, Virtual Synchronous Machines, and Power Electronics-enabled Autonomous Power Systems	T6: Preparing for the Opportunities and Challenges of WBG-Based Motor Drives
» 10:00AM-10:25AM	T7: Design Considerations for Large Format Lithium-ion Battery Systems	T8: Application of Topology Optimization Techniques in Innovative Motor Design	T9: High-efficient, High-reliable Energy Storage Power Conversion Systems (PCS) for Increased Renewable Energy and Electric Vehicle Integration
» 10:30AM-10:55AM	T10: Electrical Insulation Stresses in PWM-driven Electric Machines	T11: Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles	T12: Design and Integration of Photovoltaic and Energy Storage Converters
» 11:00AM-11:25AM	T13: Analysis, Simulation, and Implementation of Vector Control: An Extremely Low-Cost Laboratory	T14: Health-conscious Fast Charging Strategies and Battery Management Systems for Electrified Autonomous Transportation	
AFTERNOON	Video on demand at your flexibility		

IEEE ENERGY CONVERSION CONGRESS & EXPO

Live/Simu-Live Session Schedules

All session times are in Eastern Daylight Time.

Monday, October 12, 2020

8:30AM-8:45AM	**Opening (ON24 Live)**						
8:45AM-10:45AM	**Plenary Session (ON24 Live)** Prof. Anna Stefanopoulou *Energy Institute Director, William Clay Ford Professor of Technology, Professor of Mechanical Engineering, University of Michigan, Ann Arbor* **The price of degradation — The value of prognostics – Opportunities and Needs in Battery Health Estimation** Dr. John A. Cavolowsky *Director, Transformative Aeronautics Concepts Program, NASA Aeronautics Research Mission Directorate (ARMD)* **NASA Aeronautics Strategies for Hybrid/Electric Propulsion and Transforming Aviation** Rob Del Core *Assistant Vice President, Fuel Cell Power System and Hydrogen Infrastructure, Technology and Strategy Group, Ricardo North America* **Current and Future Outlook of Hydrogen Fuel Cell on Multiple Market Sectors** John 'Sam' Holeman *Vice President, System Planning and Operation, Duke Energy* **System Operations -Defenders of the Grid- Past, Present, Future**						
10:45AM-11:00AM	**Sponsorship Session**						
11:00AM-12:40PM	**Virtual 1**	**Virtual 2**	**Virtual 3**	**Virtual 4**	**Virtual 5**	**Virtual 6**	**Virtual 7**
» 11:00AM-11:30AM	S1: Machines for Transportation	S2: Power Converter Controls in Wind and PV Systems	S3: DC-DC Converters - Switched Capacitors and Datacenter Applications	S4: Wide-bandgap Semiconductors 1	SS1-A: Prof. Tom Lipo Memorial Session 1	SS-2: SiC Power Converters-based Grid Infrastructure: Technologies, Challenges, and Grid Applications	SS-3: Electric Vehicles: Implementation and Grid Interactive Applications
» 11:35AM-12:05PM	S5: High Speed and Bearingless Machines	S6: Power Converters for Solar Energy	S7: Isolated DC-DC Converters	S8: Modern Tools for Detecting and Identifying Electrical System Parameters or Attacks			
» 12:05PM-12:40PM	S9: Optimization in Electric Machines	S10: Optimization and Sizing of Energy Storage Systems	S11: DC-DC Converters for Electric Transportation	S12: Wide-bandgap Semiconductors 2			
12:40PM-1:30PM	**Sponsorship Session**						
» 1:30PM-3:10PM	Video on demand at your flexibility				SS-4: Recent Successes in Accelerating the Adoption of Wide Bandgap Power Electronics	SS-5: Standard development for power electronics systems / products	SS-6: Testing in the EV World - Simulators, Emulator, Dyno based and Vehicle level testing - Technologies, Trends, and Thoughts

Live/Simu-Live Session Schedules

All session times are in Eastern Daylight Time.

Tuesday, October 13, 2020

9:00AM-10:40AM	Virtual 1	Virtual 2	Virtual 3	Virtual 4	Virtual 5	Virtual 6	Virtual 7
» 9:00AM-9:30AM	P1: NVH, Reliability and Machine Diagnostics	P2: EV Charging Infrastructure	P3: DC-DC Converters 1	P4: Emerging Technologies and Applications	SS-1-B: Prof. Lipo's Memorial Session 2	SS-7: Adoption and Use of Standards in the Industrial Drives and in the Renewable Energy Grid Integration	SS-8-A: Cybersecurity in Power Electronics
» 9:35AM-10:05AM	P5: Electric Machines Materials, Losses, Thermal, Manufacturing, Modelling Issues	P6: Direct Drive, Actuators, Magnetic Gearing and Non-conventional Machines	P7: DC-DC Converters 2	P8: Converters for AC and DC Microgrids			
» 10:10AM-10:40AM	P9: Electric Machines (IPMSM and Synchronous Reluctance)	P10: Transportation Electrification and Battery Management Systems	P11: AC-DC Converters and AC-AC Converters (Topology, Modulation, Control)	P12: Solid State Transformers, V2G, and Power Converter Control			
10:40AM-11:00AM	**Sponsorship Session**						
» 11:00AM-11:30AM	P13: Electric Machine Applications in Automotive, Aerospace, Renewable, Robotics	P14: Converters for Renewable Energy	P15: DC-AC Converters	P16: Statistical Methods Applied to Power Electronics System Applications	SS-9: Innovation through failing better	SS-10-A: Sustainable Energy Systems and Opportunities for Power Electronics	SS-8-B: Cybersecurity in Power Electronics
» 11:35AM-12:05PM	P17: Electric Machines (Synchronous, Induction, Switched Reluctance, Flux-Switching)	P18: Controls in Alternative Energy Applications	P19: Multilevel Converters (Topology, Modulation, Control)	P20: Grid Interactive Converters			
» 12:10PM-12:40PM	P21: New Technologies, Sensors, Reliability and Testing for Electric Drives	P22: Microgrid Applications	P23: Power Quality, Reliability, Diagnostics and Fault Analysis	P24: Converter Control and Modeling 1			
12:40PM-1:30PM	**Sponsorship Session**						
» 1:30PM-2:00PM	P25: Control of Electric Drives	P26: Distributed Energy Resources and Utility Interactions	P27: Wide-bandgap Semiconductors	P28: Converter Control and Modeling 2	SS-11: Powering the Future: Criticality of System Engineering for E-Mobility and Automated Vehicles	SS-10-B: Sustainable Energy Systems and Opportunities for Power Electronics	SS-12: Heavy-duty All-electric Urban Aerial Vehicles (UAVs)
» 2:05PM-2:35PM	P29: Drive Applications	P30: Renewables and Energy Storage	P31: Gate Drivers, Modules and Packaging	P32: Converter Control and Modeling 3			
» 2:40PM-3:10PM	P33: Magnetic and Insulating Materials and Thermal Management	P34: HVDC, FACTS, Implementation and Reliability of Power Converters	P35: Other Devices, Components, and Materials	P36: Power Converter EMI and Stability			

Live/Simu-Live Session Schedules

All session times are in Eastern Daylight Time.

Wednesday, October 14, 2020

9:00AM-10:40AM	Virtual 1	Virtual 2	Virtual 3	Virtual 4	Virtual 5	Virtual 6	Virtual 7
» 9:00AM-9:30AM	S13: Additive and Alternative Manufacturing for Electric Machines	S14: Renewable Energy and Hybrid Energy Storage Systems	S15: DC-AC Three-Phase Converters	S16: Gate Drivers and Driving Techniques	SS-13: Next Generation Power-Hardware-in-the-Loop (PHIL) Testing of Traction Inverters: Challenges and Opportunities	SS-14-A: Power Electronics Intensive Power Systems: Modeling, Control, and Implementation	SS-15-A: Electric Propulsion for Future Aero and Space Vehicles
» 9:35AM-10:05AM	S17: AC Machines and Drives	S18: Microgrids 1	S19: Multilevel Converters 1	S20: Device and Module Packaging			
» 10:10AM-10:40AM	S21: Permanent Magnet Machines	S22: Converters for Electric Vehicles	S23: AC-DC and AC-AC Converters	S24: Circuits and Topologies for Wind Power Conversion			
10:40AM-11:00AM	**Sponsorship Session**						
»11:00AM-11:30AM	S25: Thermal Analysis in Electric Machines	S26: Grid-Connected Inverters	S27: Multilevel Converters 2	S28: Batteries and Battery Converters		SS-14-B: Power Electronics Intensive Power Systems: Modeling, Control, and Implementation	SS-15-B: Electric Propulsion for Future Aero and Space Vehicles
»11:35AM-12:05PM	S29: Machine Diagnostics and Protection	S30: Power Converter Control and Applications	S31: AC-DC Power Converters	S32: Microgrids 2			
»12:10PM-12:40PM	S33: Switched Reluctance and Flux Switching Machines	S34: Inverter-based Resources for Power Quality Enhancement	S35: DC-DC Converters for Renewable Energy Applications	S36 : Utility Applications of Power Electronics			
12:40PM-1:30PM	**Sponsorship Session**						
	Video on demand at your flexibility						

Thursday, October 15, 2020

9:00AM-10:40AM	Virtual 1	Virtual 2	Virtual 3	Virtual 4	Virtual 5	Virtual 6	Virtual 7
» 9:00AM-9:30AM	S37: Reliability, EMI and Fault Tolerance in Electric Drives	S38: Multilevel Converters 3	S39: Grid Interactive Converter Control	S40: Tools and Techniques for the Optimization and Protection of Power Electronic Systems	SS-16: Industry vs Academia: which career path is right for you?	SS-17: Dealing with Public Health Emergence: Online Life and Advanced Technologies in Remote Education	SS-18: Power electronics application in standalone wind/ solar based distributed generation system
» 9:35AM-10:05AM	S41: Predictive and Sensorless Control of Electric Drives	S42: Wireless Power Transfer in Transportation	S43: DC-AC Single-Phase Converters	S44: Reliability, Diagnostics and Fault Analysis			
» 10:10AM-10:40AM	S45: Multi-Phase Motor Drives	S46: Control and Stability of Power Converters	S47: High Frequency DC-DC Converters	S48: Wireless Power Transfer			
10:40AM-11:00AM	Sponsorship Session						
» 11:00AM-11:30AM	S49: Noise, Vibration and Reliability in Electric Machines	S50: Battery Management Systems	S51: Power Converter Control	S52: Multilevel Converters 4		SS-19: HVdc/ MVdc/MTdc technologies and benefits to grid	SS-20: Energy Access: Technologies, Impact and The Opportunity for PELS
» 11:35AM-12:05PM	S53: Design and Control of Electric Drives	S54: Power Converter EMI	S55: Predictive Control	S56: Dual Active Bridge	S57: Protection Devices and Solid State Circuit Breakers		
» 12:10PM-12:40PM	S58: IPM and PM Motor Drives	S59: Modelling and Stability of Converters and Systems	S60: Multilevel Converter Control	S61: Digital Control Implementation and Testing	S62: Electric Drivetrains		
12:40PM-1:30PM	Sponsorship Session						
	Video on demand at your flexibility						

Plenary Session

Monday, October 12 **8:45AM-10:45AM**

The price of degradation – The value of prognostics – Opportunities and Needs in Battery Health Estimation

Prof. Anna Stefanopoulou

Energy Institute Director, William Clay Ford Professor of Technology, Professor of Mechanical Engineering, University of Michigan, Ann Arbor

Replacing a gasoline or diesel internal combustion engine vehicle (ICEV) with an electric vehicle (EV) will zero out the direct (tailpipe) GHG emissions and depending on where it charges can have 75% lower GHG emissions. Key barriers to EV adoption include the higher first cost of EVs compared to ICEVs and the up-front investment needed to provide charging infrastructure. The total cost of ownership and the cost of the fleet transition depends on the lower operating cost due to fuel and maintenance savings that depend on the route, utilization, and charging of the vehicle. Behind the meter, vehicle to grid and 2nd life applications can provide additional cost benefits if the battery stays healthy.

The battery state of health (SOH) is currently estimated by determining capacity (cyclable energy) and cell resistance (power capability). Unfortunately, estimating these parameters with high confidence can only be done under certain discharge patterns. Identifying the physical origin of the degradation is even more difficult but very important, because it can inform the Battery Management System (BMS) about electrode specific constraints and hence prevent further degradation. Power electronics can help identify the intrinsic "aging wrinkles" in the battery material as it ages.

NASA Aeronautics Strategies for Hybrid/Electric Propulsion and Transforming Aviation

Dr. John A. Cavolowsky

Director, Transformative Aeronautics Concepts Program, NASA Aeronautics Research Mission Directorate (ARMD), NASA

NASA is making significant progress towards establishing the viability of Electrified Aircraft Propulsion (EAP) through a combination of aircraft conceptual design studies and advancement of key tall-pole technologies. Partially turboelectric and parallel hybrid candidates have been shown viable for introduction into service in the mid-2030s, and a long-term vision has been established for a fully turboelectric system. NASA is developing key powertrain technologies that are applicable for a wide variety of aircraft configurations, including electrical machines (motors/generators), converters (inverters/rectifiers), and the underlying electrical materials for EMI filters and cabling.

In the next 5 years the goal is to narrow the focus to the most viable concepts as a means to prepare for flight demonstrations of those concepts. An electric aircraft power system test facility (NASA Electric Aircraft Testbed (NEAT)) has reached operational status at and is being used to perform both industry partnership testing and in-house NASA R&D. It is believed that the correct building blocks are in place to test a viable large-plane EAP configuration in the not too distant future.

This presentation will address the strategy behind NASA's research and development efforts to accelerate this market. It will cover the enduring electrified propulsion research needs including the development of system concepts, electric machines, converters, innovative materials, components, tools, and methods that enable the performance, reliability and durability of these systems.

Current and Future Outlook of Hydrogen Fuel Cell on Multiple Market Sectors

Rob Del Core

Assistant Vice President, Fuel Cell Power System and Hydrogen Infrastructure, Technology and Strategy Group, Ricardo North America

This presentation will provide an overview on hydrogen fuel cell power technology, including but not limit to benefits, challenges, solutions and current applications on different market sectors from zero emission vehicles to renewable hydrogen powered back up power and prime power. Current US and global funding opportunities and landscape for hydrogen technologies that shape the future hydrogen economy and energy sector will also be discussed. Case studies of selected Ricardo's hydrogen fuel cell and renewable energy projects will also be featured in this presentation.

System Operations – Defenders of the Grid – Past, Present, Future

John "Sam" Holeman

Vice President, System Planning and Operation, Duke Energy

The electric grid is vital to the customers it serves. Many events have proven the belief that the electric grid is the most critical of the critical infrastructures in the world. It has been described as the most complex machine man has ever made. Research links prosperity and education to the availability of a reliable and secure electric grid. The product (electrons) traveling at close to the speed of light and consumed almost as quick as it is generated with no scalable ability to store it (at least not yet). While the grid has undergone changes for over the past hundred years, the changes we have seen recently and expect over the next several decades accelerate that pace of change to say the least. As a wise industry leader once told me, we are trying to re-wire our house while still living in it. Any of us who have remodeled a home while still living in It know how challenging, frustrating, and difficult this proposition is.

We are facing fundamental changes in the electric gird we have benefited from for over a century. From the decarbonization of generation, development of micro-grids, potential of new nuclear technologies, development of solar and wind resources, emerging energy storage technology, and more intelligent customer technology, the grid is undergoing and will undergo real change in coming years. But in spite of that change, or perhaps because of that change, the role of the System Operator becomes more important than ever. Throughout the history of interconnected system operations, the System Operator – the Defender of the Grid – has always been there to act on behalf of the users of the electric grid – our customers and communities. So how do we bridge between what we have now, what we will have in 5 years, and what we will have 20 years from now. At the end of the day, our customers expect for the lights (or whatever lights turn into 50 years from now) to stay on. That metaphor – keeping the lights on 24X7X365, continues to be the mission of the System Operator. It should be a wild and rewarding ride.

Special Sessions

These presentation-only sessions are focused on timely and practical topics in the field.

Monday, October 12 **11:00AM-12:40PM**

Special Session 1-A | In Memoriam – Thomas A. Lipo Life and Achievements

Presenter: Bulent Sarlioglu, *University of Wisconsin-Madison, United States*

Chairs: Thomas Jahns, Bulent Sarlioglu

Speakers and Presentations:

Designing a Magnetic Gear for an Electric Aircraft Drivetrain [736]
Ho Yin (David) Wong[1], Hossein Baninajar[1,2], Bertrand Dechant[2], Jonathan Bird[1,2]
[1]Portland State University, United States; [2]FluxMagic, Inc., United States

Methods to Determine the Stator Inter-Turn Short Circuit in an Induction Motor with Installed Rotor [312]
Dimas Anton Asfani[1], I Made Yulistya Negara[1], I Gusti Ngurah Satriyadi Hernanda[1], Daniar Fahmi[1], Eduard Muljadi[2], Robert M. Nelms[2]
[1]Institut Teknologi Sepuluh Nopember, Indonesia; [2]Auburn University, United States

Investigation of Asymmetric Consequent-Pole Hybrid Excited Flux Reversal Machines [11]
F.R. Wei, Z.Q. Zhu, X.Y. Sun
The University of Sheffield, United Kingdom

Comparative Study of Optimally Designed Coreless Axial Flux PM Machines with Litz Wire and with PCB Stator Windings [1494]
Narges Taran, Murat G. Kesgin, Peng Han, Dan M. Ionel
University of Kentucky, United States

Tuesday, October 13 **9:00AM-10:40AM**

Special Session 1-B | In Memoriam – Thomas A. Lipo Major Technical Contributions

Presenter: Thomas Jahns, *University of Wisconsin-Madison, United States*

Chairs: Thomas Jahns, Bulent Sarlioglu

Speakers and Presentations:

Evaluation of Current Distortion Improvement in an Asymmetrical Six-Phase Induction Motor Drive by using SiC MOSFETs with Reduced Dead Time [237]
Ajay Kumar Morya[1], Alejandro G. Yepes[2], Jesús Doval-Gandoy[2], Hamid A. Toliyat1
[1]Texas A&M University-College Station, United States; [2]University of Vigo, Spain

Overload Performance Prediction of PM and Synchronous Reluctance Machines for Traction Applications [449]
Matteo Carbonieri[1], Wen L. Soong[2], Amin Mahmoudi[3], Solmaz Kahourzade[3], Nicola Bianchi[1]
[1]University of Padova, Italy; [2]University of Adelaide, Australia, Australia; [3]Flinders University, Australia; 4University of South Australia, Australia

Performance Comparison between SiC Two-Level and Si Three-Level AFE Converters [641]
Marzieh Karami[1], Rangarajan Tallam1, Kenneth E. Pagenkopf[2], Robert Cuzner[3]
[1]Rockwell Automation, United States; [2]Cramer Magnetics, United States; [3]University of Wisconsin-Milwaukee, United States

Monday, October 12 **11:00AM-12:40PM**

SS-2 | SiC Power Converters-based Grid Infrastructure: Technologies, Challenges, and Grid Applications

Organizer: Akanksha Singh, *NREL*

The adoption of medium voltage (MV) SiC-based power electronics in the electric power grid would provide an important tool for ongoing efforts in grid modernization. The potential range of directly-connected MV power electronic converters for the future power grid infrastructure includes but is not limited to: MV to low-voltage conversion; AC to DC conversion to easily integrate inherently DC systems such as photovoltaics, battery systems, etc.; and MV to MV back-to-back converters which allow full asynchronous power flow control between intertied distribution systems. With the increasing commercial availability of high-quality and reliable SiC devices that can operate at voltages relevant to MV distribution utility applications, it is critical to develop a technical pathway for such applications to ensure the successful, widespread use of high-voltage SiC devices (3.3kV, 6.5kV, 10kV devices) and modules. This special session will focus on – a) capabilities and challenges enabled by the high-voltage SiC devices, b) the latest research progress and industry practice on design, development, and validation of high-voltage SiC devices, power modules, and power converters, and c) additional grid services and applications that can be realized using such power electronic converters, in advancing the power grid infrastructure

Speakers and Presentations:

Capabilities and challenges in using medium voltage (MV) SiC devices in advancing the grid infrastructure
Dr. Subhashish Bhattacharya
Professor, North Carolina State University, USA

Challenges and future of the direct MV grid connected power onverters for asynchronous power flow
Dr. Jin Wang, Professor
Ohio State University, USA

Grid applications and grid services enabled by MV direct connected power converters for proliferation and extensive renewable energy
Dr. Barry Mather, Group Manager
National Renewable Energy Laboratory, USA

MV SiC Based Power Conditioning Systems for Microgrids, Flexible CHP and Manufacturing Plants
Dr. Fred Wang, Professor
The University of Tennessee, Knoxville, USA

Potential and challenges of using SiC devices in the integration of the electric charging infrastructure to the power grid
Dr. Sheldon Williamson
Professor, Ontario Tech University, Canada

Switch-Capacitor Modular Multilevel Converter (SC-MMC) to Achieve Inductor-less, Filter-less, and Transformer-less Medium-Voltage Power Conversion for High Power Density Applications
Robson Bauwelz Gonzatti, Rami Yehia, Dr. Fang Z. Peng
Florida State University, USA

Monday, October 12 **11:00AM-12:40PM**

SS-3 | Electric Vehicles: Implementation and Grid Interactive Applications

Organizers: Xiaonan Lu, Po-Tai Cheng

Electric vehicles (EVs) play a significant role in modern transportation systems given their remarkable contribution to carbon emission reduction and high potential in support of grid services. The cutting-edge technologies range from device and converter level innovations to system-level grid interactions. Further, given the wide deployment of renewable energy and their inevitable stochasticity, EVs as mobile energy storage can help mitigate the uncertainties induced by renewable generation. In this special session, speakers with comprehensive industry-oriented experience are invited to introduce the state of-the-art of EV technologies with a balance between field practice and advanced innovations.

Speakers and Presentations:

EV Charging: An OEM Perspective
Dr. Rashmi Prasad
Senior Researcher, Propulsion Systems Research Lab, General Motors Research & Development

Overview of Power Electronics for Next-Generation Mobility
Dr. Goh Teck Chiang
Lead Engineer, Toyota Central R&D Labs, Inc.

Medium Voltage Input 400-kW Extreme Fast Charger by utilizing Solid-State-Transformer Technology
Dr. Charles Zhu
Vice President, Delta Electronics (Americas) Ltd.

Propulsion Systems Design Optimization with High Reliability in Mind
Dr. Yue Cao
Oregon State University

Monday, October 12 **1:30PM-3:10PM**

SS-4 | Recent Successes in Accelerating the Adoption of Wide Bandgap Power Electronics

Organizer: Power America, Victor Veliadis & Jim LeMunyon

In accelerating adoption of wide bandgap semiconductors, their must be a focus on increasing the number of applications for both SiC and GaN technologies that are most likely to deliver near term improvements in systems that can benefit from the superior efficiency, reliability, and total cost of ownership offered by SiC and GaN. This session will focus on challenges and recent successes in several key applications for SiC and GaN that have been identified by PowerAmerica's members in the PowerAmerica Technology Roadmap.

Speakers and Presentations:

Wide-Band-Gap Power Semiconductor Devices for Automotive Applications
Chingchi Chen
Ford Research and Engineering

Solid-State Circuit Breakers - a Uniform Platform for Power Distribution
Ryan Kennedy
Atom Power

Challenges in Testing SiC Devices
Joshua MacFie
GROUPNire

Monday, October 12 **1:30PM-3:10PM**

SS-5 | Standard development for power electronics systems / products

Organizer: Fang Deng, *Whirlpool Corporation*

This session provides a comprehensive example of engaging critical technical scopes and competencies in the design process of a power electronics and/or motor drives system. This example collected from five individual research cases ranging from the concept approval to product development phase provides the methodology and standardization for the advanced product design. Approaches via optimization and trade-off analysis of a such system to well balance between performance, reliability, safety and cost are demonstrated in this session. In addition, knowledge and insights in critical performance assessment such as NVH quality provides a specific perspective in design direction and focus, hence leading to practical solutions confined with the overall design targets. In particular, as modern electrification advances the power electronics with fast switching capability is favorable for high controllability, however imposes challenges to retain the motor insulation capability. Rendering solutions to overcome those challenges, system level design strategy is explored and demonstrated in this session, showcasing that the in-depth knowledge, expertise and system view all have played significance in outputting a power electronics motor drives system design achieving most performance benefits with high feasibility and practicality.

Speakers and Presentations:

Design and Optimization of High Performance Synchronous Machines
Dr. Ian P. Brown
Associate Professor, Illinois Institute of Technology, Chicago, IL, USA

Standard practices in electric machine designs to address NVH issues in regards to a mass production environment
Dr. Rakib Islam
Senior motor engineering specialist, Dura Automotive Systems, Auburn Hills, MI, USA

High-Frequency over Voltage Transients in Motor Drive Systems
Dr. Behrooz Mirafzal
Associate Professor, Kansas State University, Manhattan, KS, USA

Traction Inverter Development for Electrified Vehicles
Dr. Rashmi Prasad
Senior Researcher, Electric Drives and Power Electronics Systems Group, GM Global R&D Center, Warren, MI, USA

Dv/dt Filters for WBG Variable-Frequency Drives
Dr. Jiangbiao He
Assistant Professor, Department of Electrical and Computer Engineering, University of Kentucky, USA.

Monday, October 12 **1:30PM-3:10PM**

SS-6 | Testing in the EV World - Simulators, Emulator, Dyno based and Vehicle level testing - Technologies, Trends, and Thoughts

Organizers: Uday Deshpande & Brij N. Singh

The large-scale proliferation of EVs requires prompt yet thorough verification of electric drives (eDrives) prior to their commissioning at system level. A highly integrated test platform for the eDrive systems is required to prove system functionality under operating conditions and assessment of performance within design constraints. For example, eDrive system's performance must be assessed for all sub-components from the battery to the wheel prior to its deployment in the EV. The interdependency between components, modules and subsystems necessitate that test platforms and test approaches follow systems engineering practices. The eDrive system development cycle can be accelerated by effectively utilizing virtual testing platforms followed by the Power Hardware-in-the-loop (pHiL) simulation prior to the minimal in-lab design verification at maximum loads under real world ambient conditions. In the presentations and discussions carried out in this special session, the speakers will share their experiences gained from eDrive system design, development, and commissioning. It will be emphasized that design revisions could be avoided if data collected from the virtual and pHiL test test-ups are appropriately used by the design engineering in best practices such as data driven design engineering processes.

Speakers and Presentations:

Real-time simulators – focus on electric motor models
Dr. Amitkumar K.S.,
Opal-RT Technologies

Rapid development of electrification programs with emulator(pHIL) based testing
Dr. Uday Deshpande, Bill Peterson
D&V Electronics

Battery testing and Characterization
Prof. Saeid Habibi
McMaster University

Laboratory Testing and Emulation of Power Inverters for Heavy-Duty Vehicles
Dr. Brij N. Singh
John Deere

Tuesday, October 13 **9:00AM-10:40AM**

SS-7 | Adoption and Use of Standards in the Industrial Drives and in the Renewable Energy Grid Integration

Organizers: Joe Pavia & Kevin Lee, *Eaton*

The rise of intermittent solar gives rise to the string inverters, which provides grid management benefits. String inverters are already dominant in many global markets and the use of string inverters in large-scale U.S. projects is expected to quadruple by 2025. At Eaton, we know space is always at a premium, time is limited and cost matters. For example, Eaton offers space-saving AC solar recombiner integrates circuit breakers or fuse protection and a disconnect all within one enclosure designed for solar PV string inverters.

Speakers and Presentations:

High Penetration of Renewable Energies through Power Electronics
Joseba Arza
Ingeteam, Future Electrical Grid

Energy Efficiency and Converter Topology
Joseba Arza
Ingeteam, Standards in the Traction Industry

Close-Coupled Solar Switchboard / Transformer with String Inverters
Joe Pavia
Eaton

Interpretation of IEEE 519-2014 For Industrial and Commercial Applications
Mahesh Swamy
IEEE Industrial Drives Committee

Tuesday, October 13

SS-8-A : 9:00AM-10:40AM
SS-8-B : 11:00AM-12:40PM

SS-8-A, SS-8-B | Cybersecurity in Power Electronics

Organizers: Osama Mohammad, Burak Ozpineci

The IEEE Workshop of Cybersecurity of Power Electronic Systems (CyberPELS) provides a common forum and networking platform for industry experts, researchers, and academia to share technology updates, research findings, lessons learned, and best practices in the areas of cyber-secure power electronic systems. This special session is a part of the 1-day CyberPELS Workshop being held before ECCE and will comprised of a mix of industry and academic leaders describing the latest advances in various aspects of cybersecurity for power electronic systems.

Speakers and Presentations:

System control & cybersecurity challenges for high penetration solar grids
Jeremiah Miller
US Department of Energy

Wide Bandgap and Ultra Wide Bandgap Power Switching Devices for Secure High Frequency, High Voltage and Power Dense Applications
Lynn Petersen
Office of Naval Research

TBD
Frede Blaabjerg
Aalborg University

An active defense framework through dynamic watermarking in power electronically-interfaced distribution grids
Prasad Enjeti
Texas A&M University

A Comprehensive Assessment and Detection Methodology for Power Electronics Based Smart Grids (PESG) due to Cyber Attacks
Jinan Zhang
University of Georgia

Resilient Operation of Cooperative Grid-Forming Converters Against Cyber Attacks
Subham Sahoo
Aalborg University

An Active Detection Scheme for Cyber Attacks on Grid-tied PV Inverters
Le Xie
Texas A&M University

Resilient Distribution Systems Operation with Reconfigurable Cyber-Physical Networks Using Situationaware Power Electronics
Xiaonan Lu
Temple University

Tuesday, October 13 **11:00AM-12:40PM**

SS-9 | Innovation through failing better – Panel Session

Organizer: Peter Wung

The latest results from the cognitive sciences tells us that in order to motivate innovation and creative thinking we need to fail in order to learn lessons that are critical for our thinking process. We have heard the mantra of failing fast in order to learn lessons fast and then moving on to success. The assumption is that by failing faster that we would be able to get at the right success formula faster, thereby eliminating all the time spent chasing down the rabbit holes that pepper the scientific discovery landscape.

Prof. Stuart Firestein, a biology professor at Columbia University demurs. In his book titled: Failure, Firestein writes that we as scientists and engineers should be treat failure as an integral part of the process to discovery and pioneering new ground in our scientific work. In other words, we must go through the failure cycle in order to truly innovate.

Conferences like the ECCE however, only populate our programs with successful results. Likewise, the IEEE publications will only publish papers recounting the successes. These results are not the fault of the organizers as the academic and industrial communities emphasizes the successful solution, cursory explanations of errors, and successful applications. It is human nature to give only the good news; indeed, there are no small amount of embarrassment and shame associated with the act of revealing our failures and errors. As such, we are presenting an illusory and unreal snapshot of the research landscape, where every researcher succeeds in every problem they work on. We all know that this is not true, yet we will still only publish our success stories and hide our failures. By doing so, we are depriving the next generation of researcher a true accounting of the hardship, mental puzzlement, and resilient pursuit of the reasons of the failures in an innovative research and development process. More importantly, we are creating mythologies and fiction surrounding the critical and necessary process of the scientific method: hypothesis, experiment, fail, reformulate, and repeat.

Firestein narrows down the vast superset of failures by first eliminating the mistakes and errors, the simple miscalculations, those failures that often results in an apology: I am sorry I should have known that.

What is necessary are good failures, failures which feeds the discovery process, and propels the research forward. To quote Samuel Beckett: Ever Tried. Ever failed. No matter. Try again, Fail again. Fail better

Speakers and Presentations:

Frede Blaabjerg. Professor
Department of Energy Technology.at Aalborg University, President of IEEE Power Electronics Society

Jerry Hudgins
Chairperson, Department of ECE, University of Nebraska-Lincoln

Thomas Jahns
Grainger Professor of Power Electronics and Electrical Machines, WEMPEC, University of Wisconsin

Manoj Shah
Principal Engineer, GE GRC. Professor of Practice, RPI

Tuesday, October 13

SS-10-A : 11:00AM-12:40PM
SS-10-B : 1:30PM-3:10PM

SS-10-A, SS10-B | Sustainable Energy Systems and Opportunities for Power Electronics

Organizer: Sudip K. Mazumer

Energy sustainability and sustainable energy systems are the basis of long-term sustenance of human existence, advancement, and prosperity, social equity and mobility, energy security and surety, and environmental sustenance. It is, therefore, incumbent on us – the IEEE Power Electronics Society (PELS) – to play its part in making an attempt to explore, propose, pursue, and validate ideas that attempt to at least partly address and resolve these grand challenges using plurality of pathways that address plurality of issues ranging from economy of scale, universality, environmental compatibility, compactness and portability, energy surety and security to enhanced energy-conversion efficiency and efficacy. Overall, the main objective of this Special Session, championed by IEEE PELS Technical Committee on Sustainable Energy Systems (TC5), is to bring together the latest developments in inventions, innovations, and applications of power electronics for sustainable energy systems and energy sustainability. In that context, a further goal is to bring together leaders and experts in related areas to share their vision and expertise with the broad ECCE'20 audience. The goal is to have a series of invited presentations throughout a half-day event and intersperse them at regular intervals with questions from the target audience to create an engaging and exciting session.

Speakers and Presentations:

Design for Reliability in Renewable Energy Systems
Frede Blaabjerg
Aalborg University, Denmark

Technology Roadmap of Power Electronics for Distributed Energy Resources
Liuchen Chang
University of New Brunswick, Canada

Electrifying Innovations: Materials to Systems
Isik Kizilyalli
ARPA-E, USA

Resilient Power Systems with High Penetrations of Power Electronics Interfaced Renewable Generation
Feng Qui
Argonne National Lab, USA

Experimental Analysis of 166 kW Medium-Frequency Medium-Voltage Air-Core Transformer
Johann Kolar
ETH Zurich, Switzerland

Differential-Mode Converters
Sudip K Mazumder
University of Illinois, USA

Design of High-Frequency Transformers for Power Electronic Converters
Juan Balda
University of Arkansas, USA

Power Electronics Intelligence at the Network Edge (PINE) – to enable near 100% Solar Penetration in Distribution Grid
Prasad Enjeti
Texas A&M University, USA

Tuesday, October 13 **1:30PM-3:10PM**

SS-11 | Powering the Future: Criticality of System Engineering for E-Mobility and Automated Vehicles - A Roundtable Discussion

Organizers: Anne O'Neil, Jace Allen

Vehicles have greatly evolved from their early days as an assembly of electro-mechanical parts. Modern luxury vehicles can contain nearly 100 million lines of software code, all of which is processed by up to 100 microprocessors networked throughout the vehicle. Developing functionality and ensuring functional safety requires managing interactions and tradeoffs throughout design development and testing. Ever-increasing interdependencies and vehicle complexity drive the need to adopt System Engineering practices and expertise. As vehicles move towards autonomous driving, automation and e-mobility, the levels of integration only increase, as functionality depends upon interactions between Hardware, Software, Sensors, AI, Data analytics, and Chassis and Suspension systems. Hear experts discuss the critical role of System Engineering to manage the challenges of complexity in innovating vehicle solutions.

Speakers:

Dante Crockett
Chief Engineer, Features – Systems Engineering, Product Development Center, Ford Motor Company

Jace Allen
Director, ADAS/AD Engineering and Business Development, dSPACE Inc.

Yue Guo
Professor and Chair of Battery Systems, Coventry University

Joaquin Nuno-Whelan
VP of Hardware, Motional

Tuesday, October 13 **1:30PM-3:10PM**

SS-12 | Heavy-duty All-electric Urban Aerial Vehicles (UAVs)

Organizer: Yue Cao

As we are heading to all-electric intercity passenger aircraft, emerging Urban Aerial Vehicles (UAVs), unmanned or manned, serve as stepping stones to demonstrate start-of-the-art electrification technology. We are already familiar with light-weight drones in cinematography, entertainment, and industrial inspections. However, technology challenges still exist in larger scale (10x-100x) commercial applications such as package delivery drones or passenger flying taxis. Such aerial vehicles are the future urban mobility solutions and face unique design requirements. In this panel, we will focus on such heavy-duty all-electric UAVs, and particularly their propulsion systems. We will review the existing effort in related areas but more importantly, look at the future opportunities specially tailored for UAVs.

Speakers and Presentations:

Challenges and Opportunities in Future eVTOL Propulsion Systems
Satish Rajagopalan
Research Science Manager, Amazon Prime Air

Energy Impacts of Urban Air Mobility
Dominik Karbowski
Technical Manager, Argonne National Laboratory

Safety and Exergy Optimization of Heavy-Duty Electric Aerial Propulsion Systems with Solid-State Energy Conversion Technology
Rodger Dyson
Technical Lead, NASA Glenn Research Center

High-Speed Switched Reluctance Motor Drives for UAV Propulsion Systems
Ali Emadi
President and CEO, Enedym Inc.; Professor, McMaster University

Electrical Machine Innovative Solutions for Aircraft System Challenges
Sara Roggia
Senior Research Engineer, SAFRAN

More-electric or All-electric Aerial Vehicles for a Sustainable Future
Bulent Sarlioglu
Professor, University of Wisconsin-Madison

Wednesday, October 14 **9:00AM-10:40AM**

SS-13 | Next Generation Power-Hardware-in-the-Loop (PHIL) Testing of Traction Inverters: Challenges and Opportunities

Organizers: Ahmad Arshan Khan and Seung-Ki Sul

As automotive OEMs and inverter suppliers commit billions of dollars in the area of vehicle electrification, there is a growing need for fast, efficient, low cost, reliable testing and validation of inverters. Unfortunately, the old and traditional way of inverter testing at motor dyno is expensive, test coverage limited, time-consuming and requires motor hardware availability. Most of these limitations can be successfully solved by Power Hardware-in-the-loop (PHIL) testing and validation approach. In this special session, researchers from academia and PHIL manufacturers will share various existing solutions, opportunities and challenges in the area of Power Hardware-in-the-loop testing of traction inverters.

Speakers and Presentations:

Power electronic validation and testing – the right test methodology on the PowerHiL
Julian Koch
System Test Manager, AVL Software & Function, Germany

Thorsten Fischer
Team Manager System Test Management E-mobility & Head of PowerHiL, AVL Software & Function, Germany

Real-time emulation of IPMSM with Dynamic Motor Emulator (DME) for PHIL testing
Yong-Cheol Kwon
CEO, Plecko, South Korea

Fast, Accurate, and, Repeatable Testing of Inverters Through Effective Machine emulation
Joshua Love
Senior Power Application Engineer, Keysight Technologies, USA

Real-time Simulation and Advanced Power Emulators for Vehicle Electrification Testing – focus on electric motor models
Amit Kumar KS
Simulation & PHIL Specialist, OPAL-RT, Canada

Uday Deshpande,
CTO, D&V Electronics, USA

Brij N. Singh
Senior Staff Engineer, John Deere Electronics Solutions, USA

FPGA Based High Bandwidth Motor Emulator for Interior Permanent Magnet Machine Utilizing SiC Power Converter
Yukun Luo, Wensong Yu, Iqbal Husain
North Carolina State University, USA

High-voltage power hardware-in-the-loop system – Scalable model-based emulation environment for testing and validation of traction inverters
Ren Fang
Project Manager, dSPACE, USA

Wednesday, October 14

SS-14-A : 9:00AM-10:40AM
SS-14-B : 11:00AM-12:40PM

SS-14-A, SS-14-B | Power Electronics Intensive Power Systems: Modeling, Control, and Implementation

Organizers: Xiaonan Lu, Bo Chen

There are tremendous research efforts and industry practice of enhancing grid resilience and stability with increasing penetration of inverter-based resources, focusing on grid-forming and grid-following capabilities, localized and network interconnected microgrids, advanced substation modeling and control, etc. The challenges are identified in multiple sections throughout the electric grids, ranging from grid-edge customers to large-scale distribution systems and bulk power grids. Innovative technologies are being developed and field-validated towards modernized power grids. The session serves to share the latest research progress and industry practice of grid-interactive power electronics and covers a broad audience group, including manufacturers, utilities, national labs, and universities.

Speakers and Presentations:

Impacts to BPS Reliability under Increasing Penetrations of Distributed Energy Resources
Dr. Deepak Ramasubramanian
Engineer Scientist III at Electric Power Research Institute (EPRI)

Advanced Grid-forming Controllers for Low-inertia Systems
Prof. Florian Dörfler
Department of Information Technology and Electrical Engineering, ETH Zürich

Cyber-induced Microgrid Resilience Issues: Analysis, Control, and HIL Testing
Dr. Jianzhe Liui
Argonne National Laboratory

Frequency-Domain Stability Analysis of Grid-Connected Converters
Prof. Xiongfei Wang
Department of Energy Technology, Aalborg University

Control of Parallel Grid-forming Inverters: Experiences from Lab and Field Tests
Dr. Ulrich Münz
Group Lead for Autonomous Systems and Control, Siemens Corporation

Advanced EMT Simulation for Modern Power Grids with GFM and GFL Controls: An Industry Perspective
Andy Hoke
Senior Engineer, National Renewable Energy Laboratory (NREL)

Hybrid AC and DC Distribution Protection
Dr. Lisa Qi
Senior Principal Scientist, ABB

Dynamic Microgrids for Grid Resiliency Enhancement: Design and Implementation
Dr. Bo Chen
Energy Systems Division, Argonne National Laboratory (ANL)

Prof. Xiaonan Lu
College of Engineering, Temple University

Wednesday, October 14

SS-15-A : 9:00AM-10:40AM
SS-15-B : 11:00AM-12:40PM

SS-15-A, SS-15-B | Electric Propulsion for Future Aero and Space Vehicles

Organizer: Jin Wang

For better fuel economy and carbon oxide reduction, future aircrafts calls for electric propulsion. Though there have been significant developments in electric machines and power electronics in the last few decades, electric propulsion presents significant challenges and opportunities.

At the system level, the high power rating of the electric propulsion calls for higher distribution voltage. Currently, the distribution voltage for more electric aircrafts is limited to 540 V because of partial discharge related issues. In the future, where a single aisle commercial aircraft will require more than 10 Megawatt of propulsion power, the electric power distribution voltage is expected to reach as high as 4 kV, which presents a significant challenge in the system architecture and insulation designs.

At the sub-system level, to realize high fuel economy, electric machines and power electronics drives are expected to have ultra-high power densities of 14 kW/kg and 25 kW/kg, respectively, which requires significant innovations in material, device, machine structure, power electronic packaging, control and thermal management.

For future space explorations, there are also significant challenges on power conversion systems in terms of weight and volume power density, device radiation hardness, light weigh insulation material, harsh operation environment, power distribution and protection, etc. Some of the challenges are similar to the ones faced by aero vehicles and solutions can possibly apply to both type of applications.

This proposed special session has invited speakers from NASA, US Air Force, industry and academia to present challenges and solutions for electric propulsion for future aero and space vehicles.

Speakers and Presentations:

Space Power Technology Challenges and Needs to Support Lunar/Mars Campaign
Raymond F. Beach
Principal Technologist for Power & Energy Storage, NASA Glenn Research Center

How Do We Make Electrified Aircraft Propulsion Systems Safe to Fly?
Thomas M. Jahns
Professor, University of Wisconsin

Considerations for Failure Prevention in Aerospace Electrical Power Systems Utilizing Higher Voltages
Daniel L. Schweickart
Air Force Research Laboratory/Aerospace Systems Directorate

Doubly Fed Brushless Machine for High Speed Variable Systems
Longya Xu
Professor, The Ohio State University

Electric Aircraft Propulsion System – Scaling-up to Meet Future Aircraft Roadmaps
Pat Wheeler
Professor, University of Nottingham

Challenges and Opportunities for Electric Drive Train in Electrified Aircraft Propulsion Systems
Xin Wu
Principal Scientist at UTRC

State-of-the-art and Emerging Electric Drive Architectures for More-Electric-Aircraft Propulsion
Julia Zhang
Assistant Professor, The Ohio State University

20 MW Electrified Aircraft
Dr. Parag Kshirsagar
Associate Director, Collins Aerospace Program Office, Raytheon Technologies Research Center

Thursday, October 15 **9:00AM-10:40AM**

SS-16 | Industry vs Academia: which career path is right for you?

Withdrawn by organizers

Thursday, October 15 **9:00AM-10:40AM**

SS-17 | Dealing with Public Health Emergence: Online Life and Advanced Technologies in Remote Education

Organizers: *Women in Engineering (WiE),* Norma Anglani, Hong Li, Giovanna Oriti, Katherine A. Kim, Jin Ye, Jingya Dai, Mi Dong, Shu Yang, Na Zhi

Remote education has become an important part of schools and universities all over the world during the outbreak of the coronavirus. Advanced technologies, such as advanced meeting software and online education, are playing an important part in the remote education. In this workshop, various engineers and educators will share their approach, tools and advanced software they use, and lessons learned in successfully implementing remote education for people around the world.

Speakers and Presentations:

How to frame and offer a class of energy planning to electrical engineering Master students online
Noma Anglani
University of Pavia, litaly

Developing online educational videos to reach a global audience
Katherine Kim
National Taiwan University, Taiwan

Distance learning virtual and hardware laboratories
Giowanna Oriti
Naval Postgraduate School, Monterey, CA

Some thoughts on online-teaching and webinar
Hong Li
Bejing Jiaotong University, China

Thursday, October 15 **9:00AM-10:40AM**

SS-18 | Power electronics application in standalone wind/ solar based distributed generation system

Organizers: Ashutosh K Giri, Sabha Raj Arya, Rakesh Maurya, Yangheng Yang

The aim of proposed special session is to bring together researchers/academia and practicing engineers in power electronics industry for sharing their innovative ideas for fostering the new research and development in this area. The importance of renewable energy based distributed power generation system have increased manifold in recent years. The power quality (PQ) issues in distributed power generation system are a major concern for customers. The role of power electronics based custom power devices such as voltage source converter is to mitigate the PQ issues and make the system more reliable and practically feasible. The operation of voltage source converter is dependent on the control algorithm used for estimating the modulating signal followed by Pulse width modulation techniques that is used for gate pulses generation. Therefore, this create awareness among teachers, research students and industry persons about better utilization of distributed power generation system by making it more efficient with the use of power electronics. This is intended to cover all the traditional as well as advanced control algorithms of power filtering and their control including modeling and simulations. The application of various converter topologies in solar and wind power generation is the thrust area of this session. The adaptive control, model predictive control, fuzzy based controllers, artificial intelligence based control algorithm and optimization techniques application for estimating the error regulator gains are the focus area for estimating the reference current. The authors can submit their research articles mentioned above, however there is no restriction for some innovative applications used in the domain of wind or solar based distributed power generation system.

Speakers and Presentations:

Design and Control of Solar Photovoltaic Energy System
Bhim Singh
CEA Chair Professor and Professor, Department of Electrical Engineering, Indian Institute of Technology Delhi, New Delhi -110016-India

Hybrid Renewable Energy Standalone Systems
Ambrish Chandra
Professor, Department of Electrical and Computer Engineering, École de Technologie Supérieure, Montreal, QC, Canada

High Energy Efficiency AC Machines and Their Application in Wind Energy Conversion System
Dr. Sanjeet Kumar Dwivedi
Senior R&D engineer, Danfoss Drives A/S, Gra°sten, Denmark

Integration of Renewable Energy System to the Power Grid – Impact and Challenges
Dr. Parag Upadhyay, PhD
Principal Scientist – Transformers & Electromagnetics, ABB Power Grid Research, Raleigh, NC – 27606, USA

Thursday, October 15 **11:00AM-12:40PM**

SS-19 | HVdc/MVdc/MTdc technologies and benefits to grid

Organizers: Suman Debnath, Maryam Saeedifard

During this session, the audience will be provided an overview of updates in ongoing research activities in HVdc/MVdc/MTdc systems and highlight the challenges in greater acceptance of such technologies. The talks will broadly be categorized into modeling, control, opportunities and challenges, and protection of dc systems. The following topics will be discussed: (i) Means to model and simulate converters as well as hybrid grids, (ii) Technical and reliability benefits that can be provided by HVdc/MTdc systems through advanced control methods, (iii) Manufacturer's perspective on HVdc and MVdc technologies, and (iv) Breakers, algorithms, and advances needed to protect hybrid ac-dc grids.

Speakers and Presentations:

High-fidelity modeling, simulation algorithms, and advanced control systems in HVdc converters and systems that enable improved reliability of grids
Suman Debnath (ORNL)
CEA Chair Professor and Professor, Department of Electrical Engineering, Indian Institute of Technology Delhi, New

Frequency response and congestion management benefits and modeling challenges for HVdc macrogrids in continental North American electric system
Marcelo Elizondo
PNNL

Recent developments and future trends of HVDC & MVDC technologies. A manufacturer's view
Orestes Macchione
Siemens

Inline medium voltage direct current circuit breaker
David Smith
General Electric

Protection of Multi-Terminal High-Voltage DC Grids
Maryam Saeedifard
Georgia Institute of Technology

Thursday, October 15 **11:00AM-12:40PM**

SS-20 | Energy Access: Technologies, Impact and The Opportunity for PELS

Organizers: PELS Technical Committee – 12: Energy Access, Deepak Divan, Jelena Popović

Ensuring universal, affordable and sustainable energy access is one of the biggest societal challenges of our time. As of 2020, close to a billion people worldwide live without electricity, and another two billion have unreliable access. The centralized electricity grid is not the optimal choice for remote and rural applications, due to environmental impact, cost, mismatch to user needs and challenges around financial feasibility. Decentralized approaches, such as solar home systems and microgrids, have emerged as a response to shortcomings of the centralized grid approach, but affordability, scalability, interoperability and societal and technical sustainability remain a challenge.

Power electronics is one of the key enabling technologies for context-appropriate and sustainable energy access solutions. The IEEE Power Electronics Society (PELS) engaged with Energy Access through organizing a global challenge - Empower a Billion Lives (EBL), and by including Energy Access as a new and core topic in its long-range planning. Following on the success of the first EBL round, a strong expression of interest in the technologies underlying energy access, and a burgeoning need for decentralized power systems with more autonomous control, Technical Committee – 12: Energy Access is being formed by PELS to provide global technical leadership in this important area.

The panel discussion is centred around a discussion of the key technology gaps in the broader field of energy access, identifying possible solutions that could have great impact in the communities that need them. This discussion can help guide TC-12 in defining areas of activity, and can further put a spotlight on Empower a Billion Lives as a PELS flagship initiative. The panellists will give positioning statements, followed by a moderated discussion on the following topics:

- Technical challenges and opportunities in decentralized systems for energy access and necessity of context-appropriate, impact-driven approach.
- Possible technology topics: DC nanogrids, hyper-efficient appliances, self-organizing microgrids, solar home systems, productive energy use appliances, transactive energy for microgrids, bottom-up clustered microgrids, autonomous inverters, improving battery life, simple easy to use and easy to scale systems.
- Technology gaps based on field experience, major concerns for field practitioners
- TC-12 roles and activities:
- Events, publications, technical leadership in the broader community.
- Empower a Billion Lives: reflecting on the first round of EBL, lessons learned and looking forward to the second round.
- Collaboration with relevant IEEE initiatives (e.g. IEEE Smart Village) and groups as well as outside stakeholders (industry, organizations, foundations, governments etc).

The discussions of this panel are expected to raise enthusiasm for this important topic within the PELS community, stimulate involvement in TC-12 activities and energy access as a topic on the whole. The discussions will also be used as inputs for TC-12 activities including the second round of EBL.

Speakers and Presentations:

Off-grid solar opportunities and challenges
Nana Nuamoah Asamoah-Manu
Lighting Africa IFC, Kenya

Social impact, Localization and scaling, Open-source design
Chetan Singh Solanki
SoULS initative IIT Bombay, India

Nanogrids, Challenges of serving base-of-pyramid
Richard Mori
MeshPower, Rwanda

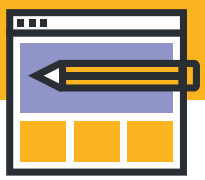
Interconnected solar home systems, peer-to-peer energy sharing
Felix Boldt
Solar Worx, Germany

IEEE Smart Village, Capacity building
Rajan Kapur
IEEE Smart Village/IIT Mandi, USA/India

Empower a Billion Lives, PELS TC-12 Energy Access, Technology innovation
Deepak Divan
Georgia Institute of Technology, USA (moderator)

PELS TC-12 Energy Access, Impact and context-appropriate technology within TC-12
Jelena Popovic
University of Twente, The Netherlands (moderator)

Tutorials



Pre-registration for each tutorial is required.
The following Tutorials are all video on demand.
See live "meet the author" times in the Live/Simu-Live Session Schedules.

Sunday, October 11

T1 | Modelling and Control of Automotive Grade Interior Permanent Magnet Synchronous Motor

Instructors: Seung-Ki Sul and Young-Cheol Kwon

Since Interior Permanent Magnet Synchronous Motor (IPMSM) has been used as a traction motor for hybrid and electric vehicle, the control and modelling of IPMSM have been continuously evolved. Most of modelling and control of IPMSM have been developed based on the ideal model of IPMSM, where the parameters of IPMSM are constant regardless of the operating conditions. In this tutorial, the modelling of automotive grade IPMSM considering magnetic saturation, cross coupling and spatial harmonics will be discussed. As an example, the characteristics of traction motors used in Prius and Bolt will be addressed.

T2 | Challenges and Solutions of Smart Solid State Transformer

Instructors: Marco Liserre, Alex Q. Huang, Rongwu Zhu, and Levy Costa

The smart transformer based on solid state transformer technology provides dc connectivity and power flow controllability increasing the hosting capacity of renewables and electric vehicle charging stations, and consequently reducing the need for updating the grid assets. In this context, this tutorial introduces the recent advancements in the field of smart transformer in terms of power semiconductor technology (e.g. 10 kV SiC), magnetic components (medium voltage, medium frequency and multi-winding), power converter topologies and architectures, connecting them to the services in power system when operating in radial, meshed and hybrid grids, with examples from pilot projects.

T3 | GaN-Based Power Converter Ecosystem Design: Magnetics, Gate Driver IC, and Applications

Instructors: Yaow-Ming Chen, Yu-Chen Liu, Ching-Jan Chen, and Katherine Kim

The power density and efficiency demand of power converters keep increasing in applications such as data centers, vehicles, satellite, and renewable energy system. As demonstrated by industry and academy, GaN switch becomes a game changing device to meet such demands. However, to fully use the potential of GaN-based power converter, an ecosystem including magnetics, gate driver IC, and converter implementation have to be designed together. This tutorial will cover high-frequency converter design and magnetics in the first part, high-speed gate driving design in the second part, and converter applications using GaN switches in the third part. The presentation will introduce each of these main concepts and give concrete examples and experimental results.

T4 | Physics-based Modeling and Control of PWM Converters

Instructors: Christoph Henrik van der Broeck, Marc Stephane Petit, and Rik W. De Doncker

This tutorial presents control design of PWM converters in a physically insightful way enabling the audience to develop creative solutions for their own applications. The tutorial reviews fundamental principles for modeling, design, implementation and analysis of controls for power converters by focusing on the physics of controlled power electronic converters. The tutorial examines these principles using a half-bridge converter as an example, such that a straightforward adaption to other converter topologies is possible. It uses a wide range of MATLAB, Simulink, and PLECS computation and simulation examples that are made available to the audience for in-depth personal study.

T5 | Grid-forming Inverters, Virtual Synchronous Machines, and Power Electronics-enabled Autonomous Power Systems

Instructors: Qing-Chang Zhong

Power systems are going through a paradigm change. Future power systems will be power-electronics-based. These power electronic converters can be controlled as grid-forming inverters, more specifically, as virtual synchronous machines. This leads to synchronized and democratized (SYNDEM) smart grids. This tutorial will cover the underlying principles of the SYNDEM grid architecture, associated control problems, virtual synchronous machines technologies, field demonstration results, and future research directions. Moreover, the SYNDEM Smart Grid Research and Educational Kit, which is an open-source reconfigurable power electronic converter with the capability of directly downloading codes from Matlab/Simulink, will be presented as well.

T6 | Preparing for the Opportunities and Challenges of WBG-Based Motor Drives

Instructors: T.M. Jahns, B. Sarlioglu, *UW-Madison*; and J.W. Kolar, *ETH-Zurich*

Wide-bandgap (WBG) power devices are poised to have a major impact on future machine drives. The objective of this tutorial is to assistdrive design engineers to prepare for this transition.The impact of introducing WBG switches into hard-switched voltage-source inverters (VSI) will highlight the challenges associated with drop-in replacement strategies. Advanced inverter bridge-leg topologies that are well-suited to WBG switches will be presented, as well as opportunities for the re-emergence of current-source inverters (CSIs). The tutorial will address practical challenges associated with designing WBG-based inverters and conclude with a discussion of current and future applications of WBG-based motor drives.

Sunday, October 11

T7 | Design Considerations for Large Format Lithium-ion Battery Systems

Instructors: Ashish Arora and Sneha Lele

This tutorial will provide an overview of the requirements and challenges of designing large format Li-ion battery systems such as those used in electric vehicles, grid storage applications etc. Functional safety concepts commonly used when designing these battery systems will be introduced and the hazards associated with large format battery systems will be explained using case studies. The tutorial will also provide an overview of applicable industry standards, examples of common large format battery system architectures and their advantages and disadvantages and the typical failure modes of protection schemes commonly used for large format battery systems.

T8 | Application of Topology Optimization Techniques in Innovative Motor Design

Instructors: Sainan Xue and Vedanadam Acharya

The tutorial reviews the technical challenges in machine design where the high torque density and efficiency are required across the entire drive range, introduces two major topology optimization techniques – genetic algorithm with on/off method and the normalized Gaussian Network (NGnet) as well as density method for local optimization, then elaborates on how machine design can utilize these topology optimization techniques in narrowing down the best innovative topologies under the predefined operating conditions. The effectiveness, calculation complexity, and hardware requirements for each optimization technique are presented with case studies. Finally, we propose future application scenarios where topology optimization made possible.

T9 | High-Efficient, High-Reliable Energy Storage Power Conversion Systems (PCS) for Increased Renewable Energy and Electric Vehicle Integration

Instructors: Johan Enslin and Zheyu Zhang

The increased use of variable and intermittent renewable generation, as well as integration of more rapid EV charging infrastructure, with increased requirements for reliability and resiliency power grid, makes the case for more energy storage capacity on distribution feeders. Through practical case studies and installed systems, this tutorial will present energy storage technologies, value proposition, regulatory environment and interconnection standards. Also, energy storage power conversion systems technologies will be overviewed with the development of high-efficiency SiC-based energy storage converter emphasized. This is an intermediate-level tutorial for researchers and engineers with fundamental power electronics knowledge.

T10 | Electrical Insulation Stresses in PWM-driven Electric Machines

Instructors: Julia Zhang, Yanyan Xie, Franco Leonardi, Alfredo Munoz and Feng Liang

This tutorial will teach the finite element modeling, mathematical modeling, and experimental testing of electrical stress distribution inside electric machine windings driven by PWM voltage excitations. The instructors will discuss: 1) industry standards on winding insulation design and testing for electric machines; 2) how to use finite element techniques to model the winding pulse voltage propagation and current distribution in individual conductors of inverter-driven machine windings; 3) mathematical modeling of voltage/current distribution in machine windings; 4) challenges and solutions in testing winding electrical stress distribution using both machine prototypes and electrified vehicle productions; 5) factors that affect the winding pulse voltage propagation, including wire distributions in slots, parasitic parameters, current level, DC bus voltage, rotor speed, etc. 6) the voltage stress map on the insulation parts along machine windings, providing support for machine insulation system design.

T11 | Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles

Instructors: John Hayes and Abas Goodarzi

In this introductory tutorial, the authors present a three-part seminar based on their 2018 book Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, an industry reference and a structured holistic textbook for the teaching of the fundamental theories and applications. The first half of the tutorial is a lively overview of battery, fuel cell, and hybrid electric vehicles with their strong Detroit roots. The second part of the tutorial reviews the traction machines. The third part of the tutorial reviews the power electronics, and discusses the propulsion, charging, accessory, and auxiliary power converters.

T12 | Design and Integration of Photovoltaic and Energy Storage Converters

Instructors: Martin Ordonez, Emanuel Serban and Francisco Paz

Renewable energy systems, especially solar photovoltaic (PV), are growing at an unprecedented pace and pairing them with energy storage systems (ESS) is crucial. Successful system integration depends on the careful balance between cost and functionality. This seminar covers the design and integration of PV with ESS to extend system features beyond the limits of the current technology. Three aspects of PV+ESS are covered: 1) Design and Optimization of Power Converters for PV, 2) PV+ESS Integration, and 3) PV+ESS System Design Through Optimization. Industry-standard practices and an introduction of advanced techniques that yield better performance and extend functionality are discussed.

T13 | Analysis, Simulation, and Implementation of Vector Control: An Extremely Low-Cost Laboratory

Instructors: Ned Mohan and Siddharth Raju

This tutorial will describe closed-loop position/speed/torque control of ac drives using vector control. One of the major bottlenecks in the implementation and testing of new motor controls is the cost of software and hardware necessary to evaluate these controls. This tutorial relies solely on the ONR-funded simulation and model-based real-time code generation and control software, Sciamble® Workbench (https://sciamble.com/), available free-of-cost. The real-time implementation will be demonstrated using an inexpensive low-voltage lab kit developed by the University of Minnesota through ONR funds(https://cusp.umn.edu/). All participants will be able to remotely implement vector control of AC drives.

T14 | Health-conscious Fast Charging Strategies and Battery Management Systems for Electrified Autonomous Transportation

Instructor: Sheldon Williamson

Enhancing the calendar life and safety of Lithium-ion battery packs has been the topic of much interest when it comes to transportation electrification. In this framework, the role of on-board active cell voltage balancing of Li-ion batteries will be highlighted in this talk. This is a very important topic in the context of battery energy storage cost and life/state-of-charge, SOC/state-of-health, SOH monitoring. This talk will also introduce a first-of-its-kind closed-loop cell charge (voltage) balancing and extreme fast charging technique. The technique uses instantaneous cell voltage and/or temperature rise (ΔT) as a control parameter.

ORAL SESSIONS

The following Oral Sessions are all video on demand.
See live "meet the author" times in the Live/Simu-Live Session Schedules.

Virtual 1

Monday, October 12 **11:00AM-11:30AM**

S1 | Machines for Transportation

Chairs: Alireza Fatemi, Rajesh Deodhar

0597 | Basic Study on Efficiency Improvement of Hybrid Excitation Flux Switching Motor using Variably Magnetizable Permanent Magnet for Automotive Traction Drives
Keita Otsuka, Takeshi Okada, Tomoya Mifune, Hiroaki Matsumori, Takashi Kosaka, Nobuyuki Matsui
Nagoya Institute of Technology, Japan

1225 | A 3D-Airgap Slotless Permanent Magnet Machine for Transportation Applications
Md Sariful Islam[1], Rajib Mikail[2], Ritvik Chattopadhyay[1], Iqbal Husain[1]
[1]North Carolina State University, United States; [2]ABB US Corporate Research Center, United States

0024 | Air-Cooled Multi Phase Dual-Winding In-Wheel Motor integrated with Ultra Small SiC Module
Kan Akatsu[1], Satoshi Tanimoto[2], Yoshinori Murakami[3]
[1]Yokohama National University, Japan; [2]Fukushima SiC Applied Engineering Inc., Japan; [3]Nissan Motor Co., Ltd, Japan

0273 | Novel Efficiency-Shifting Radial-Axial Hybrid Interior Permanent Magnet Synchronous Motor for Electric Vehicle
Hoyun Won, Yang-Ki Hong, Minyeong Choi, Hwan-Sik Yoon, Shuhui Li, Tim Haskew
The University of Alabama, United States

0390 | Investigation of Enhancing Reluctance Torque of a Delta-Type Variable Flux Memory Motor having Large Flux Barrier for EV/HEV Traction
Ren Tsunata, Masatsugu Takemoto, Satoshi Ogasawara, Koji Orikawa{}
Hokkaido University, Japan

0759 | A High-Speed High-Power-Density Non-Heavy Rare-Earth Permanent Magnet Traction Motor
Tsarafidy Raminosoa[1], Randy Wiles[1], J. Emily Cousineau[2], Kevin Bennion[2], Jon Wilkins[1]
[1]Oak Ridge National Laboratory, United States; [2]National Renewable Energy Laboratory, United States

0388 | Motor System Integrated Magnetic Multiple Spur Gear and High Speed Motors for Electric Vehicle
Kohei Aiso[1], Kan Akatsu[2], Yasuaki Aoyama[3]
[1]Waseda University, Japan; [2]Yokohama National University, Japan; [3]Hitachi, Ltd., Japan

Virtual 2

Monday, October 12 **11:00AM-11:30AM**

S2 | Power Converter Controls in Wind and PV Systems

Chairs: Eduard Muljadi, Fei Gao

1324 | Modulated Predictive Current Control of NPC Converter-Based PMSG Wind Energy System
Venkata Yaramasu[1], Kristiyan Milev[1], Apparao Dekka[2], Jose Rodriguez[3]
[1]Northern Arizona University, United States; [2]Lakehead University, Canada; [3]Universidad Andres Bello, Chile

0137 | Anti-Disturbance Full-Order Sliding Mode Control of PMSG-Based Wind Energy Conversion Systems
Chun Wei[1], Jianxing Xu[1], Qiang Chen[1], Wei Qiao[2], Jianwu Zeng[3]
[1]Zhejiang University of Technology, China; [2]University of Nebraska-Lincoln, United States; [3]Minnesota State University-Mankato, United States

1571 | Impact of Virtual Synchronous Generator (VSG) on Sub Synchronous Control Interaction (SSCI) in DFIG Systems using Sequence Domain Impedance Method
Mohammad Khatibi, Yu-Fang Jin, Sara Ahmed
University of Texas at San Antonio, United States

1389 | LVRT Control based on Partial State-Feedback Linearization for SCIG Wind Turbine Systems
Anh Tan Nguyen, Dong-Choon Lee
Yeungnam University, Korea

1463 | Power Optimizer based on Model Predictive Control for a Cascade Multilevel Impedance Source Inverter
Sally Sajadian
Lafayette College, United States

0094 | Circulating Current Analysis and Power Mismatch Elimination Strategy for an MMC-Based Photovoltaic System
Xicai Pan, Shangzhi Pan, Jinwu Gong, Xiaoming Zha
Wuhan University, China

1419 | Comparative Analysis of Flexible Power Point Tracking Algorithms in Photovoltaic Systems
Hossein Dehghani Tafti[1], Georgios Konstantinou[1], Christopher D. Townsend[2], Glen G. Farivar[3], Salvador Ceballos[4], John E. Fletcher[1], Josep Pou[4]
[1]University of New Wales, Australia; [2]The University of Western Australia, Australia; [3]Nanyang Technological University, Singapore; [4]Basque Research and Technology Alliance, Spain

0593 | Energy Harvesting Comparison and Analysis in 1000V and 1500V Grid-Connected PV Systems
Branislav Stevanović[1], Emanuel Serban[2], Miroslav Vasić[1], Martin Ordonez[2], Santiago Cóbreces[3]
[1]Universidad Politécnica de Madrid, Spain; [2]The University of British Columbia, Canada; [3]Universidad de Alcalá, Spain

Virtual 3

Monday, October 12 **11:00AM-11:30AM**

S3 | DC-DC Converters – Switched Capacitors and Datacenter Applications

Chairs: Wenkang Huang, Gui-Jia Su

1570 | Upscaling Supercapacitor assisted Low Dropout Regulator for High-Current and High-Voltage for the 48 V DC Google Rack Architecture
Thilanga Ariyarathna[1], Nihal Kularatna[2], D. Alistair Steyn-Rosse[2]
[1]Waikato Institute of Technology, New Zealand; [2]The University of Waikato, New Zealand

1095 | An Integrated Programmable Gate Timing Control and Gate Driver Chip for a 48V-to-0.75V Active-Clamp Forward Converter Power Block
Dongkwun Kim[1,2], Yoshitaka Yamauchi[1], Xiaodong Meng[1], Tianyu Jia[1], Liam McAuliffe[1], Kevin Tien[1], Shurong Tian[1], Yuan Yao[1], Andrew Ferencz[1], Mingoo Seok[2], Xin Zhang[1], Todd Takken[1]
[1]IBM T. J. Watson Research Center, United States; [2]Columbia University, United States

1403 | Series Voltage Compensator for Differential Power Processing
Ping Wang, Minjie Chen
Princeton University, United States

1086 | A 12 Switch Zero-Inductor Voltage Converter Topology For Next Generation Datacenters
Samuel Webb, Yan-Fei Liu
Queen's University, Canada

0551 | Merged-Two-Stage Resonant and PWM Soft-Charging of Hybrid-Switched-Capacitor DC-DC Converters
Yenan Chen, Jaeil Baek, Minjie Chen
Princeton University, United States

0380 | Reducing C_{oss} Switching Loss in a GaN-Based Resonant Cockcroft-Walton Converter using Resonant Charge Redistribution
Nathan Miles Ellis, Rajeevan Amirtharajah
University of California-Davis, United States

1238 | Switched Capacitor Converter with Flexible Voltage Gain and 99.2% Efficiency Utilizing Autotransformer
Fnu Satvik, Wensong Yu, Dakai Wang, Siyuan Chen
North Carolina State University, United States

0684 | A Novel Hybrid 4:1 Step Down Converter using an Autotransformer with DC Winding Current
Cheng Li, Diego Serrano, José A. Cobos
Universidad Politécnica de Madrid, Spain

Virtual 4

Monday, October 12 **11:00AM-11:30AM**

S4 | Wide-Bandgap Semiconductors 1

Chairs: Cong Li, Christina DiMarino

0816 | Comparison of Medium-Voltage Oscilloscope Probes for Evaluating Silicon-Carbide Multi-Chip Power Modules
Christopher D. New, Andrew N. Lemmon, Brian T. DeBoi, Jared C. Helton, Blake W. Nelson
The University of Alabama, United States

0838 | A Physical Investigation of Large-Signal Dynamic Output Capacitance and Energy Loss in GaN-on-Si Power HEMTs at High-Frequency Applications
Jia Zhuang[1], Grayson Zulauf[1], Jaume Roig[2], James D. Plummer[1], Juan Rivas-Davila[1]
[1]Stanford University, United States; [2]ON Semiconductors, Belgium

0296 | Characterization and Analysis of Insulated Metal Substrate-Based SiC Power Module for Traction Application
Shajjad Chowdhury, Emre Gurpinar, Burak Ozpineci
Oak Ridge National Laboratory, United States

0254 | An Intelligent Three-Level Active Gate Driver for Crosstalk Suppression of SiC MOSFET
Zhidong Qiu, Hong Li, Yanfeng Jiang, Tiancong Shao, Zhichang Yang, Zhipeng Zhang, Jiaxin Wang
Beijing Jiaotong University, China

0538 | A 500kW Forced-Air-Cooled Silicon Carbide (SiC) 3-Phase DC/AC Converter with a Power Density of 1.246MW/m^3 and Efficiency >98.5%
Yan Li[1], Yonglei Zhang[1], Xibo Yuan[2], Lei Zhang[1], Fei Ye[1], Yaohua Li[1], Yipu Xu[1], Zijian Wang[1], Zhe Li[1]
[1]China University of Mining and Technology, China; [2]University of Bristol, United Kingdom

0518 | Characterizing Threshold Voltage Shifts and Recovery in Schottky Gate and Ohmic Gate GaN HEMTs
Jose Ortiz Gonzalez, Burhan Etoz, Olayiwola Alatise
University of Warwick, United Kingdom

0963 | Impact of Parasitics and Load Current on the Switching Transient Time and Motor Terminal Overvoltage in SiC-Based Drives
Wenzhi Zhou, Mohamed S. Diab, Xibo Yuan
University of Bristol, United Kingdom

0726 | 3D Commutation-Loop Design Methodology for a Silicon-Carbide based 15 kW, 380:480 V Matrix Converter with PCB Aluminum Nitride Cooling Inlay
Victoria Baker[1], Boran Fan[1], Rolando Burgos[1], Vladimir Blasko[2], Warren Chen[2]
[1]Virginia Polytechnic Institute and State University, United States; [2]Raytheon Technologies Research Center, United States

0680 | Performance of Wide-Bandgap Gallium Nitride vs Silicon Carbide Cascode Transistors
Yasin Gunaydin[1], Saeed Jahdi[1], Olayiwola Alatise[2], Jose Ortiz Gonzalez[2], Ruizhu Wu[2], Mohammad Hedayati[1], Xibo Yuan[1], Phil Mellor[1], Bernard Stark[1]
[1]University of Bristol, United Kingdom; [2]University of Warwick, United Kingdom

Virtual 1

Monday, October 12 **11:35AM-12:05PM**

S5 | High Speed and Bearingless Machines

Chairs: Eric Severson, Peng Han

1407 | Design of an Ultra-High Speed Bearingless Motor for Significant Rated Power
Ashad Farhan, Martin Johnson, Kyle Hanson, Eric L. Severson,
University of Wisconsin-Madison, United States

0267 | Fully Passively Levitated Self-Bearing Machines with Combined Windings
Joachim Van Verdeghem, Bruno Dehez
Université Catholique de Louvain, Belgium

0995 | Investigation of Enhancing Output Power Density in Ultra-High-Speed Motors with Concentrated Winding Structure
Takayuki Iida[1], Masatsugu Takemoto[2], Satoshi Ogasawara[1], Koji Orikawa[1], Ikuya Sato[3], Akio Toba[3], Masao Shuto[3], Hiroyuki Kokubun[3]
[1]Hokkaido University, Japan; [2]Okayama University, Japan; [3]Fuji Electric Co., Ltd., Japan

1058 | Towards Electrostatic Levitation of Rotating Machines
Michael Mayberry, Daniel C. Ludois, Eric L. Severson
University of Wisconsin-Madison, United States

0637 | Investigation of Combined Electro Magnetic Structure of Bearingless Motor and Magnetic Gear
Akira Kumashiro[1], Akira Chiba[1], Wolfgang Gruber[2], Wolfgang Amrhein[2], Gerald Jungmayr[3]
[1]Tokyo Institute of Technology, Japan; [2]Johannes Kepler University Linz, Austria; [3]Linz Center of Mechatronics GmbH, Austria

0615 | Magnetically Geared Conveyor Drive Unit – An Updated Version
Simon Staal Nielsen[1], Rasmus Koldborg Holm[2], Nick Ilsøe Berg, Peter Omand Rasmussen[1],
[1]Aalborg University, Denmark; [2]Dansk Ingeniørsservice A/S, Denmark

1502 | Effects of Axial Flux Magnetic Gear Misalignment
Bryton Praslicka[1], Matthew Johnson[2], Matthew C. Gardner[1], Ellen Dangtran[1], Hamid A. Toliyat[1]
[1]Texas A&M University, United States; [2]U.S. Army CCDC, United States

0607 | A Dual Stator/Rotor PM and Winding Flux Modulated PM Machine
Shaofeng Jia, Shuai Feng, Deliang Liang, Jinjun Liu,
Xi'an Jiaotong University, China

1509 | Comparison of Reluctance and Surface Permanent Magnet Coaxial Magnetic Gears
Shima Hasanpour[1], Matthew C. Gardner[1], Matthew Johnson[2], Hamid A. Toliyat[1],
[1]Texas A&M University, United States; [2]U.S. Army CCDC, United States

Virtual 2

Monday, October 12 **11:35AM-12:05PM**

S6 | Power Converters for Solar Energy

Chairs: Deepak Divan, Kaushik Basu

0886 | Internal Energy Balance of a Modular Multilevel Cascade Converter based on Chopper-Cells with Distributed Energy Resources for Grid-Connected Photovoltaic Systems
Bruno E. de O. B. Luna[1], Cursino B. Jacobina[2], Alexandre C. Oliveira[2] ,
[1]Federal University of Semi-Arid Region, Brazil; [2]Federal University of Campina Grande, Brazil

0119 | A Fundamental Voltage and Harmonics Elimination Control Strategy for Single-Phase Cascade Off-Grid Photovoltaic-Storage System using Hybrid Modulations
Yiyan Lu[1], Zhao Liu[1], Jianshou Kong[2], Deping Tang[3], Jie Yu[1], Jiawei Ji[1]
[1]Nanjing University of Science and Technology, China; [2]Changshu Intelligent Laser Equipment Research Institute, China; [3]Hefei Kewell Power System Co., Ltd., China

0998 | Optimized Predictive Control of Hybrid Multilevel PV Inverter with Reduced Leakage Current
Jayesh Kumar Motwani, Abhinandan Routray, Nimish Kumar Chaudhari, Rajeev Kumar Singh, Ranjit Mahanty
Indian Institute of Technology (BHU) Varanasi, India

1143 | Multiport Power Management Method with Partial Power Processing in a MV Solid-State Transformer for PV, Storage, and Fast-Charging EV Integration
Liran Zheng, Rajendra Prasad Kandula, Deepak Divan
Georgia Institute of Technology, United States

1587 | A Series Interharmonic Filter for Cascaded H-Bridge PV Inverters
Yiwei Pan, Ariya Sangwongwanich, Yongheng Yang, Frede Blaabjerg
Aalborg University, Denmark

0218 | A Solution for the Full-Bridge Grid-Tie Inverter using Single Virtual Ground Capacitor with UPWM
Ruihua Shen, Henry Shu-Hung Chung
City University of Hong Kong, China

0779 | A Current-Mode Controller for an HB-NPC Inverter using the Virtual-Ground Trajectory for Power Injection in PV Systems
S. Iturriaga-Medina[1], P.R. Martinez-Rodriguez[1], G. Escobar[2], J.C. Mayo-Maldonado[2], J.E. Valdez-Resendiz[2], O.F. Ruiz-Martinez[3]
[1]Universidad Autonoma de San Luis Potosi, Mexico; [2]Tecnologico de Monterrey, Mexico; [3]Universidad Panamericana, Mexico

1093 | An 11 kV AC, 16 kV DC, 200 kW Direct-to-Line Inverter Building-Block using Series-Connected 10 kV SiC MOSFETs
Lakshmi Ravi, Xiang Lin, Dong Dong, Rolando Burgos
Virginia Polytechnic Institute and State University, United States

Virtual 3

Monday, October 12 **11:35AM-12:05PM**

S7 | Isolated DC-DC Converters

Chairs: Shafiq Ahmed Odhano, Yuan Xibo

0006 | LLC Converters Power Density Enhancement through Optimized Current Shaping using Multi-Resonant Branches
Ali Elrayyah
Hamad Bin Khalifa University, Qatar

1138 | Current Balancing and Phase Shedding by Split Capacitor for a Three-Phase LLC Resonant Converter
Akiteru Chiba, Yuuki Aoyagi, Kazuto Takagi
Sanken Electric Co., Ltd., Japan

1582 | Analysis and Control of Three-Phase Interleaved SCC-LLC Resonant Converter Load Sharing Considering Component Tolerance
Bo Sheng, Xiang Zhou, Wenbo Liu, Yang Chen, Yan-Fei Liu, Paresh C. Sen
Queen's University, Canada

1135 | An Interchangeable Soft-Switched Voltage Boosting Circuit for a Multi-Mode LLC Step-Up Converter Module in Medium Voltage Applications
Mehdi Abbasi[1], Reza Emamalipour[1], Muhammad Ali Masood Cheema[2], John Lam[1]
[1]York University, Canada; [2]Northern Transformer, Canada

0725 | Dual Voltage Flyback Topology Operation with Efficiency Enhancers at Dual Voltage Mains
Noam Ezra, Teng Long
University of Cambridge, United Kingdom

0162 | The Asymmetrical Half-Bridge Flyback Converter: A Reexamination
Giorgio Spiazzi, Simone Buso
University of Padova, Italy

0674 | Family of Hybrid DC-DC Converters for Connecting DC Current Bus and DC Voltage Bus
Nie Hou, Yun Wei Li
University of Alberta, Canada

1183 | Fault Tolerant Isolated Dual Active DC-DC Converter using WBG Devices
Amin Ashraf Gandomi[1], Leila Parsa[1], Vahid Dargahi[2], Keith Corzine[1]
[1]University of California-Santa Cruz, United States; [2]University of Washington-Tacoma, United States

Virtual 4

Monday, October 12 **11:35AM-12:05PM**

S8 | Modern Tools for Detecting and Identifying Electrical System Parameters or Attacks

Chairs: Burak Ozpineci, Osama Mohammed

1567 | DC Microgrids under Denial of Service Attacks: Feasibility and Stability Issues
Jianzhe Liu[1], Bai Cui[2], Bo Chen[1], Xiaonan Lu[3], Feng Qiu[1], Sudip Mazumder[4]
[1]Argonne National Laboratory, United States; [2]National Renewable Energy Laboratory, United States; [3]Temple University, United States; [4]University of Illinois at Chicago, United States

0734 | Data-Driven Cyberattack Detection for Photovoltaic (PV) Systems through Analyzing Micro-PMU Data
Qi Li[1], Fangyu Li[1], Jinan Zhang[1], Jin Ye[1], Wenzhan Song[1], Alan Mantooth[2]
[1]University of Georgia, United States; [2]University of Arkansas, United States

0796 | Composite Load Model Parameter Identification with Distributed Machine Learning for the Stability Study of Microgrids
Javad Khodabakhsh[1], Gerry Moschopoulos[1], Pirathayini Srikantha[2]
[1]Western University, Canada; [2]York University, Canada

0891 | Detection of False-Data Injection Attacks in Supercapacitor Charging Systems
Bowen Liu, Fu Jiang, Heng Li, Hongtao Liao, Hang Zhang, Jun Peng, Zhiwu Huang, Xianqi Lu
Central South University, China

0845 | Expanding Exposure Area of Magnetic Field Generator for Biological Evaluation by using Dual Air-Core Inductor
Kazuki Matsubara, Keiji Wada, Yukihisa Suzuki
Tokyo Metropolitan University, Japan

1307 | Design Consideration for Power Line Sensors in Power Distribution Systems
Xianyong Feng, Robert Hebner, Shannon Strank
The University of Texas at Austin, United States

0352 | Design and Implementation of Remote Plasma Sources for Semiconductor Chamber Cleaning
T.F. Wu, L.C. Yu, A. Kumari, R.Z. Hung, P.J. Chen
National Tsing-Hua University, Taiwan

0155 | A Design Methodology of a Free Positioning None-Overlapping Wireless Charging System for Consumer Electronics with a Limited Parameter Variation
Yiming Zhang, Shuxin Chen, Xin Li, Li Zhang, Yi Tang
Nanyang Technological University, Singapore

Virtual 1

Monday, October 12 **12:10PM-12:40PM**

S9 | Optimization in Electric Machines

Chairs: Rukmi Dutta, Giulio De Donato

1076 | Multiphysics Optimisation of a Slotless Permanent Magnet Machine with a Composite Winding Layer
Suzanne Collins, Philip H. Mellor, Nick Simpson
University of Bristol, United Kingdom

1250 | Co-Optimization of an Electric Motor-Drivetrain System for Concentrated Solar Power Heliostats
Abdulaziz M. Qwbaiban, Shen Zhang, Thomas G. Habetler
Georgia Institute of Technology, United States

0217 | Rotor Surface Optimization of Interior Permanent Magnet Synchronous Motors to Reduce both Rotor Core Loss and Torque Ripples
Katsumi Yamazaki[1], Kento Utsunomiya[1], Akihiro Tanaka[2], Toru Nakada[2]
[1]Chiba Institute of Technology, Japan; [2]Nissan Motor Co. Ltd., Japan

0263 | Multi-Objective Whale Optimization Algorithm and Optimal Area Product Model based Design of Litz-Wire Gapped High-Frequency Transformer for LLC Resonant Converters
Daniyal Ahmed, Li Wang, Zehua Dai
Nanjing University of Aeronautics and Astronautics, China

1440 | Electromagnetic and Thermal Analysis of a Line-Start Permanent-Magnet Synchronous Motor
Mousalreza Faramarzi Palangar[1], Amin Mahmoudi[1], Solmaz Kahourzade[2], Wen L. Soong[3]
[1]Flinders University, Australia; [2]University of South Austria, Australia; [3]University of Adelaide, Australia

1515 | Design and Magnetic Field Analysis of a Dual Rotor Axial Flux PM Machine with Steel-Assisted Halbach Magnet Configuration
Sodiq Agoro, Iqbal Husain
North Carolina State University, United States

0234 | Prediction of Transient Voltage Distribution in Inverter-Fed Stator Winding, Considering Mutual Couplings in Time Domain
Shubham Sundeep, Jiabin Wang, Antonio Griffo
The University of Sheffield, United Kingdom

0513 | Frequency-Domain based Windings Voltage Distribution Modelling for Converter-Fed Electrical Machines
Yi Wei[1], Antonio Griffo[1], Fernando Alvarez-Gonzalez[1], Ravindra Bhide[2], Subhra Samanta[2], Arwyn Thomas[2], Zi-Qiang Zhu[1], Richard Clark[2]
[1]University of Sheffield, United Kingdom; [2]Siemens Gamesa Renewable Energy Limited, United Kingdom

0464 | Two-Axis Vector Control of Double Stator Linear and Rotary Permanent Magnet Machine Considering Orthogonally Coupling Effect
Lei Xu, Xiaoyong Zhu, Li Zhang, Chao Zhang, Deyang Fan
Jiangsu University, China

1531 | Design and Analysis of a Hook Shaped Stator Core with Ring Winding Transverse Flux Machine for Wind Turbine Applications
Anik Chowdhury, Yilmaz Sozer
The University of Akron, United States

Virtual 2

Monday, October 12 **12:10PM-12:40PM**

S10 | Optimization and Sizing of Energy Storage Systems

Chairs: Yilmaz Sozer, Xiaofeng Yang

0860 | Robustness Evaluation of PV-Battery Sizing Principle under Mission Profile Variations
Monika Sandelic, Ariya Sangwongwanich, Frede Blaabjerg
Aalborg University, Denmark

1356 | Distributed ESS Capacity Decision for Home Appliances in Smart Home
Yeon ju Baik[1], Ye gu Kang[2]
[1]University of Wisconsin-Madison, United States; [2]University of Oviedo, Spain

1553 | Cost Optimization of Battery and Supercapacitor Hybrid Energy Storage System for Dispatching Solar PV Power
Pranoy Kumar Singha Roy, JiangBiao He, Yuan Liao
University of Kentucky, United States

0896 | An Online Extremum Seeking Optimization Strategy for Warm-Up of Lithium Batteries
Kaifu Guan, Zhiwu Huang, Yongjie Liu, Hongtao Liao, Zhiwei Gao, Yinhui Le, Xiaoyong Zhang, Jun Peng, Yue Wu
Central South University, China

0945 | Reactive Balancing Circuit for Paralleled Battery Modules Employing Dynamic Capacitance Modulation
Phuong-Ha La, Sung-Jin Choi
University of Ulsan, Korea

0766 | Power Management of Supercapacitors using Auxiliary Bank Switching for Hybrid Energy Storage Systems
Yashwanth Dasari, Deepak Ronanki, Sheldon S. Williamson
University of Ontario Institute of Technology, Canada

0914 | Cooperative Cell Balancing of Supercapacitors with Adaptive Observers
Minghui Guo, Xiaoyong Zhang, Heng Li, Hongtao Liao, Yexin Liao, Hang Zhang, Zhiwu Huang, Zhiqiang Meng
Central South University, China

0186 | Analysis of the Inter-Submodule Active Power Disparity Limits in Modular Multilevel Converter-Based Battery Energy Storage Systems
Gaowen Liang[1], Hossein Dehghan Tafti[2], Glen G. Farivar[1], Josep Pou[1], Christopher D. Townsend[3], Georgios Konstantinou[2]
[1]Nanyang Technological University, Singapore; [2]University of New South Wales, Australia; [3]University of Western Australia, Australia

Virtual 3

Monday, October 12 **12:10PM-12:40PM**

S11 | DC-DC Converters for Electric Transportation

Chairs: Li Zhang, Manuel Arias

1173 | Variable-Frequency Controlled Interleaved Boost Converter
Shamar Christian, Roberto Armin Fantino, Roderick Amir Gomez, Yue Zhao, Juan Carlos Balda
University of Arkansas, United States

0727 | A Composite DC-DC Converter using Current-Fed Dual-Half Bridge
Nan Lin, Zhe Zhao, Fei Diao, Yue Zhao, Juan Carlos Balda
University of Arkansas, United States

0326 | A Bidirectional Non-Isolated DC-DC Converter based on Switched-Capacitor Converters for DC Electric Railways
Kazuaki Tesaki, Makoto Hagiwara
Tokyo Institute of Technology, Japan

1335 | Split Duty Cycle Coupled Multi-Phase Boost-Buck Converter
Ahmed K. Khamis[1], Mohammed Agamy[1], Ramanujam Ramabhadran[2]
[1]University at Albany, SUNY, United States; [2]GE Aviation, United States

0486 | Auxiliary Power Module – Integrated EV Charger with Extended ZVS Range
Gibum Yu, Sewan Choi
Seoul National University of Science and Technology, Korea

0337 | Isolated DC/DC Multimode Converter with Energy Storage Integration for Charging Stations
Felix Hoffmann, Thiago Pereira, Marco Liserre
Christian-Albrechts-Universität zu Kiel, Germany

1159 | High Efficiency Bidirectional DC-DC Converter with Matrix Transformer for Heavy Duty Hybrid Electric Vehicles
Shubham Mungekar, Akash Dey, Ghansyamsinh Gohil
The University of Texas at Dallas, United States

0073 | Experimental Characterization of a 750-V 100-kW 16-kHz Bidirectional Isolated DC-DC Converter with a Unity-Turns-Ratio Transformer at Different Voltage Ratios
Ryo Haneda, Hirofumi Akagi
Tokyo Institute of Technology, Japan

0479 | Zero-Voltage-Switching Current-Source Rectifier based EV Charging System using SiC Devices
Yang Xu[1], Zheng Wang[1], Pengcheng Liu[1], Yihan Chen[1], Jiangbiao He[2]
[1]Southeast University, China; [2]University of Kentucky, United States

Virtual 4

Monday, October 12 **12:10PM-12:40PM**

S12 | Wide-Bandgap Semiconductors 2

Chairs: Xiu Yao, He Li

1445 | Mitigation of Motor Overvoltage in SiC-Device-Based Drives using a Soft-Switching Inverter
Wenzhi Zhou, Mohamed S. Diab, Xibo Yuan
University of Bristol, United Kingdom

0519 | Online Health Monitoring and Aging Prognostics for SiC Power Converters
Eddy Aeloiza[1], Arun Kadavelugu[1], Liming Liu[1], Joonas Puukko[2]
[1]ABB Inc., United States; [2]ABB Oy, Finland

1369 | Hard-Switched Overvoltage Robustness of p-Gate GaN HEMTs at Increasing Temperatures
Joseph P. Kozak, Ruizhe Zhang, Jingcun Liu, Qihao Song, Ming Xiao, Yuhao Zhang
Virginia Polytechnic Institute and State University, United States

0399 | Influence of Paralleled SiC MOSFET on Turn-Off Gate Voltage Oscillation
Ye Zhu[1], Han Li[1], Cheng Luo[2], Yong Liu[1], Cheng Wan[1], Jie Ma[1]
[1]Eaton Corp., China; [2]Eaton Corp., United States

0730 | Trade-Offs between Gate Oxide Protection and Performance in SiC MOSFETs
Jose Ortiz Gonzalez, Ruizhu Wu, Olayiwola Alatise
University of Warwick, United Kingdom

0883 | Turn on Switching Transient Analysis of SiC MOSFET and Schottky Diode Pair
Shamibrota Kishore Roy, Kaushik Basu
Indian Institute of Science-Bangalore, India

0960 | Switching Current Imbalance Mitigation for Paralleled SiC MOSFETs using Common-Mode Choke in Gate Loop
Jiye Liu, Zedong Zheng
Tsinghua University, China

1574 | Current Sharing Analysis of SiC Power Modules in Parallel Operation
Yue Zhang, Zhining Zhang, Boxue Hu, Faisal Alsaif, Khalid Alkhalid, Jin Wang, Xiao Li
The Ohio State University, United States

1140 | A 1200V/650V/160A SiC+Si IGBT 3-Level T-Type NPC Power Module with Optimized Loop Inductance
Asif Imran Emon, Zhao Yuan, Amol Deshpande, Hongwu Peng, Riya Paul, Fang Luo
University of Arkansas, United States

Virtual 1

Wednesday, October 14 **9:00AM-9:30AM**

S13 | Additive and Alternative Manufacturing for Electric Machines

Chairs: Nick Simpson, Nicola Bianchi

0700 | Novel Multi-Layer Design and Additive Manufacturing Fabrication of a High Power Density and Efficiency Interior PM Motor
Maged Ibrahim, Fabrice Bernier, Jean-Michel Lamarre
National Research Council of Canada, Canada

0371 | Minimization of Winding AC Losses using Inhomogeneous Electrical Conductivity Enabled by Additive Manufacturing
Fan Wu, Ayman M. El-Refaie
Marquette University, United States

1082 | Investigation on the Potential of PCB Winding Technology for High-Dynamic and High-Precision Linear Actuators
Guillaume Colinet[1], William Lamberts[1], Francois Baudart[2], Bruno Dehez[1]
Université Catholique de Louvain, Belgium

0561 | A Study of Switched Reluctance Motor using Grain-Oriented Electrical Steel Sheets
Yuzuki Tsuchiya[1], Kan Akatsu[2]
[1]Shibaura Institute of Technology, Japan; [2]Yokohama National University, Japan

0605 | Comparative Analysis of PWM Power Losses in IPM Machines with Different Modulation Schemes using Wide-Bandgap-Based Inverters
Le Chang[1], Woongkul Lee[1], Thomas M. Jahns[1], Jihyun Kim[2]
[1]University of Wisconsin- Madison, United States; [2]General Motors Global Propulsion Systems, United States

0705 | Design of an Iron Loss Tester for the Evaluation of Assembled Stator Cores of Electric Machines
Maged Ibrahim[1], Jaydeep Bhalala[2], Pragasen Pillay[2]
[1]National Research Council, Canada; [2]Concordia University, Canada

0936 | Identifying AC Loss Distributions in Electrical Machines through Experimentally Informed Virtual Prototyping
Dominic North, Nick Simpson, Phil Mellor
University of Bristol, United Kingdom

Virtual 2

Wednesday, October 14 **9:00AM-9:30AM**

S14 | Renewable Energy and Hybrid Energy Storage Systems

Chairs: Yongheng Yang, Ahmed Elasser

0150 | A Hybrid Model Parameter Extraction Method for Single-Diode Model of PV Module
Xiangjian Meng, Feng Gao, Tao Xu
Shandong University, China

0356 | Power Electronic Implementation of Electrochemical Impedance Spectroscopy on Photovoltaic Modules
Olufemi I. Olayiwola, Paul S. Barendse
University of Cape Town, South Africa

1003 | Accelerated Aging Method and Lifetime Evaluation of Aluminum Electrolytic Capacitors for Power Electronic Application
Sagar B. Narale, Amit Verma, Sandeep Anand
Indian Institute of Technology Kanpur, India

1087 | Practical Design and Evaluation of a High-Efficiency 30-kVA Grid-Connected PV Inverter with Hybrid Switch Structure
Hongwu Peng[1], Zhao Yuan[1], Dereje Lemma Woldegiorgis[1], Asif Imran Emon[1], Balaji Narayanasamy[1], Fang Luo[1], Alan Mantooth[1], Haider Ghazi Mhiesan[1], Yusi Liu[2]
[1]University of Arkansas, United States; [2]On Semiconductor, United States

0572 | Optimal Planning of Renewable Energy Resources and Battery Storage System for an Educational Campus in South Australia
Rahmat Khezri[1], Amin Mahmoudi[1], Hirohisa Aki[2]
[1]Flinders University, Australia; [2]University of Tsukuba, Japan

0708 | A Cost-Effective Standalone E-Bike Charging Station Powered by Hybrid Wind and Solar Power System including Second-Life BESS
Cong-Long Nguyen[1], Ettore Colicchio[2], Paolo Primiani[2], Louis Viglione[2], Kamal Al-Haddad[1], Lyne Woodward[1]
[1]École de Technologie Supérieure, Canada; [2]Alizeti Ubimobil Inc., Canada

0382 | Energy Management Strategy for Ultracapacitors in Hybrid Electric Vehicles
Carlos Villarreal-Hernandez[1], Javier Loranca-Coutino[1], Omar F. Ruiz-Martinez[2], Jonathan C. Mayo-Maldonado[2], Jesus E. Valdez-Resendiz[1], Gerardo Escobar-Valderrama[1], Carolina Del-Valle-Soto[2], Julio C. Rosas-Caro[2]
[1]Tecnologico de Monterrey, Mexico; [2]Universidad Panamericana, Mexico

1253 | A Hierarchical Energy Management Strategy for Battery/Ultracapacitor Hybrid Energy Storage Systems via Supervised Learning
Yao Lu, Weirong Liu, Yue Wu, Jiahao Huang, Hongtao Liao, Jun Peng, Zhiwu Huang, Yongjie Liu
Central South University, China

Virtual 3

Wednesday, October 14 **9:00AM-9:30AM**

S15 | DC-AC Three-Phase Converters

Chairs: Leila Parsa, Pahlevani Majid

0598 | Minimizing Losses Induced by Parasitic Winding Capacitance in Electric Drives by Means of Soft-Switching GaN-Based ARCP
Thiago Pereira[1], Klaus Krischan[2], Annette Muetze[2], Marco Liserre[1]
[1]Christian-Albrechts-Universität zu Kiel, Germany; [2]Graz University of Technology, Austria

1585 | High-Frequency Quasi-Z-Source Inverter Concept for Short-Circuit Capable GaN-HEMT-Based Converters
Taichi Nakayama, Tomoyuki Mannen, Akira Nakajima, Takanori Isobe
University of Tsukuba, Japan

0982 | Efficiency, Cost and Volume Comparison of Si-IGBT based T-NPC and 2-Level SiC-MOSFET based Topology with DV/DT Filter for High Speed Drives
Jelena Loncarski[1], Vito Giuseppe Monopoli[1], Riccardo Leuzzi[2], Pericle Zanchetta[2], Francesco Cupertino[1]
[1]Politecnico di Bari, Italy; [2]University of Nottingham, United Kingdom

0005 | New Cascaded Converter Topologies for Transformerless Galvanic Active Isolation
Clint Halsted, Madhav Manjrekar
University of North Carolina at Charlotte, United States

1577 | Region-Based Stability Analysis of Resilient Distribution Systems with Hybrid Grid-Forming and Grid-Following Inverters
Lizhi Ding[1], Yuxi Men[1], Yuhua Du[1], Xiaonan Lu[1], Bo Chen[2], Yuzhang Lin[4], Jin Tan[3]
[1]Temple University, United States; [2]Argonne National Laboratory, United States; [3]National Renewable Energy Laboratory, United States; [4]University of Massachusetts, Lowell, United States

1108 | Power Control of Hybrid Grid-Connected Inverter to Improve Power Quality
Wooyoung Choi, Kyungsub Jung, Bulent Sarlioglu
University of Wisconsin-Madison, United States

0650 | Current Limitation Strategy for Grid-Forming Converters under Symmetrical and Asymmetrical Grid Faults
Roberto Rosso[1], Soenke Engelken[1], Marco Liserre[2]
[1]WRD GmbH, Germany; [2]Christian-Albrechts Universitaet zu Kiel, Germany

1035 | Grid Application and Controls Development for Medium-Voltage SiC-Based Grid Interconnects
Akanksha Singh, Xiangqi Zhu, Barry Mather, Firehiwot Gurara
National Renewable Energy Laboratory, United States

Virtual 4

Wednesday, October 14 **9:00AM-9:30AM**

S16 | Gate Drivers and Driving Techniques

Chairs: Tanya Gachovska, Hengzhao Yang

1053 | Gate-Driver Integrated Junction Temperature Estimation of SiC MOSFET Modules
Slavko Mocevic[1], Vladimir Mitrovic[1], Jun Wang[1], Rolando Burgos[1], Dushan Boroyevich[1], Mehrdad Teimor[2], Marko Jaksic[2]
[1]Virginia Polytechnic Institute and State University, United States; [2]General Motors, United States

0723 | Hybrid Voltage Balancing approach for Series-Connected 10 kV SiC MOSFETs for DC-AC Medium-Voltage Power Conversion Applications
Xiang Lin, Lakshmi Ravi, Dong Dong, Rolando Burgos
Virginia Polytechnic Institute and State University, United States

0770 | A 10 MHz GaN Driver IC with Bang-Bang Dead-Time Control for Synchronous Rectifier Buck Converter
Pin Ying Wang[1], Ping Kun Chiu[1], Sheng Teng Li[1], Ching Jan Chen[1], Chih Chao Hsu[2]
[1]National Taiwan University, Taiwan; [2]National Chung-Shan Institute of Science and Technology, Taiwan

1596 | Digital Active Gate Control for a Three-Phase Inverter Circuit for a Surge Voltage Suppression and Switching Loss Reduction
Daiki Yamaguchi[1], Yu Shan Cheng[1], Tomoyuki Mannen[1], Hidemine Obara[2], Keiji Wada[1], Makoto Takamiya[3], Takayasu Sakurai[3], Toru Sai[3]
[1]Tokyo Metropolitan University, Japan; [2]Yokohama National University, Japan; [3]The University of Tokyo, Japan

0808 | A GaN Driver IC with Novel Highly Digitally Adaptive Dead-Time Control for Synchronous Rectifier Buck Converter
Ping Kun Chiu[1], Pin Ying Wang[1], Sheng Teng Li[1], Ching Jan Chen[1], Yi Ting Chen[2]
[1]National Taiwan University, Taiwan; [2]National Chung-Shan Institute of Science and Technology, Taiwan

0421 | A Resonant Gate Driver with Variable Gain and a Capacitively Decoupled High-Side GaN-FET
Nathan Miles Ellis, Evan Sousa, Rajeevan Amirtharajah
University of California-Davis, United States

0439 | Automatic Search Method of Robust Gate Driving Vectors for Digital Gate Drivers against Variations in Operating Conditions of IGBT's
Ting-Wei Wang[1,2], Toru Sai[1], Ryuzo Morikawa[1], Katsuhiro Hata[1], Takayasu Sakurai[1], Makoto Takamiya[1], Po-Hung Chen[2]
[1]The University of Tokyo, Japan; [2]National Chiao Tung University, Taiwan

0317 | Design Guidelines of Current Source Gate Driver for Series Connected SiC MOSFETs
Chunhui Liu, Zhengda Zhang, Yifu Liu, Yunpeng Si, Mengzhi Wang, Qin Lei
Arizona State University, United States

0262 | Statistics-Based Switching Loss Characterization of Power Semiconductor Device
Jiayang Lin, Ke Ma, Ye Zhu
Shanghai Jiao Tong University, China

Virtual 1

Wednesday, October 14 **9:35AM-10:05AM**

S17 | AC Machines and Drives

Chairs: Andrea Cavagnino, Mahesh Swamy

1059 | Analytical Model and Performance Prediction of Induction Motors using Subdomain Technique
Emad Roshandel[1], Amin Mahmoudi[1], Solmaz Kahourzade[2], Wen Soong[3]
[1]Flinders University, Australia; [2]University of South Australia, Australia; [3]University of Adelaide, Australia

1514 | On the Effects of Ultra-High Switching Frequency on PWM-Inverter-Fed Induction Motors
Giacomo Scelba[1], Danilo Camuglia[1], Giulio de Donato[2], Silvio Vaschetto[3], Andrea Cavagnino[3], Emmanuel Agamloh[4]
[1]University of Catania, Italy; [2]Sapienza University of Rome, Italy; [3]Politecnico di Torino, Italy; [4]Baylor University, United States

1556 | Parameter Estimation of a Three Phase Induction Machine with a Solid Copper-Coated Rotor and a Large Air Gap
Christiane Mellak[1], Josef Deuringer[2], Annette Muetze[1]
[1]Graz University of Technology, Austria; [2]Siemens Healthcare GmbH, Germany

0264 | Design of an Energy Efficient Outer Rotor Ceiling Fan Single Phase Induction Motor
Utkarsh Sharma, Bhim Singh
Indian Institute of Technology Delhi, India

1568 | Sensorless Cascade-Model Predictive Control Applied to a Doubly Fed Induction Machine
Jacopo Riccio[1], Shafiq Odhano[2], Mi Tang[1], Pericle Zanchetta[1]
[1]University of Nottingham, United Kingdom; [2]University of Newcastle, United Kingdom

1580 | Position Sensorless Control of PMSM Drives based on HF Sinusoidal Pulsating Voltage Injection
Jiali Liu, Yongchang Zhang, Haitao Yang, Wenjia Shen
North China University of Technology, China

0214 | Novel Compensation Method of Digital Delay for High-Speed Permanent Magnet Synchronous Motor Under Low Carrier Ratio
Keyuan Huang, Jiaxin Zhou, He Zhao, Wei Lv, Shoudao Huang
Hunan University, China

0657 | Saliency-Based Position Sensorless Drive for Permanent Magnet Machine with Low Cost Shunt Resistor Current Sensing using Modified PWM Voltage Injection
Jyun-You Chen, Kuo-Yuan Hung, Guan-Ren Chen, Shih-Chin Yang
National Taiwan University, Taiwan

Virtual 2

Wednesday, October 14 **9:35AM-10:05AM**

S18 | Microgrids 1

Chairs: Meiqin Mao, Lina He

0212 | Transient Load Sharing between Grid-Forming Generators in Islanded Microgrid
Yelun Peng[1], Xin Zhang[2], Li Zhan[1]
[1]Nanyang Technological University, Singapore; [2]Zhejiang University, China

1557 | Autonomous Current Sharing Control with Integrated Virtual Impedance and Self Synchronisation for Unbalanced Islanded Microgrids
A.A. Nazib, D.G. Holmes, B.P. McGrath
RMIT University, Australia

0634 | Improved Adaptive Filter FLL Control Algorithm for Enhancing Performance of Islanded Microgrid Supplying Dynamic Loads
Rohini Sharma, Seema Kewat, Bhim Singh
Indian Institute of Technology-Delhi, India

1613 | A New Current Limiting and Overload Protection Strategy for Droop-Controlled Voltage-Source Converters in Islanded AC Microgrids under Grid Faulted Conditions
Zi-lin Li[1], Jiefeng Hu[2], Ka Wing Chan[1]
[1]The Hong Kong Polytechnic University, Hong Kong; [2]Federation University Australia, Australia

0676 | Reduced Battery Usage in a Hybrid Battery and Photovoltaic Stand-Alone DC Microgrid with Flexible Power Point Tracking
Hein Wai Yan[1], Aditi Narang[1], Hossein Dehghani Tafti[2], Glen G. Farivar[1], Josep Pou[1]
[1]Nanyang Technological University, Singapore; [2]University of New South Wales, Australia

1101 | Sharing Control Strategies for a Hybrid 48V/375V/400Vac AC/DC Microgrid
Carlos Gómez-Aleixandre, Ángel Navarro-Rodríguez, Geber Villa, Cristian Blanco, Pablo García
University of Oviedo, Spain

0585 | Adaptive PR and BBO based Control Strategy of Wind-Solar Integrated Standalone Microgrid for Residential Application
Farheen Chishti, Bhim Singh, Shadab Murshid
Indian Institute of Technology-Delhi, India

Virtual 3

Wednesday, October 14 **9:35AM-10:05AM**

S19 | Multilevel Converters 1

Chairs: Younghoon Cho, Marco di Benedetto

0029 | A Five-Switch Four-Level Converter
Jianfei Chen, Caisheng Wang
Wayne State University, United States

0670 | A Novel 7-Level X-Boost Active Neutral Point Clamped Inverter
Haider Mhiesan, Dereje Woldegiorgis, Yuqi Wei, Alan Mantooth
University of Arkansas, United States

1583 | A Pyramid-Type (PT) Multilevel Converter Topology
Vahid Dargahi[1], Keith Corzine[2], Arash Khoshkbar Sadigh[3]
[1]University of Washington, United States; [2]University of California, Santa Cruz, United States; [3]Pennsylvania State University, United States

0527 | A Family of Modular Multilevel Bidirectional DC-DC Converters for High Voltage-Ratio and Low Ripple Applications
Pekik Argo Dahono, Andriazis Dahono
Institute of Technology Bandung, Indonesia

1360 | A New Asymmetric 49-Levels Cascaded MPUC Multilevel Inverter Fed by a Single DC-Source
Samuel C.S. Júnior[1], Cursino Jacobina[1], Edgard L.L. Fabricio[2], Alan S. Felinto[1]
[1]Federal University of Campina Grande, Brazil; [2]Federal Institute of Paraíba, Brazil

0553 | A Seven-Level Switched Capacitor Inverter using Series/Parallel Conversion with Reduced Number of Switches
Masaki Sugiyama, Daiki Yamaguchi, Hirotaka Koizumi
Tokyo University of Science, Japan

1479 | Design of High-Power Density Interleaved 3-Phase 5-Level E-Type Back-to-Back Converter
M. di Benedetto[1], A. Lidozzi[1], L. Solero[1], F. Crescimbini[1], P.J. Grbović[2]
[1]Roma Tre University, Italy; [2]Innsbruck University, Australia

0916 | New Cascaded-Transformers Multilevel Inverter for Renewable Distribution Systems
Ahmed Ismail M. Ali[1,2], Mahmoud A. Abdallah[2], Takaharu Takeshita[1]
[1]Nagoya Institute of Technology, Japan; [2]South Valley University, Egypt

0345 | A Novel Solid-State Transformer with Loosely Coupled Resonant Dual-Active-Bridge Converters
Jaehong Lee[1], Junghyeon Roh[1], Seung-Hwan Lee[1], Sungmin Kim[2], Myung-Yong Kim[3]
[1]University of Seoul, Korea; [2]Hanyang University, Korea; [3]Korea Railroad Research Institute, Korea

Virtual 4

Wednesday, October 14 **9:35AM-10:05AM**

S20 | Device and Module Packaging

Chairs: Andrew Lemmon, Kristen Booth

1217 | High Power Density 1700-V/ 300-A Si-IGBT and SiC-MOSFET Hybrid Switch-Based Half-Bridge Power Module
Amol Deshpande, Asif Imran, Riya Paul, Zhao Yuan, Hongwu Peng, Fang Luo
University of Arkansas, United States

0563 | Low-Inductance Double-Sided Cooling Power Module with Branched Lead Frame Terminals for EV Traction Inverter
Takeshi Tokuyama[1], Akira Mima[1], Yusuke Takagi[2], Akira Matsushita[2]
[1]Hitachi, Ltd., Japan; [2]Hitachi Automotive Systems, Ltd., Japan

0171 | Design of a Low Multi-Loop Inductance Three Level Neutral Point Clamped Inverter with GaN HEMTs
Eduard Dechant[1], Norbert Seliger[1], Ralph Kennel[2]
[1]Technical University of Rosenheim, Germany; [2]Technical University of Munich, Germany

1096 | A 16 kV PCB-Based DC-Bus Distributed Capacitor Array with Integrated Power-AC-Terminal for 10 kV SiC MOSFET Modules in Medium-Voltage Inverter Applications
Lakshmi Ravi, Xiang Lin, Dong Dong, Rolando Burgos
Virginia Polytechnic Institute and State University, United States

0531 | Applying GaN HEMTs in Conventional Housing-Type Power Modules
Lei Kou, Juncheng Lu
GaN Systems Inc., Canada

1374 | Chip Metallization Aging Monitoring with Induced Voltage v_{eE} between Kelvin and Power Emitter for High Power IGBT Modules
Yu Chen, Fanxu Meng, Ankang Zhu, Wuhua Li, Xiangning He
Zhejiang University, China

0504 | Fourier Analysis-Based Evolutionary Multi-Objective Multiphysics Optimization of Liquid-Cooled Heat Sinks
Raj Sahu, Emre Gurpinar, Burak Ozpineci
Oak Ridge National Laboratory, United States

1236 | Reliability Enhancement of Power Modules by Restricting Junction Temperature Fluctuation through Increased Transient Thermal Capacity
Xin Fang[1], Huaping Jiang[1], Xiaoyong Wang[1], Weihua Shao[1], Hai Ren[1], Hengchun Mao[2], Li Ran[1]
[1]Chongqing University, China; [2]Quanten Technologies, United States

Virtual 1

Wednesday, October 14 **10:10AM-10:40AM**

S21 | Permanent Magnet Machines

Chairs: Tsarafidy Raminosoa, Rajesh Deodhar

0336 | A Novel Asymmetric Rotor Interior PM Machine with Hybrid-Layer PMs
Yang Xiao[1], Zi-Qiang Zhu[1], Jin-Tao Chen[2], Di Wu[2], Li-Ming Gong[2]
[1]The University of Sheffield, United Kingdom; [2]Midea Shanghai Motors and Drives Research Center, China

1607 | Control of a Dual Fed Open End Winding SPMSM with a Floating Capacitor
Davide Minaglia[1], Luca Rovere[2], Andrea Formentini[2], Riccardo Leuzzi[3], Sabino Pipolo[2], Pericle Zanchetta[2], Mario Marchesoni[4]
[1]Danieli Automation S.P.A., Italy; [2]University of Nottingham, United Kingdom; [3]University of Pavia, Italy; [4]University of Genoa, Italy

0699 | A Novel Toroidal Permanent Magnet Motor Structure with High Torque Density and Enhanced Cooling
Maged Ibrahim, Fabrice Bernier, Jean-Michel Lamarre
National Research Council of Canada, Canada

0157 | A Novel Spoke-Type Asymmetric Rotor Interior PM Machine
Yang Xiao[1], Zi-Qiang Zhu[1], Jin-Tao Chen[2], Di Wu[2], Li-Ming Gong[2]
[1]The University of Sheffield, United Kingdom; [2]Midea Shanghai Motors and Drives Research Center, China

0290 | Difference in Reluctance Torque Utility between Concentrated and Distributed Windings
Akeshi Takahashi, Wataru Hatsuse
Hitachi, Ltd, Japan

1467 | Optimal Study of a High Specific Torque Vernier-Type Axial-flux PM Machine with Two Different Stators and a Single Winding
Murat G. Kesgin, Peng Han, Narges Taran, Dan M. Ionel
University of Kentucky, United States

0250 | Sensorless Capacity Evaluation of a New Five-Phase Flux-Intensifying Fault-Tolerant Interior-Permanent-Magnet Motor
Li Zhang, Xiaoyong Zhu, Lei Xu, Deyang Fan
Jiangsu University, China

0494 | A Method to Estimate the Worst-Case Torque Ripple under Manufacturing Uncertainties for Permanent Magnet Synchronous Machines
Yongxi Yang[1], Nicola Bianchi[2], Gerd Bramerdorfer[3], Yong Kong[4], Chengning Zhang[1], Shuo Zhang[1]
[1]Beijing Institute of Technology, China; [2]University of Padova, Italy; [3]Johannes Kepler University Linz, Austria; [4]Southeast University, China

1007 | Design and Analysis of Double-Stator Flux Modulated Permanent Magnet Motor based on Flux Modulation Theory
Deyang Fan[1], Li Quan[1], Xiaoyong Zhu[1], Peng Han[2], Zixuan Xiang[1]
[1]Jiangsu University, China; [2]University of Kentucky, United States

Virtual 2

Wednesday, October 14 **10:10AM-10:40AM**

S22 | Converters for Electric Vehicles

Chairs: Yilmaz Sozer, Mohamed Badawy

1326 | An Improved Pre-Filtering Moving Average Filter based Synchronization Algorithm for Single-Phase V2G Application
Komal Saleem[1], Kamyar Mehran[1], Zunaib Ali[2]
[1]Queen Mary University of London, United Kingdom; [2]Northumbria University Newcastle, United Kingdom

0782 | Bidirectional Universal Converter Transformer Design for Electric Vehicle Onboard Charging
Jacob Buys[1], Ameer Janabi[1], Wei Qian[1], Xiaorui Wang[1], Yunting Liu[1], Xi Lu[2], Ke Zou[2], Chingchi Chen[2], Fang Z. Peng, Bingsen Wang[1]
[1]Michigan State University, United States; [2]Ford Motors, United States; [3]Florida State University, United States

0515 | A Novel Multipurpose V2G and G2V Power Electronics Interface for Electric Vehicles
Tamanwè Payarou, Pragasen Pillay
Concordia University, Canada

1265 | Control of SiC based Integrated DC-DC Powertrain Charger for Electric Vehicles
Saeed Anwar[1], Daniel Costinett[1], Subhajyoti Mukherjee[2], Shajjad Chowdhury[2]
[1]The University of Tennessee, United States; [2]Oak Ridge National Laboratory, United States

0901 | Integrated Isolated OBC for EVs with 6-Phase Traction Motor Drives
Paolo Pescetto, Gianmario Pellegrino
Politecnico di Torino, Italy

0798 | Modeling, Analysis, Design, and Verification of a Reduced Model Capacitive Power Transfer based Wireless Charging System
Deepa Vincent, Sheldon S. Williamson
Ontario Tech University, Canada

Virtual 3

Wednesday, October 14 **10:10AM-10:40AM**

S23 | AC-DC and AC-AC Converters

Chairs: Pritam Das, Z. John Shen

1044 | Predictive Direct DC-Link Control for Active Power Decoupling of a Single-Phase Reduced DC-Link MV Solid-State Transformer
Liran Zheng, Rajendra Prasad Kandula, Deepak Divan
Georgia Institute of Technology, United States

0955 | Modular Filter Building Block for Modular full-SiC AC-DC Converters by an Arrangement of Coupled Inductors
Sungjae Ohn[1], Ripun Phukan[1], Dong Dong[1], Rolando Burgos[1], Dushan Boroyevich[1], Sebastian Nielebock[2], Mondal Gopal[2]
[1]Virginia Polytechnic Institute and State University, United States; [2]Siemens AG Corporate Technology, Germany

1112 | Architecture and Control of an Interleaved 6-Level Bidirectional Converter with an Active Energy Buffer for Level-II Electric Vehicle Charging
Zitao Liao[1], Derek Chou[1], Kelly Fernandez[1], Yong-Long Syu[2], Robert C.N. Pilawa-Podgurski[1]
[1]University of California-Berkeley, United States; [2]National Taiwan University of Science and Technology, Taiwan

1062 | Single-Phase Multilevel Rectifier based on Series and Parallel Connections
Filipe Vieira Rocha[1], Cursino Brandão Jacobina[1], Antonio de Paula Dias Queiroz[2], Nady Rocha[2]
[1]Federal University of Campina Grande, Brazil; [2]Federal Institute of Paraíba, Brazil

0478 | SVPWM Strategy of Matrix Converter Fed Asymmetrical Six-Phase Induction Motor with Common-Mode Voltage Elimination and Unity Power-Factor Operation
Sayan Paul, Kaushik Basu
Indian Institute of Science, India

0586 | An Advanced Commutation Method for Bidirectional Isolated Three-Phase AC/DC Dual-Active-Bridge Converter based on Matrix Converter
Kazuma Sumiya[1], Yuji Naito[1], Jin Xu[2], Noboru Shimosato[2], Yukihiko Sato[1]
[1]Chiba University, Japan; [2]Myway Plus Corp., Japan

0781 | Multilevel Single-Phase AC-DC-AC Converter based on Packed U Cell
Jean T. Cardoso[1], Cursino B. Jacobina[1], Maxsuel F. Cunha[1], Antonio de P.D. Queiroz[2], Samuel C.S. Júnior[1]
[1]Federal University of Campina Grande, Brazil; [2]Federal Institute of Paraíba, Brazil

1579 | Modulated Model Predictive Control for the 3TSMC
Guanguan Zhang[1], Hui Wang[2], Chenghui Zhang[1]
[1]Shandong University, China; [2]Central South University, China

Virtual 4

Wednesday, October 14 **10:10AM-10:40AM**

S24 | Circuits and Topologies for Wind Power Conversion

Chairs: Frede Blaabjerg, Wei Qiao

1313 | Unit Partition Method for the Resonance Research in the DC-Link Busbar of Back-to-Back Converter
Yangyang Meng[1], Zipeng Liang[1], Sideng Hu[1], Zhenyu Ma[2], Xiangning He[1]
[1]Zhejiang University, China; [2]CRRC Zhuzhou Institute Co. Ltd, China

0369 | Investigation of a New Voltage Balancing Circuit for Parallel-Connected Offshore P MSG-Based Wind Turbines
Ahmed A. Elserougi[1], Otavio Bertozzi[2], Ahmed M. Massoud[3], Shehab Ahmed[2]
[1]Alexandria University, Egypt; [2]King Abdullah University of Science and Technology, Saudi Arabia; [3]Qatar University, Qatar

0114 | Variable Stator Frequency Diode Rectifier DFIG for Lower Cost MVDC Interface
Chao Wu[1], Ion Boldea[2], Dao Zhou[1], Lucian Tutelea[2], Frede Blaabjerg[1]
[1]Aalborg University, Denmark; [2]Politehnica University of Timisoara, Romania

0333 | Integrated Generator-Rectifier Co-Design for Offshore Wind Turbines
Phuc Huynh, Samith Sirimanna, Jay Mok, Dongsu Lee, Olaolu Ajala, Daniel Mulas, Kiruba Haran, Alejandro Dominguez-Garcia, George Gross, Arijit Banerjee
University of Illinois at Urbana-Champaign, United States

1069 | Half-Controlled Converters Connecting Open-End Winding Doubly-Fed Induction Generator to a DC-Microgrid
Emerson L. Soares[1], Cursino B. Jacobina[1], Ítalo André C. Oliveira[1], Nady Rocha[2], Victor Felipe M.B. Melo[2]
[1]Federal University of Campina Grande, Brazil; [2]Federal University of Paraíba, Brazil

1131 | Cascaded Three-Phase H-Bridge Converter Applied as Series Active Compensator for DFIG-Based Wind Energy Conversion Systems
Italo A. Cavalcanti de Oliveira[1], Cursino Brandão Jacobina[1], Emerson de Lacerda Soares[1], Nady Rocha[2]
[1]Federal University of Campina Grande, Brazil; [2]Federal University of Paraíba, Brazil

0536 | Reduced-Size Converter in DFIG-Based Wind Energy Conversion System
Rasoul Akbari, Afshin Izadian
Purdue School of Engineering and Technology, United States

0993 | Stand-Alone Wind Power System with Improved Light-Power Efficiency
Ramtin Rasoulinezhad, Ebrahim Mohammadi, Adel Abosnina, Gerry Moschopoulos
Western University, Canada

Virtual 1

Wednesday, October 14 **11:00AM-11:30AM**

S25 | Thermal Analysis in Electric Machines

Chairs: Antonio Griffo, Nick Simpson

0877 | A Feasibility Study of Heat Pipes for Thermal Management of Electrical Machines
Rafal Wrobel, David Reay
Newcastle University, United Kingdom

1473 | A Rotating Double Layer Capacitive Slip Ring Concept for Power & Heat Transfer in Machines using an Ionic Conducting Working Fluid
Daniel C. Ludois, Kevin Frankforter
University of Wisconsin-Madison, United States

0086 | Measurement of Rotor Thermal Time-Constant for Permanent Magnet Synchronous Machines
Eric Armando, Aldo Boglietti, Salvatore Musumeci, Sandro Rubino, Enrico Carpaneto, Daniele Martinello
Politecnico di Torino, Italy

0120 | Improved Cooling in Modular Consequent Pole PM Machine Utilizing Flux Gaps
R. Zhou, G.J. Li, Z.Q. Zhu, M.P. Foster, D.A. Stone
The University of Sheffield, United Kingdom

0517 | Measurement-Based Optimization of Thermal Networks for Temperature Monitoring of Outer Rotor PM Machines
Daniel Wöckinger[1], Gerd Bramerdorfer[1], Stephan Drexler[1], Silvio Vaschetto[2], Andrea Cavagnino[2], Wolfgang Amrhein[1], Frank Jeske[3]
[1]Johannes Kepler University Linz, Austria; [2]Politecnico di Torino, Italy; [3]EBM-Papst St. Georgen GmbH and Co. KG, Germany

0856 | Characterization of the Thermal Performances of Low-Cost Sub-Fractional Horsepower BLDC Claw-Pole Motor Designs
Stefan Leitner, Thomas Kulterer, Hannes Gruebler, Annette Muetze
Graz University of Technology, Austria

0049 | Electromagnetic-Thermal Coupled Fault Analysis of PMASynRM with Turn-to-Turn Short Circuit involving a Few Strands
Yanwen Shi, Jiabin Wang, Bo Wang
[1]University of Sheffield, United Kingdom

1031 | A Fast Calculation Method for Steady State Performance of High Speed Traction Induction Machine by Finite Element Analysis
Haiwei Cai
Southeast University, China

Virtual 2

Wednesday, October 14 **11:00AM-11:30AM**

S26 | Grid-Connected Inverters

Chairs: Dong Dong, Bo Wen

0649 | Grid-Forming Converters: An Overview of Control approaches and Future Trends
Roberto Rosso[1], Xiongfei Wang[2], Marco Liserre[3], Xiaonan Lu[4], Soenke Engelken[1]
[1]WRD GmbH, Germany; [2]Aalborg University, Denmark; [3]Christian-Albrechts Universitaet zu Kiel, Germany; [4]Temple University, United States

0981 | A Grid-Forming Multi-Port Converter using Unified Virtual Oscillator Control
M.A. Awal, Md Rashed Hassan Bipu, Siyuan Chen, Mehnaz Khan, Wensong Yu, Iqbal Husain
North Carolina State University, United States

1306 | A Pre-Synchronization Strategy for Grid-Forming Virtual Oscillator Controlled Inverters
Minghui Lu[1], Soham Dutta[1], Victor Purba[2], Sairaj Dhople[2], Brian Johnson[1]
[1]University of Washington, United States; [2]University of Minnesota, United States

1458 | Developing a Machine Equivalent Inertial Response for a Virtual Oscillator Controlled Inverter in a Machine-Inverter based Microgrid
Jiacheng Li[1], John E. Fletcher[1], D.G. Holmes[2], B.P. McGrath[2]
[1]University of New South Wales, Australia; [2]RMIT, Australia

1309 | PLL-Less Active and Reactive Power Controller for Grid-Following Inverter
Ahmad Khan[1,2], Mitchell Easley[1], Mohsen Hosseinzadehtaher[1,2], Mohammad B. Shadmand[1,2], Haitham Abu-Rub[3], Poria Fajri[4]
[1]Kansas State University, United States; [2]University of Illinois at Chicago, United States; [3]Texas A&M University at Qatar, Qatar; [4]University of Nevada-Reno, United States

0472 | Current Harmonic Analysis of Multisampled LCL-Type Grid-Connected Inverter
Shan He, Yiwei Pan, Dao Zhou, Xiongfei Wang, Frede Blaabjerg
Aalborg University, Denmark

0481 | Multisampling Control of LCL-Type Grid-Connected Inverter with an Improved Repetitive Filter
Shan He, Dao Zhou, Xiongfei Wang, Frede Blaabjerg
Aalborg University, Denmark

Virtual 3

Wednesday, October 14 **11:00AM-11:30AM**

S27 | Multilevel Converters 2

Chairs: Montie Vitorino, Dragan Maksimov

0240 | Switched Capacitor MMC Submodule Voltage Balancing with Reduced Number of Voltage Sensors
Robson Bauwelz Gonzatti[1,2], Qichen Yang[2], Hamed Pourgharibshahi[2], Fang Peng[2]
[1]Federal University of Itajuba, Brazil; [2]Florida State University, United States

0828 | A Simple Carrier-Based Implementation for a General 3-Level Inverter using Nearest Three Space Vector PWM Approach
Aditya Dholakia[1], Sayan Paul[1], Shailesh Ghotgalkar[2], Kaushik Basu[1]
[1]Indian Institute of Science, India; [2]Texas Instrument, India

0913 | A New Voltage-Balance Control Method for a Four-Level Hybrid-Clamped Converter
Jianfei Chen[1], Jianyu Pan[2], Caisheng Wang[1], Jian Li[2]
[1]Wayne State University, United States; [2]Chongqing University, China

0314 | Simplified Model Predictive Control of Multilevel Converters with Internal Identical Structure
Dehong Zhou[1], Zhongyi Quan[2], Yunwei (Ryan) Li[2]
[1]University of Electronic Science and Technology of China, China; [2]University of Alberta, Canada

1339 | Ripple Decoupling of Modular Multilevel Converter with Flux Cancelled Three-Port Converter
Yifu Liu, Yunpeng Si, Mengzhi Wang, Zhengda Zhang, Chunhui Liu, Qin Lei
Arizona State University, United States

0807 | Steady-State Analysis of the Switched-Capacitor Modular Multilevel Converter with Γ-Matrix Modulation
Qichen Yang[1], Robson Bauwelz Gonzatti[1,2], Hamed Pourgharibshahi[1], Fang Peng[1]
[1]Florida State University, United States; [2]Federal University of Itajuba, Brazil

0473 | A Bidirectional Modular Multilevel Resonant DC-DC Converter for Medium Voltage Power Conversion
Wentao Cui, Shuai Shao, Jianjia Zhang, Yucen Li, Junming Zhang
Zhejiang University, China

0983 | Evaluation of Medium Voltage SiC Flying Capacitor Converter and Modular Multilevel Converter
Da Jiao, Qingyun Huang, Alex Q. Huang
The University of Texas at Austin, United States

0720 | Three-Phase Multilevel Flying Capacitor Rectifier with Reduced Switch Count
Ailton do Egito Dutra, Montiê Alves Vitorino, Maurício Beltrão de Rossiter Corrêa
Federal University of Campina Grande, Brazil

Virtual 4

Wednesday, October 14 **11:00AM-11:30AM**

S28 | Batteries and Battery Converters

Chairs: Harish Krishnamoorthy, Sheldon Williamson

0097 | Fuzzy Entropy-Based State of Health Estimation of $LiFePO_4$ Batteries Considering Temperature Variation
Xin Sui[1], Shan He[1], Jinhao Meng[2], Remus Teodorescu[1], Daniel-Ioan Stroe[1]
[1]Aalborg University, Denmark; [2]Sichuan University, China

1114 | Online Li-Ion Battery State of Health Implementation for Grid-Tied Applications
Irene Peláez[1], Ramy Georgious[1], Sarah Saeed[1], Pablo García[1], Igor Cantero[2]
[1]University of Oviedo, Spain; [2]CEGASA Energía, Spain

0056 | Voltage Variation with Hybrid Pulse as a Novel Indicator for Lifetime Estimation of Li-Ion Battery using in Smart Grid
Shiqi Liu, Junhua Wang, Qisheng Liu, Jia Tang, Haolu Liu
Wuhan University, China, China

0302 | Simple and Low-Cost Online AC Ripple Current Injection Methods for a Single-Cell Li-Ion Battery
Julio C. Yela, Abdulraouf Benshatti, Thomas Link, S.M. Rakiul Islam, Sung-Yeul Park
University of Connecticut, United States

1562 | Digital Multi-Loop Control of an LLC Resonant Converter for Electric Vehicle DC Fast Charging
Davide Cittanti, Matteo Gregorio, Eric Armando, Radu Bojoi
Politecnico di Torino, Italy

1041 | Active Equalization of Series/Parallel Li-Ion Battery Modules including No-Load Conditions
Miguel Crespo[1], Ramy Georgious[2], Pablo García[2], Geber Villa[2]
[1]Cegasa Energía, S.L.U., Spain; [2]University of Oviedo, Spain

1105 | Multi-Objective Optimization of Triple Port Converter for Photovoltaic and Energy Storage Integration
Sneha Thakur, Ghanshyamsinh Gohil, Poras T. Balsara
The University of Texas at Dallas, United States

0898 | A Fast Energy-Efficient Pulse Preheating Strategy for Li-Ion Battery at Subzero Temperatures
Zhiwu Huang, Zhiwei Gao, Yongjie Liu, Kaifu Guan, Hongtao Liao, Yinhui Le, Fu Jiang, Jun Peng
Central South University, China

Virtual 1

Wednesday, October 14 **11:35AM-12:05PM**

S29 | Machine Diagnostics and Protection

Chairs: Narges Taran, Bryan P. Ruddy

0678 | Challenges of Common Mode Current and Voltage Acquisition for Stator Winding Insulation Health Monitoring
Fernando Alvarez-Gonzalez, David Hewitt, Antonio Griffo, Jiabin Wang
The University of Sheffield, United Kingdom

1077 | Detection and Compensation of Inter-turn Short Circuits in Interior Permanent Magnet Synchronous Machines with 2-Level Voltage Source Inverter
Pablo Castro Palavicino, Woongkul Lee, Bulent Sarlioglu
University of Wisconsin-Madison, United States

1397 | Effect of System Grounding, AC-DC Converter Topology and Inverter Modulation on Motor Insulation Voltage Stress
G.Y. Sizov, Z. Vrankovic, M.J. Melfi, G.L. Skibinski, Zhijun Liu
Rockwell Automation, United States

0349 | A Novel Method of Monitoring and Locating Stator Winding Insulation Ageing for Inverter-Fed Machine based on Switching Harmonics
Dayong Zheng, Pinjia Zhang
Tsinghua University, China

0233 | Triaxial Smart Sensor based on the Advanced Analysis of Stray Flux and Currents for the Reliable Fault Detection in Induction Motors
Israel Zamudio-Ramirez[1,2], Roque A. Osornio-Rios[1], Jose Antonino-Daviu[2]
[1]Universidad Autonoma de Querétaro, Mexico; [2]Universitat Politecnica de Valencia, Spain

0604 | Bispectrum Analysis of Stray Flux Signals for the Robust Detection of Winding Asymmetries in Wound Rotor Induction Motors
Miguel E. Iglesias-Martínez[1], Pedro Fernández de Córdoba[2], Jose Alfonso Antonino-Daviu[2], J. Alberto Conejero[2]
[1]Universidad de Pinar del Río, Cuba; [2]Universitat Politècnica de València, Spain

0251 | Flux-Based Detection and Classification of Induction Motor Eccentricity, Rotor Cage, and Load Defects
Jaehoon Shin, Yonghyun Park, Sang Bin Lee
Korea University, Korea

0939 | Fault Tolerance Analysis of a Ironless PM Machine for Energy Storage
Claudio Bianchini[1], Ambra Torreggiani[1], Danilo David[2], Matteo Davoli[2], Alberto Bellini[3]
[1]University of Modena and Reggio Emilia, Italy; [2]Raw Power srl, Italy; [3]University of Bologna, Italy

Virtual 2

Wednesday, October 14 **11:35AM-12:05PM**

S30 | Power Converter Control and Applications

Chairs: Ruxi Wang, Igor Cvetkovic

0794 | Grid-Connected Converter without Interfacing Filters: Principle, Analysis and Implementation
Yuchen He[1], Yuan Li[1], Qichen Yang[1], Robson Bauwelz Gonzatti[1,2], Allan Taylor[3], Fangzheng Peng1
[1]Florida State University, United States; [2]Federal University of Itajuba, Brazil; [3]Kettering University, United States

0241 | Virtual Impedance-Based Grid Synchronization for Converters Connected through Long Cables
Robson Bauwelz Gonzatti[1,2], Bokang Zhou[2], Yuchen He[2], Allan R. Taylor[3], Fang Peng[2]
[1]Federal University of Itajuba, Brazil; [2]Florida State University, United States; [3]Kettering University, United States

1248 | Negative Virtual Capacitance to Eliminate Resonance Oscillations in a Three-Phase Inverter with LCL Filter
Vikram Roy Chowdhury, Jonathan W. Kimball
Missouri University of Science and Technology, United States

1219 | A Comparative Study between the PQ and IV Droop Control
Gustavo P. de Pontes, Camila S. Gehrke, Edison R. Cabral da Silva, Fabiano Salvadori, Lucas V. Hartmann
Universidade Federal da Paraíba, Brazil

0325 | Integrated Magnetics Design for an Interleaved Three-Phase Buck Converter
Yu-Chen Liu[1], Chen Chen[2], Yu-Chen Chung[1], Meng-Chi Tsai[1], Kim Ann Katherine[3]
[1]National Ilan University, Taiwan; [2]National Taiwan University of Science and Technology, Taiwan; [3]National Taiwan University, Taiwan

0397 | Reduction of Vital Sensors in RSyM based Solar Water Pumping System
Hina Parveen, Utkarsh Sharma, Bhim Singh
Indian Institute of Technology-Delhi, India

1496 | Demand Response of HVACs in Large Residential Communities based on Experimental Developments
Huangjie Gong[1], Evan S. Jones[1], Rosemary E. Alden[1], Andrew G. Frye[1], Donald Colliver[2], Dan M. Ionel[1]
[1]Tennessee Valley Authority, United States; [2]University of Kentucky, United States

0004 | Hierarchical Control of Heterogeneous Inverter Air-Conditionings for Primary Frequency Regulation
Tingyu Jiang[1], Ping Ju[1], Wenjie Ruan[1], Yang Yang[2], Jian Zhao[2], Fu Shen[2]
[1]Hohai University, China; [2]State Grid Taizhou Power Supply Co., China; [3]State Grid Nanjing Power Supply Co., China

Virtual 3

Wednesday, October 14 **11:35AM-12:05PM**

S31 | AC-DC Power Converters

Chairs: Mehdi Narimani, Mohamed Youssef

1065 | Three-Phase Bidirectional Buck-Boost Current DC-Link EV Battery Charger featuring a Wide Output Voltage Range of 200 to 1000V
Daifei Zhang[1], Mattia Guacci[1], Michael Haider[1], Dominik Bortis[1], Johann W. Kolar[1], Jordi Everts[2]
[1]ETH Zürich, Switzerland; [2]Prodrive Technologies, Netherlands

1198 | Isolated Three-Phase AC to DC Converter with Matrix Converter Applying Wide Output Voltage Operation
Jun-ichi Itoh, Satoshi Nakamura, Shunsuke Takuma, Hiroki Watanabe
Nagaoka University of Technology, Japan

0783 | A Direct Three-Phase AC to DC Rectifier with a High-Frequency Open Delta Transformer Isolation
Erick I. Pool-Mazun[1], Jose Juan Sandoval[1], Prasad Enjeti[1], Ira J. Pitel[2]
[1]Texas A&M University, United States; [2]Magna-Power Electronics Inc., United States

0161 | Control of a Three-Phase Diode Rectifier with an Instantaneous Reactive Power Compensator
Nuilers Surasak, Hideaki Fujita
Tokyo Institute of Technology, Japan

1168 | A Three-Phase Isolated Rectifier using Current Unfolding and Active Damping Methods
Ha Pham N.[1], Tomoyuki Mannen[2], Keiji Wada[3]
[1]University of Technology-Sydney, Australia; [2]University of Tsukuba, Japan; [3]Tokyo Metropolitan University, Japan

1565 | A Single Stage 1.65kW AC-DC LLC Converter with Power Factor Correction (PFC) for On-Board Charger (OBC) Application
Wenbo Liu, Andrew Yurek, Bo Sheng, Yang Chen, Yan-Fei Liu, Paresh C. Sen
Queen's University, Canada

0879 | Electrolytic Capacitor-Less Quasi-Single-Stage AC/DC Converter with Controllable Rectifier Circuits
Zhennan Wang[1], Shengwen Fan[1], Zhenyu Shan[2], Xiaofeng Ding[2]
[1]North China University of Technology, China; [2]Beihang University, China

1340 | Self-Synchronized Class E Resonant Rectifier with Direct Voltage Detection Method
Minki Kim, Jungwon Choi
University of Minnesota, United States

1204 | Multilevel Single-Phase Four-Leg AC-DC-AC Converter
Phelipe L.S. Rodrigues, Cursino B. Jacobina, Antônio M.N. Lima
Federal University of Campina Grande, Brazil

Virtual 4

Wednesday, October 14 **11:35AM-12:05PM**

S32 | Microgrids 2

Chairs: Akshay Rathore, Yue Zhao

0126 | An Adaptive Virtual Impedance Control for Improving Power Sharing among Inverters in Islanded AC Microgrids
A.S. Vijay, N. Parth, Suryanarayana Doolla, Mukul C. Chandorkar
Indian Institute of Technology-Bombay, India

1208 | Distributed Average Observation in Inverter Dominated Dynamic Microgrids
Yuhua Du[1], Xiaonan Lu[1], Bo Chen[2], Jianzhe Liu[2], Xiongfei Wang[3], Frede Blaabjerg[3]
[1]Temple University, United States; [2]Argonne National Laboratory, United States; [3]Aalborg University, Denmark

0226 | Toward Distributed Control for Reconfigurable Robust Microgrids
Xia Miao[1], Marija Ilić[1], Christopher Smith[2], Matthew Overlin[2], Ryan Wiechens[2]
[1]Massachusetts Institute of Technology, United States; [2]MIT Lincoln Laboratory, United States

1254 | Controller Design and Implementation of a Medium Voltage (13.8 kV) Modular Multi-Level Converter for Asynchronous Microgrids
Dingrui Li[1], Xingxuan Huang[1], Shiqi Ji[1], Cheng Nie[1], Fred Wang[1,2], Leon M. Tolbert[1,2]
[1]The University of Tennessee, United States; [2]Oak Ridge National Laboratory, United States

1049 | Dual State-Parameter Estimation for Series Arc Fault Detection on a DC Microgrid
Kaushik Gajula, Xiu Yao, Luis Herrera
University at Buffalo, United States

1098 | Communicationless Power Management Strategy for the Multiple-DAB-Based Energy Storage System in Isolated DC Microgrid
Nie Hou, Yun Wei Li, Li Ding
University of Alberta, Canada

0953 | Distributed Control and Power Management of Islanded DC Nanogrids with Applications to Rural Electrification
Ali Arsalan[1], Jameel Ahmad[2], Muhammad Tahir[3], Sudip K. Mazumder[4]
[1]Khwaja Fareed University of Engineering and Information Technology, Pakistan; [2]University of Management and Technology Lahore, Pakistan; [3]University of Engineering and Technology Lahore, Pakistan; [4]University of Illinois at Chicago, United States

0923 | Uncertainty Reduction for Data Centers in Energy Internet by a Compact AC-DC Energy Router and Coordinated Energy Management Strategy
Javad Khodabakhsh, Gerry Moschopoulos
Western University, Canada

Virtual 1

Wednesday, October 14 **12:10PM-12:40PM**

S33 | Switched Reluctance and Flux Switching Machines

Chairs: Gerd Bramerdorfer, Silvio Vaschetto

1544 | Direct Voltage Controller for SRMs in Achieving Torque Ripple Minimization over Wide Speed Range
Okan Boler, Omer Gundogmus, Yilmaz Sozer
The University of Akron, United States

0010 | Voltage Pulsation Induced in DC Field Winding of Different Hybrid Excitation Switched Flux Machines
Xiaoyong Sun, Zi-Qiang Zhu, Fangrui Wei
The University of Sheffield, United Kingdom

0881 | The Effectiveness of Radial Force Sum Flattening for Vibration Mode 0 and Noise Reduction in Switched Reluctance Motor
Candra Adi Wiguna[1], Yifei Cai[1], Atsuya Ohashi[2], Jihad Furqani[3], Junichi Asama[2], Akira Chiba[1]
[1]Tokyo Institute of Technology, Japan; [2]Shizuoka University, Japan; [3]Bandung Institute of Technology, Indonesia

0619 | Design and Performance Analysis of Switched Reluctance Motor with Inner Holes to Reduce Radial Force
Grace Firsta Lukman, Xuan Son Nguyen, Kwang-Il Jeong, Jin-Woo Ahn
Kyungsung University, Korea

0621 | Reduction Method of Torque Ripple, DC Current Ripple, and Radial Force Ripple with Control Flexibility of Five-Phase SRM
Takahiro Kumagai, Jun-Ichi Itoh, Keisuke Kusaka
Nagaoka University of Technology, Japan

1104 | Design of a Novel Integrated Switched Reluctance Motor-Compressor
Ahmed Hembel, Hao Ding, Leyue Zhang, Bulent Sarlioglu
University of Wisconsin-Madison, United States

0866 | Analytical and Experimental Investigations of Radial Force Detection by Strain Gauge for Possible Application for Switched Reluctance Machines
Yifei Cai[1], Candra Adi Wiguna[1], Hiroya Sugimoto[2], Akira Chiba[1]
[1]Tokyo Institute of Technology, Japan; [2]Tokyo Denki University, Japan

Virtual 2

Wednesday, October 14 **12:10PM-12:40PM**

S34 | Inverter-Based Resources for Power Quality Enhancement

Chairs: Igor Cvetkovic, Jingxin Wang

0461 | CIMMCC and MSTOGI based Solar PV System for Improvement in Power Quality under Grid Voltage Variation
Abhishek Ranjan, Seema Kewat, Bhim Singh, Rohini Sharma
Indian Institute of Technology-Delhi, India

0257 | Power Oscillation Control of Grid-Feeding Converter Considering Next Generation Grid Code during Asymmetrical Faults
Yu Feng[1], Zhikang Shuai[1], Jun Ge[1], Huimin Zhao[1], Z. John Shen[2]
[1]Hunan University, China; [2]Illinois Institute of Technology, United States

0436 | Solar Photovoltaic Array Fed Unified Power Quality Conditioner System Enabling Alleviation of Asymmetrical Voltage Sag
Sanjenbam Chandrakala Devi[1], Bhim Singh[1], Priyank Shah[2], Sachin Devassy[3], Hina Parveen[1]
[1]Indian Institute of Technology-Delhi, India; [2]The University of Warwick Coventry, United Kingdom; [3]CSIR-Central Electronics Engineering Research Institute, India

1368 | Resonance Suppression based on Predictive Control of Grid-following Inverters with LCL Filter in Weak Grid Condition
Muhammed Farooq Umar[1,2], Ahmad Khan[1,2], Mitchell Easley[1], Silvanus D'silva[1], Brevann Nun[1], Mohammad B. Shadmand[1,2]
[1]Kansas State University, United States; [2]University of Illinois at Chicago, United States

0172 | A Novel Phase-Locked Loop based Four-Leg Converter Control for Unbalanced Load Compensation under Distorted and Unbalanced Grid Condition
Shilei Jiao, Krishna Raj R., Kaushik Rajashekara
University of Houston, United States

0258 | Development of a Hybrid Cascaded Converter based STATCOM with Reduced Switching Losses
Yu-Chen Su, Po-Tai Cheng
National Tsing Hua University, Taiwan

0984 | State-Feedback-Based Low-Frequency Active Damping of VSC Operating in Weak-Grid Conditions
Federico Cecati[1], Rongwu Zhu[1], Marco Liserre[1], Xiongfei Wang[2]
[1]Christian-Albrechts-Universität Kiel, Germany; [2]Aalborg University, Denmark

1202 | Universal Active Power Filter based on AC-DC-AC Converter with Six Controlled Switches for Single-Phase Systems
Phelipe L.S. Rodrigues, Cursino B. Jacobina, Antônio M.N. Lima
Federal University of Campina Grande, Brazil

Virtual 3

Wednesday, October 14 **12:10PM-12:40PM**

S35 | DC-DC Converters for Renewable Energy Applications

Chairs: Santanu Mishra, Giorgio Spiazzi

0989 | Improvement of DC Nanogrid Energy Performance with a New Multi-Port Converter
Ramtin Rasoulinezhad, Adel Abosnina, Gerry Moschopoulos
Western University, Canada

1350 | A High Gain DC-DC Topology based on Two-Winding Coupled Inductors Featuring Continuous Input Current
Mohsen Mahmoudi[1], Ali Ajami[1], Ebrahim Babaei[2], Nima Abdolmaleki[3], Caisheng Wang[3]
[1]Azarbaijan Shahid Madani University, Iran; [2]University of Tabriz, Iran; [3]Wayne State University, United States

0767 | A Novel Single-Switch High Step-Up DC-DC Converter with Low Voltage Stress on Active Components
Pedram Chavoshipour Heris[1], Zahra Saadatizadeh[1], Frede Blaabjerg[2]
[1]University of Tabriz, Iran; [2]Aalborg University, Denmark

1025 | New CRM Topology for Zero Voltage Switching in Quadratic High Gain Boost Converter
Nikhil Korada, Raja Ayyanar
Arizona State University, United States

0396 | Low Side Switch based Regenerative Snubber Circuit for Flyback Converter
Saumya Bohra[1], Arnab Sarkar[1], Sandeep Anand[1,2]
[1]Indian Institute of Technology-Kanpur, India; [2]Indian Institute of Technology-Bombay, India

0229 | Minimum Current-Ripple Point Tracking for Renewable Energy Applications
C.A. Villarreal-Hernandez[1], J. Loranca-Coutino[1], O.F. Ruiz-Martinez[2], J.C. Mayo-Maldonado[1], J.E. Valdez-Resendiz[1], Daniel Guillen[1]
[1]Tecnologico de Monterrey, Mexico; [2]Universidad Panamericana, Mexico

0694 | A Novel Boost Converter Topology with Non-Pulsating Input and Output Current
Enrique Garza-Arias[1], Julio C. Rosas-Caro[2], Jesus E. Valdez-Resendiz[1], Jonathan C. Mayo-Maldonado[1], Gerardo Escobar-Valderrama[1], Carlos Villarreal-Hernandez[1], Leonardo J. Valdivia[2]
[1]Tecnologico de Monterrey, Mexico; [2]Universidad Panamericana, Mexico

0889 | A High Efficiency and High Power SiC DC-DC Converter based on Interleaved-Boost and Full-Bridge LLC Integration for PV Applications
Shilei Lu[1], Kai Sun[1], Guoen Cao[2], Zheyuan Yi[1], Hanyu Liu[1], Yongdong Li[1]
[1]Tsinghua University, China; [2]Chinese Academy of Sciences, China

1118 | Analysis of an LCL-Isolated Modular Multilevel DC-DC Converter
Mahmoud Mehrabankhomartash, Xiangyu Han, Maryam Saeedifard, Deepak Divan
Georgia Institute of Technology, United States

Virtual 4

Wednesday, October 14 **12:10PM-12:40PM**

S36 | Utility Applications of Power Electronics

Chairs: Nathan Weise, Necmi Altin

0354 | Modular Smart Transformer Topology for the Interconnection of Multiple Isolated AC and DC Grids
Johannes Kuprat, Markus Andresen, Vivek Raveendran, Marco Liserre
Kiel University, Germany

1288 | An Active Damping Control Strategy for a Multi-Cell AC-DC Solid State Transformer
Vishnu Mahadeva Iyer[1], Srinivas Gulur[2], Subhashish Bhattacharya[2]
[1]GE Global Research, United States; [2]North Carolina State University, United States

0255 | Coordinated Power Control Strategy of Modified Electrical Energy Router
Zixun Pan[1], Xiaofeng Yang[1], Zejie Li[1], Haibo Tao[1], Yanbin Zhang[1], Pavel Kobrle[2]
[1]Beijing Jiaotong University, China; [2]Czech Technical University, Czech Republic

0743 | A Hybrid Voltage Regulator with Arcless Tap Change and Stepless Voltage Regulation Functions
Yafeng Wang, Tiefu Zhao
University of North Carolina-Charlotte, United States

1315 | 500kVA Hybrid Solid State Transformer (HSST): Architecture, Functionality and Control
Qingyun Huang, Sanjay Rajendran, Soumik Sen, Zhicheng Guo, Liqi Zhang, Alex Q. Huang
The University of Texas at Austin, United States

1387 | A Control Method of Hybrid Transformer Enabled Harmonic Isolator for Sensitive Clustered Harmonic Loads
Yos Prabowo[1], Vishnu Mahadeva Iyer[2], Subhashish Bhattacharya[1], Eddy Aeloiza[3]
[1]North Carolina State University, United States; [2]GE Global Research, United States; [3]ABB Inc., United States

1447 | High Power DC-DC Converter based on Parallel Hybrid Converter
Mohd Shadab Ansari[1], Ibhan Chand Rath[1], Siba Kumar Patro[2], Anshuman Shukla[1]
[1]Indian Institute of Technology Bombay, India; [2]Visvesvaraya National Institute of Technology, India

1446 | A Control Technique to Eliminate dc Harmonics in Series-Connected Hybrid VSCs for HVDC Applications
Siba Kumar Patro[1], Anshuman Shukla[2]
[1]Visvesvaraya National Institute of Technology, India; {2]Indian Institute of Technology Bombay, India

1057 | Virtual Friction for Oscillation Damping and Inertia Sharing from Multi-Terminal VSC-HVDC Grids
Alberto Rodríguez-Cabero[1], Javier Roldán-Pérez[1], Milan Prodanovic[1], Jon Are Suul[2], Salvatore D'arco[2]
[1]IMDEA Energy Institute, Spain; [2]SINTEF Energy Research, Norway

Virtual 1

Thursday, October 15 **9:00AM-9:30AM**

S37 | Reliability, EMI and Fault Tolerance in Electric Drives

Chairs: Antonio J. Marques Cardoso, Thomas Wolbank

0357 | Fault-Tolerant Control of Five-Phase Open-End Induction motor Drive with a Floating Capacitor
Xiangwen Sun, Zicheng Liu, Dong Jiang, An Li
Huazhong University of Science and Technology, China

0813 | Time-Frequency Domain based Diagnostics of Stator Faults in Motors Drives via Dispersal Magnetic Field
Hassan H. Eldeeb[1], Haisen Zhao[1,2], Osama A. Mohammed[1]
[1]Florida International University, United States; [2]North China Electric Power University, China

0196 | Universal SVPWM Fault-Tolerant Control of a New Five-Phase Flux-Intensifying Fault-Tolerant Interior-Permanent-Magnet Motor
Li Zhang, Xaiyong Zhu, Deyang Fan
Jiangsu University, China

0712 | Fully Integrated Fault-Tolerance for PMSMs in Aviation Applications
Alastair P. Thurlbeck, Yue Cao
Oregon State University, United States

1145 | Analysis and Evaluation of Active/Hybrid/Passive DV/DT-Filter Concepts for Next Generation SiC-Based Variable Speed Drive Inverter Systems
M. Haider[1], M. Guacci[1], D. Bortis[1], J.W. Kolar[1], Y. Ono[2]
[1]ETH Zürich, Switzerland; [2]Nabtesco R&D Center, Japan

1226 | Automatic Generation of Gate Driving Vectors for Digital Gate Drivers to Satisfy EMI Regulations
Ryuzo Morikawa, Toru Sai, Katsuhiro Hata, Makoto Takamiya
The University of Tokyo, Japan

1310 | A Novel Multi-Physical Coupled Model of Press-Pack IGBT in Steady Conducting State Considering Fretting Wear
Cao Zhan[1], Lingyu Zhu[1], Jiangang Dai[1], Ting Hou[2]
[1]Xi'an Jiaotong University, China; [2]State Key Laboratory of HVDC Transmission Technology, China

1581 | SiC based Interleaved VSI Fed Transverse Flux Machine Drive for High Efficiency, Low EMI Noise and High Power Density Applications
Salman K. Harasis, Md Ehsanul Haque, Anik Chowdhury, Yilmaz Sozer
The University of Akron, United States

Virtual 2

Thursday, October 15 **9:00AM-9:30AM**

S38 | Multilevel Converters 3

Chairs: Sheng Zheng, Alinaghi Marzoughi

0997 | Design and Optimization of a Highly Integrated Modular Filter Building Block for Three-Level Grid Tied Converters
Ripun Phukan[1], Sungjae Ohn[1], Dong Dong[1], Rolando Burgos[1], Gopal Mondal[2], Sebastian Nielebock[2]
[1]Virginia Polytechnic Institute and State University, United States; [2]Siemens Corporate Research, Germany

0093 | A Parallel Control Strategy for Power Mismatch Elimination of Photovoltaic Grid-Connected Cascaded H-Bridge Multilevel Inverter
Xicai Pan, Shangzhi Pan, Jinwu Gong, Xiaoming Zha
Wuhan University, China

0721 | Single-Phase Cascaded Multilevel Rectifier using Totem-Pole Bridgeless Cells
Ailton do Egito Dutra, Montiê Alves Vitorino, Alan Santana Felinto, Maurício Beltrão de Rossiter Corrêa
Federal University of Campina Grande, Brazil

0079 | A New Reduced Switch-Count Configuration for Regenerative Cascaded H-Bridge Converter
Sarah Badawi[1], Mehdi Narimani[1], Zhongyuan Cheng[2], Navid Reza Zargari[2]
[1]McMaster University, Canada; [2]Rockwell Automation Canada, Canada

0692 | Current Harmonic Reduction in DC-Link Capacitors of a Regenerative Cascaded H-Bridge Converter
Shaoyi Yuan, Mehdi Narimani
McMaster University, Canada

1584 | A New Model-Based Fault Detection and Localization Scheme for Cascaded H-Bridge Multilevel Converter
Naga Brahmendra Yadav Gorla, Sandeep Kolluri, Merlin Chai, Sanjib Kumar Panda
National University of Singapore, Singapore

Virtual 3

Thursday, October 15 **9:00AM-9:30AM**

S39 | Grid Interactive Converter Control

Chairs: Gab-Su Seo, Xiongfei Wang

0242 | CCS-MPC with Long Predictive Horizon for Grid-Connected Current Source Converter
Cheng Xue, Li Ding, Yunwei (Ryan) Li
University of Alberta, Canada

1304 | Decoupled Active and Reactive Power Control without PLL Requirement for Differential Buck Converter
Ahmad Khan[1,2], Mohsen Hosseinzadehtaher[1,2], Mitchell Easley[1], Mohammad B. Shadmand[1,2], Haitham Abu-Rub[3]
[1]Kansas State University, United States; [2]University of Illinois at Chicago, United States; [3]Texas A&M University at Qatar, Qatar

1281 | Control Technique for High-Frequency Soft-Switching Three-Phase Inverter under Grid Fault Condition
Gibong Son, Zhengrong Huang, Qiang Li, Fred C. Lee
Virginia Polytechnic Institute and State University, United States

0994 | Virtual Admittance PLL Structure for Grid Forming Power Converters in Microgrids
Andres Tarraso[1], Jose Ignacio Candela[1], Ngoc Bao Lai[2], Gregory N. Baltas[2], Pedro Rodriguez[2]
[1]Universitat Politecnica de Catalunya, Spain; [2]Universidad Loyola Andalucia, Spain

0709 | A Single Feedback Current Control Design Technique for LCL Grid-Connected Inverters based on Pole Allocation in the Frequency Domain
Uziel Santos de Araújo[1], João Raphael Souza Martins[2], André Pires Nóbrega Tahim[1], Darlan Alexandria Fernandes[3], José Renes Pinheiro[1], Fabiano Fragoso Costa[1]
[1]Federal University of Bahia, Brazil; [2]Federal University of Campina Grande, Brazil; [3]Federal University of Paraíba, Brazil

1240 | Synchronverter-Based Control of Multi-Port Autonomous Reconfigurable Solar Plants (MARS)
Phani R.V. Marthi[1], Suman Debnath[1], Mariesa L. Crow[2]
[1]Oak Ridge National Laboratory, United States; [2]Missouri University of Science and Technology, United States

1222 | Adaptive-Passive Virtual Inertia Control based on Energy Balance between a Synchronous Generator and a Three-Phase Inverter
Sara Yazdani, Mehdi Ferdowsi, Pourya Shamsi
Missouri University of Science and Technology, United States

0675 | Dynamic Discontinuous PWM for Grid-Tied Inverter Applications
Zeljko Jankovic[1], Puneeth Murthy[1], Lixiang Wei[1], Adel Nasiri[2]
[1]Rockwell Automation, United States; [2]University of Wisconsin-Milwaukee, United States

1289 | Optimal Design of Grid Interactive Inverters based on Harmonic State Space Modeling
Dongsen Sun, Xiaonan Lu, Liang Du
Temple University, United States

Virtual 4

Thursday, October 15 **9:00AM-9:30AM**

S40 | Tools and Techniques for the Optimization and Protection of Power Electronic Systems

Chairs: Brandon Grainger, Shajjad Chowdhury

1243 | Electronic Design Automation (EDA) Tools and Considerations for Electro-Thermo-Mechanical Co-Design of High Voltage Power Modules
Tristan M. Evans, Shilpi Mukherjee, Yarui Peng, H. Alan Mantooth
University of Arkansas, United States

1187 | High-Frequency Transformer Design with High-Voltage Insulation for Modular Power Conversion from Medium-Voltage AC to 400-V DC
Zheqing Li, Yi-Hsun Hsieh, Qiang Li, Fred C. Lee, Mohamed H. Ahmed
Virginia Polytechnic Institute and State University, United States

0549 | Relative Entropy based Lithium-Ion Battery Pack Short Circuit Detection for Electric Vehicle
Zhenyu Sun[1], Zhenpo Wang[1], Peng Liu[1], Zhaosheng Zhang[1], Shuo Wang[1], David G. Dorrell[2]
[1]Beijing Institute of Technology, China; [2]University of Witwatersrand, South Africa

0992 | Q-Learning-Based Smart Selective Harmonic Current Mitigation-PWM (S^2HCM-PWM) for Grid-Connected Converters
Amirhossein Moeini[1], Morteza Dabbaghjamanesh[2], Jonathan W. Kimball[1]
[1]Missouri University of Science and Technology, United States; [2]The University of Texas at Dallas, United States

1576 | High Frequency Signal Injection Method for Online Condition Monitoring of Electric Machines
Okan Boler, Senol Sancar, Yilmaz Sozer, J. Alexis De Abreu-Garcia
The University of Akron, United States

1605 | A Frequency-Domain Method for Stray Parameters Extraction in Arbitrary Section of Laminated Busbars
Mingyang Wang, Guofeng Wu, Sideng Hu, Xiangning He
Zhejiang University, China

1134 | A Synchronous Distributed Control and Communication Network for SiC-Based Scalable Impedance Measurement Unit
Yu Rong[1], Jun Wang[1], Zhiyu Shen[2], Sizhan Zhou[1], Bo Wen[1], Dushan Boroyevich[1]
[1]Virginia Polytechnic Institute and State University, United States; [2]Delta Electronics (America) LTD., United States

0559 | Partial Discharge Signal Propagation in Three-Phase Gas-Insulated Switchgear: CIGRE Recommendations-Based Analysis
Ahmad Darwish[1], Shady S. Refaat[2], Haitham Abu-Rub[2], Hamid A. Toliyat[1]
[1]Texas A&M University-College Station, United States; [2]Texas A&M University-Doha, Qatar

Virtual 1

Thursday, October 15 **9:35AM-10:05AM**

S41 | Predictive and Sensorless Control of Electric Drives

Chairs: David Diaz Reigosa, Francisco Paz

0580 | Saliency-Based Speed Sensorless Control of Single-Inverter Dual Induction Machines using Reduced Amount of Current Sensors
Eduardo Rodriguez Montero[1], Markus Vogelsberger[2], Martin Bazant[3], Thomas Wolbank[1]
[1]Vienna University of Technology, Austria; [2]Bombardier Transportation Austria GmbH, Austria; [3]Bombardier Transportation Switzerland Ltd., Switzerland

0476 | Improved Sensorless Control Method for Permanent Magnet Synchronous Machines Considering Resistance Asymmetry and Temperature Variation
Tianyi Liu[1], Ziqiang Zhu[1], Zhanyuan Wu[2], David Stone[1], Martin Foster[1]
[1]University of Sheffield, United Kingdom; [2]Siemens Gamesa Renewable Energy, United Kingdom

0339 | Sensorless Control of Wound Rotor Synchronous Motors based on Rotor High-Frequency Signal Injection
David Reigosa, Ye Gu Kang, María Martínez, Daniel Fernández, J.M. Guerrero, Fernando Briz
University of Oviedo, Spain

1595 | Realization of Signal-Injection Sensorless Control of SMPMSM by Modification of Current Trajectory
Yoon-Ro Lee, Yong-Cheol Kwon, Seung-Ki Sul
Seoul National University, Korea

0985 | Position-Sensorless Control Design for Safety-Relevant Steer-by-Wire Applications
Kilian Rehorik[1], Abdelrahmen Elsman[2], Benjamin Grothmann[3], Nikolaus Reiland[1], Dieter Gerling[1], Fabio Giulii Capponi[2]
[1]Bundeswehr University Munich, Germany; [2]University of Rome La Sapienza, Italy; [3]Audi AG, Germany

0958 | Mitigating DV/DT Stress Caused by the Line-Line Voltage Polarity Reversal in Model Predictive Controlled VSI Drives
Ameer Janabi, Shukai Wang, Jacob Buys, Bingsen Wang
Michigan State University, United States

0505 | A Robust Predictive Current Control of Induction Motor Drives
Xing Wang[1], Yongchang Zhang[1], Haitao Yang[1], Boyue Zhang[1], Jose Rodriguez[2]
[1]North China University of Technology, China; [2]Universidad Andres Bello, Chile

0957 | One Improved Finite-Set Model Predictive Current Control with Nonlinear Speed Regulator for Linear Induction Motor based on Linear Metro
Mosaad M. Ali[1,2], Wei Xu[1], Mahmoud F. Elmorshedy[1,3], Yi Liu[1], Minghai Dong[4]
[1]Huazhong University of Science and Technology, China; [2]Kafrelsheikh University, Egypt; [3]Tanta University, Egypt; [4]Foshan Golden Age Motor Technology Co., Ltd., China

0663 | Data-Driven Predictive Current Control for Synchronous Motor Drives
Paolo Gherardo Carlet[1], Andrea Favato[1], Saverio Bolognani[2], Florian Dörfler[2]
[1]University of Padova, Italy; [2]ETH Zürich, Switzerland

Virtual 2

Thursday, October 15 **9:35AM-10:05AM**

S42 | Wireless Power Transfer in Transportation

Chairs: Burak Ozpineci, Salman Harasis

0508 | An Inductive Power Transfer System using Soft-Switched AC/AC Active-Clamped Half-Bridge Converter with Predictive Dead-Beat Grid Current Control
Phuoc Sang Huynh, Deepak Ronanki, Sheldon S. Williamson
Ontario Tech University, Canada

1439 | Multi-Pad Receivers for High Power Dynamic Wireless Power Transfer
Benny J. Varghese[1], Regan A. Zane[1], Abhilash Kamineni[1], Reza Tavakoli[2], Zeljko Pantic[2], Leo Liu[3]
[1]Utah State University, United States; [2]North Carolina State University, United States; [3]Toyota Research Institute North America, United States

1545 | Design of a 7.7 kW Three-Phase Wireless Charging System for Light Duty Vehicles based on Overlapping Windings
Samir Chowdhury, Md Tawhid Bin Tarek, Yilmaz Sozer
The University of Akron, United States

1347 | Wireless Power Transfer System Integration with an On-Board Conductive Charger for Plug-In Electric Vehicles
Mohamed Elshaer[1], Chris Bell[1], Aqil Hamid[1], Jin Wang[2]
[1]Ford Motor Co., United States; [2]The Ohio State University, United States

0224 | Electromagnetic Shielding Design for 200 kW Stationary Wireless Charging of Light-Duty EV
Bo Zhang[1], Richard B. Carlson[1], Veda P. Galigekere[2], Omer C. Onar[2], Jason L. Pries[2]
[1]Idaho National Laboratory, United States; [2]Oak Ridge National Laboratory, United States

1354 | Unfolder-Based Single-Stage AC-AC Conversion System for Wireless Charging Applications
Chakridhar Reddy Teeneti, Rees Hatch, Dorai Babu Yelaverthi, Abhilash Kamineni, Hongjie Wang, Regan Zane
Utah State University, United States

1455 | Comparative Analysis of DWPT Topologies and Regulation Schemes for Improved Controllability
Anindya Chitta Bagchi[1], Abhilash Kamineni[1], Regan Zane[1], Richard Carlson[2]
[1]Utah State University, United States; [2]Idaho National Laboratory, United States

1351 | Zero-Crossing Current Detection for Modular and Robust Dynamic Wireless Power Transfer
Matthew Hansen, Abhilash Kamineni, Regan Zane
Utah State University, United States

Virtual 3

Thursday, October 15 **9:35AM-10:05AM**

S43 | DC-AC Single-Phase Converters

Chairs: Liuchen Chang, Pedro Rodriguez

0944 | An Active Power Decoupling-integrated Four-Switch Quasi-Switched Boost Inverter
Pramit Nandi, Ravindranath Adda
Indian Institute of Technology Guwahati, India

1106 | An n-Phase Interleaved Current Fed Switched Inverter
Sonam Acharya[1], Santanu Mishra[1], Arvind Tiwari[2]
[1]Indian Institute of Technology Kanpur, India; [2]GE Global Research, United States

1123 | New Five-Level Double-Flying-Capacitor Inverter Fed by a Boost-Flyback Converter
Antonio Venancio de M. Filho[1], Edison Roberto C. da Silva[1,2], André Elias L. Costa[1]
[1]Federal University of Campina Grande, Brazil; [2]Federal University of Paraíba, Brazil

1320 | Efficiency Improvement with Off-Time Discrete Control for 1 MHz Operated Discontinuous Current Mode Grid-Tied Inverter
Cheng Huang, Jiantao Zhang, Tomoyuki Mannen, Takanori Isobe
University of Tsukuba, Japan

1294 | Model Predictive Control with Low Switching Frequency for Railway Power Compensator
Jeonghyeon Lee, Jehun Woo, Jongmin Jo, Hanju Cha
Chungnam National University, Korea

0432 | Verification of Iron Loss Affected by Secondary Frequency in Multi-Core Transformer for Frequency Multiplying Circuit
Shogo Nishikawa[1], Koji Orikawa[1], Satoshi Ogasawara[1], Masatsugu Takemoto[2]
[1]Hokkaido University, Japan; [2]Okayama University, Japan

0173 | A Resonant Current Regulator for Direct Electrical Heating of Subsea Pipelines
Anindya Ray, Kaushik Rajashekara
University of Houston, United States

0826 | Dynamic Performance Improvement of Single-Phase DC-AC Converter with Non-Linear Digital Predictive Control
Shah Zaman[1], Yan Zhang[1], Liu Jinjun[1], Li Xinying[1], Nauman Ali Larik[2], Zhang Jinshui[1]
[1]Xi'an Jiaotong University, China; [2]South China University of Technology, China

Virtual 4

Thursday, October 15 **9:35AM-10:05AM**

S44 | Reliability, Diagnostics and Fault Analysis

Chairs: Huai Wang, Rongwu Zhu

0045 | Impact of Mission Profile Dynamics on Accuracy of Thermal Stress Modeling in PV Inverters
Ariya Sangwongwanich, Huai Wang, Frede Blaabjerg
Aalborg University, Denmark

0304 | A Calculation Method of Analytical DC Fault Current in MMC-HVDC Grid including Current-Limiting Devices
Song Tang, Guanlong Jia, Chenghao Zhang, Min Chen
Zhejiang University, China

0205 | A Simple Diagnosis Approach for Multiple IGBT Faults in Cascaded H-Bridge Multilevel Converters
Dong Xie, Xinglai Ge
Southwest Jiaotong University, China

0775 | Separation of Bond-Wire and Solder Layer Failure Modes in IGBT Power Modules
Wenzhao Liu[1], Dao Zhou[1], Michael Hartmann[2], Francesco Iannuzzo[1], Frede Blaabjerg[1]
[1]Aalborg University, Denmark; [2]Schneider Electric Power Drives GmbH, Austria

1586 | Case Temperature Monitoring-Based Online Condition Monitoring of SiC MOSFET Power Modules using a Radial Basis Function Network
Cameron Entzminger, Wei Qiao, Liyan Qu
University of Nebraska-Lincoln, United States

0544 | Co-Optimization of Boost Converter Reliability and Volumetric Power Density using Genetic Algorithm
Lee Gill, Jason C. Neely, Lee J. Rashkin, Jack D. Flicker, Robert J. Kaplar
Sandia National Laboratories, United States

0917 | Preserving Converter Lifetime by Active Thermal Boundary Control
Patrick T. Lewis[1], Brandon M. Grainger[2]
[1]Hepburn and Sons, LLC, United States; [2]University of Pittsburgh, United States

1103 | Condition Monitoring of DC-Link Capacitors in Grid-Tied Solar Inverters using Data-Driven Techniques
Vahe Seferian[1], Ali Bazzi[1,2], Hazem Hajj[1]
[1]American University of Beirut, Lebanon; [2]University of Connecticut, United States

0210 | An IGBT Open-Circuit Fault Diagnosis Method for Grid-Tied T-Type Three-Level Inverters
Zhan Li[1], Bohui Zhao[1], Xin Zhang[2], Hao Ma[2]
[1]Nanyang Technological University, Singapore; [2]Zhejiang University, China

Virtual 1

Thursday, October 15 **10:10AM-10:40AM**

S45 | Multi-Phase Motor Drives

Chairs: Prerit Pramod, Mario Pulvirenti

0046 | Performance Evaluation and Improvement of Symmetrical Six-Phase Drives under Two Open Legs with Star and Hexagon Connections
Alejandro G. Yepes, Jesús Doval-Gandoy
University of Vigo, Spain

0358 | A Generalized Carrier-Based PWM with Zero-Axis Voltage Elimination for Open-End Winding Motor Drive
An Li, Xiangwen Sun, Dong Jiang, Zicheng Liu
Huazhong University of Science and Technology, China

1431 | Direct Instantaneous Torque Control of Five-Phase Segmented Switched Reluctance Motor with Bipolar Excitation for In-Wheel Electric Vehicles
Deepak Ronanki[1], Apparao Dekka[1], Parthiban Perumal[2], Abdul R. Beig[3]
[1]Lakehead University, Canada; [2]National Institute of Technology Karnataka, India; [3]Khalifa University, United Arab Emirates

0616 | Active Disturbance Rejection Control of Synchronous Reluctance Motors
Angelo Accetta[1], Maurizio Cirrincione[2], Filippo D'Ippolito[3], Marcello Pucci[1], Antonino Sferlazza[3]
[1]National Research Council of Italy, Italy; [2]University of the South Pacific, Fiji; [3]University of Palermo, Italy

0215 | Self-Commissioning of Synchronous Reluctance Motor Drives: Magnetic Model Identification with Online Adaptation
Anantaram Varatharajan, Gianmario Pellegrino, Eric Armando
Politecnico di Torino, Italy

0424 | Minimum Loss Control of a Five-Phase Permanent Magnet Assisted Synchronous Reluctance Motor under Open Phase Fault
Akm Arafat[1], Md. Khurshedul Islam[2], Kazi Nishat Tasnim[2], Seungdeog Choi[2]
[1]Commins Inc., United States; [2]Mississippi State University, United States

1591 | Dynamic Overmodulation for Improved Current Regulation of PMSM
Jiwon Yoo, Seung-Ki Sul
Seoul National University, Korea

Virtual 2

Thursday, October 15 **10:10AM-10:40AM**

S46 | Control and Stability of Power Converters

Chairs: Ke Ma, Mohammad B Shadmand

0433 | Asymmetric Parameters Design for Bidirectional Resonant CLLC Battery Charger
Jun Min, Martin Ordonez
The University of British Columbia, Canada

0926 | Primary Frequency Control in Islanded Microgrids using Solid-State Transformers as Virtual Synchronous Machines
Javad Khodabakhsh, Gerry Moschopoulos
Western University, Canada

0706 | Design and Optimization of AC-Side Filter using Coupled Inductor for Single-Phase Full-Bridge Inverter
Zhe Yang[1], Paige Williford[1], Fred Wang[1], Sandeep Bala[2], Jing Xu[2]
[1]The University of Tennessee, United States; [2]ABB Corporate Research, United States

0749 | CCM vs. CRM Design Optimization of a Boost-Derived Parallel Active Power Decoupler for Microinverter Applications
Yidi Shen, Michael D'Antonio, Shiladri Chakraborty, Alireza Khaligh
University of Maryland, United States

0329 | Using Deterministic Optimization to Compare Interleaved and Coupled Inverters: Results and Experimental Verification
Adrien Voldoire[1], Jean-Luc Schanen[1], Jean-Paul Ferrieux[1], Benoit Sarrazin[1], Cyrille Gautier[2], Marwan Ali[2]
[1]University Grenoble Alpes, France; [2]Safran Tech, France

0406 | A Hybrid Multi-Loop Current Control of the Grid-Connected Converter with LCL Filter
Yong-Yao Shen, Meng-Jiang Tsai, Jiuyang Zhou, Po-Tai Cheng
National Tsing-Hua University, Taiwan

0599 | A Trigonometric Solution to the Problem of Overmodulation in Five-Phase Inverters
Luca Vancini, Michele Mengoni, Giacomo Sala, Gabriele Rizzoli, Luca Zarri, Angelo Tani
University of Bologna, Italy

Virtual 3

Thursday, October 15 **10:10AM-10:40AM**

S47 | High Frequency DC-DC Converters

Chairs: Dong Cao, Emanuel Serban

0707 | Current Sharing Analysis of Interleaved LCLC Resonant Converter
Mojtaba Forouzesh, Bo Sheng, Yang Chen, Yan-Fei Liu
Queen's University, Canada

0009 | Optimal Design of GaN and PCB-Winding based Transformer-Inductor-Integrated Magnetics for CLL Resonant Converter
Yue Liu, Hongfei Wu, Yu Tai, Jun Zou, Yihang Jia
Nanjing University of Aeronautics and Astronautics, China

1085 | An Accurate Voltage Gain Model Considering Diode Effect for LLC Resonant Converter in Wide Gain Range Applications
Hao Wen[1], Dong Jiao[1], Jih-Sheng Lai[1], Johan Strydom[2], Lanhua Zhang[2]
[1]Virginia Polytechnic Institute and State University, United States; [2]Texas Instruments Inc., United States

0244 | A 48V-to-1V Buck-Assisted Active-Clamp Forward Converter with Reduced Voltage Stress for Datacenter Applications
Lixiong Du, D. Brian Ma
The University of Texas-Dallas, United States

0355 | Analysis and Design of Active Snubber of a Step-Up Phase Shifted Full Bridge DC-DC Converter Considering Parasitics
Manmohan Mahapatra, Anirban Pal, Kaushik Basu
Indian Institute of Science, India

1380 | A 27.12-MHz 10-kV Power Amplifier for Compact Particle Accelerators Utilizing an Optimized Matching Network
Sreyam Sinha[1], Yuetao Hou[1], Di Ni[1], Qing Ji[2], Arun Persaud[2], Thomas Schenkel[2], Amit Lal[1], Khurram K. Afridi[1]
[1]Cornell University, United States; [2]Lawrence Berkeley National Laboratory, United States

1273 | A 50-MHz Multi-kV Power Amplifier for Ion-Beam Accelerator Utilizing an Optimized Toroidal Inductor
Yuetao Hou[1], Sreyam Sinha[1], Di Ni[1], Qing Ji[2], Arun Persaud[2], Thomas Schenkel[2], Amit Lal[1], Khurram K. Afridi[1]
[1]Cornell University, United States; [2]Lawrence Berkeley National Laboratory, United States

1169 | LLC Resonant Converter using Pre-Charged Capacitor for High Input Voltage – High PAPR Envelope Tracking
Yu Yao, Harish S. Krishnamoorthy
University of Houston, United States

0211 | Spread Spectrum based Power Line Communication and EM Noise Reduction Technique for Bidirectional HB CLLC Resonant Converter
Hwa-Pyeong Park[1], Mina Kim[2], Jongbok Baek[1], Moses Kang[1], Jee-Hoon Jung[2]
[1]Korea Institute of Energy Research, Korea; [2]Ulsan National Institute of Science and Technology, Korea

Virtual 4

Thursday, October 15 **10:10AM-10:40AM**

S48 | Wireless Power Transfer

Chairs: Chi-Kwan Lee, Yi Tang

1371 | Multiple-Transmitter Achieving Load-Independent Transmitter Current and Compensation of Cross-Interference Among Transmitters for Wide Charging Area Wireless Power Transfer Systems
Kodai Matsuura[1], Masataka Ishihara[1], Akihiro Konishi[1], Kazuhiro Umetani[2], Eiji Hiraki[1]
[1]Okayama University, Japan; [2]Tohoku University, Japan

1264 | Challenges and Solutions to Passive Rectification in Multi-MHz Frequency Capacitive Wireless Power Transfer Systems for Electric Vehicle Charging
Brandon Regensburger, Khurram K. Afridi
Cornell University, United States

0809 | A High Frequency Wireless Power Transfer System for Electric Vehicle Charging using Multi-Layer Non-Uniform Self-Resonant Coil at MHz
Ruiyang Qin, Jie Li, Daniel Costinett
The University of Tennessee-Knoxville, United States

0034 | A Direct AC-AC Single-Inductor Multiple-Output (SIMO) Converter for Multi-Coil Wireless Power Transfer Applications
Jiayang Wu, Albert T.L.Lee, Siew-Chong Tan, S.Y. (Ron) Hui
The University of Hong Kong, Hong Kong

1291 | Active Rectifier Design and Synchronization Control for 6.78 MHz Wireless Power Transfer
Peter Pham, Spencer Cochran, Daniel J. Costinett, Leon M. Tolbert
The University of Tennessee, United States

0268 | A Novel Method to Design High Efficiency Transmission Line Class E Power Amplifier
Dongqin Mao, Ke Jin, Xirui Zhu
Nanjing University of Aeronautics and Astronautics, China

0568 | A New Control Method of Semi-Bridgeless Active Rectifier for Wireless Power Transfer System based on the Double-Sided LCC Compensation
Min Wu, Yongbin Jiang, Longyang Yu, Chengzi Yang, Mengyu Zhu, Laili Wang, Wenjie Chen, Xu Yang
Xi'an Jiaotong University, China

0679 | A Dual Phase Shedding Method for the Improvement of Efficiency and Reduction of Regulating Requirements in Series-Series Inductive Power Transfer
Shuxin Chen[1], Yang Chen[2], Hongchang Li[3], Yiming Zhang[1], Xin Li[1], Yi Tang[1]
[1]Nanyang Technological University, Singapore; [2]Southwest Jiaotong University, China; [3]Xinjiang University, China

0728 | Optically-Coupled Switched-Mode Converter for Smartphones Wireless Charging Application
Weiyang Zhou[1], Mengqi Wang[1], Qunfang Wu[1], Guanliang Liu[1], Wencong Su[1], Can Huang[2]
[1]University of Michigan-Dearborn, United States; [2]Lawrence Livermore National Laboratory, United States

0287 | Data-Enabled Estimation and Feedback Control Method Utilizing Online Magnetic Positioning System for Wireless Power Transfer Systems
Zeqian Cheng, Hao Chen, Zhongnan Qian, Jiande Wu, Xiangning He
Zhejiang University, China

1348 | Control of Output Power in Primary Side LCC and Secondary Series Tuned Wireless Power Transfer System without Secondary Side Sensors
Subhajyoti Mukherjee, Veda P. Galigekere, Omer Onar, Burak Ozpineci, Jason Pries, Gui-Jia Su
Oak Ridge National Laboratory, United States

1328 | Design of Auxiliary Circuit Elements for Achieving Zero Voltage Switching in a Wireless Power Transfer System
Tarak Saha[1], Subhajyoti Mukherjee[2], Veda Prakash Galigekere[2], Omer C. Onar[2]
[1]Utah State University, United States; [2]Oak Ridge National Laboratory, United States

Virtual 1

Thursday, October 15 **11:00AM-11:30AM**

S49 | Noise, Vibration and Reliability in Electric Machines

Chairs: Jose Antonino-Daviu, Shanelle Foster

1009 | Investigation of the Effects of Skew of an Integrated Flux-Switching Motor-Compressor
Hao Ding, Leyue Zhang, Ahmed Hembel, Bulent Sarlioglu
University of Wisconsin-Madison, United States

1536 | Impact of Damping Material on Vibration Isolation in Switched Reluctance Machines
Lavanya Vadamodala[1], Anik Chowdhury[1], Md. Tawhid Bin Tarek[1], Shuvajit Das[1], Abdul W. Bandarkar[1], Yilmaz Sozer[1], Fernando Venegas[2], David Colavincenzo[2]
[1]The University of Akron, United States; [2]Bendix Commercial Vehicle Systems, United States

1532 | Analysis of Radial Force Ripple with Sensor Errors and its Effect in NVH Performance for SRMs
Omer Gundogmus, Anik Chowdhury, Abdul Wahab Bandarkar, Lavanya Vadamodala, Md Ehsanul Haque, Yilmaz Sozer
The University of Akron, United States

0121 | Vibrations and Acoustic Noise Analyses of Modular SPM Machines
Guang-Jin Li[1], Xiao-Bin Liang[2], Zi-Qiang Zhu[1], Javier Ojeda[3], Mohamed Gabsi[3]
[1]The University of Sheffield, United Kingdom; [2]State Grid Sichuan Electric Power Institute, China; [3]École Normale Supérieure Paris-Saclay, France

1535 | Current Profile Optimization Method for Simultaneous DC-Link Current Ripple and Acoustic Noise Minimization in Switched Reluctance Machines
Omer Gundogmus[1], Md Ehsanul Haque[1], Lavanya Vadamodala[1], Abdul Wahab Bandarkar[1], Anik Chowdhury[1], Fernando Venegas[2], David Colavincenzo[2]
[1]The University of Akron, United States; [2]Bendix Commercial Vehicle Systems, United States

0455 | Comparison of Frequency Responses of the Motors with Bearing Voltage Reduction Structures
Jun-Hyuk Im, Woo-Jong Kim, Jin Hur
Incheon National University, Korea

1468 | Evaluation of Bearing Voltage Reduction in Electric Machines by using Insulated Shaft and Bearings
Peng Han[1], Greg Heins[2], Dean Patterson[2], Mark Thiele[2], Dan M. Ionel[1]
[1]University of Kentucky, United States; [2]Regal Beloit Corp., Australia

1471 | Combined Numerical and Experimental Determination of Ball Bearing Capacitances for Bearing Current Prediction
Peng Han[1], Greg Heins[2], Dean Patterson[2], Mark Thiele[2], Dan M. Ionel[1]
[1]University of Kentucky, United States; [2]Regal Beloit Corp., Australia

Virtual 2

Thursday, October 15 **11:00AM-11:30AM**

S50 | Battery Management Systems

Chairs: Jaber Abu Qahouq, Sheldon Williamson

1325 | Unbiased Model Identification and State of Energy Estimation of Lithium-Ion Battery
Zhongbao Wei, Hongwen He, Jian Hu
Beijing Institute of Technology, China

0418 | Data-Driven Nonparametric Li-Ion Battery Ageing Model Aiming at Learning from Real Operation Data: Holistic Validation with EV Driving Profiles
Mattin Lucu[1], Markel Azkue[1], Haritza Camblong[2], Egoitz Martinez-Laserna[1]
[1]Ikerlan Technology Research Centre, Spain; [2]University of the Basque Country, Spain

0139 | Li-Ion Battery State of Charge Estimation of Multi-Type Working Conditions using a Segmented Multiple Independent Forgetting Factors Recursive Least Squares Method
Haolu Liu, Junhua Wang, Qisheng Liu, Shiqi Liu, Jia Tang
Wuhan University, China

0847 | Combined SOC and SOE Estimation of Lithium-Ion Battery for Electric Vehicle Applications
Prashant Shrivastava, Tey Kok Soon, Mohd Yamani Idna Idris, Saad Mekhilef
University Malaya, Malaysia

1002 | Wireless Smart Battery Management System for Electric Vehicles
Xinrong Huang[1], Anirudh Budnar Acharya[1], Jinhao Meng[2], Xin Sui[1], Daniel-Ioan Stroe[1], Remus Teodorescu[1]
[1]Aalborg University, Denmark; [2]Sichuan University, China

0409 | Comparison of Lithium-Ion Battery Pack Models based on Test Data from Idaho and Argonne National Laboratories
Kevin Davis[1], John G. Hayes[2]
[1]Cork Institute of Technology, Ireland; [2]University College Cork, Ireland

1010 | The Effect of Pulsed Current on the Performance of Lithium-Ion Batteries
Xinrong Huang[1], Yuanyuan Li[2], Jinhao Meng[3], Xin Sui[1], Remus Teodorescu[1], Daniel-Ioan Stroe[1]
[1]Aalborg University, Denmark; [2]University of Electronic Science and Technology, China; [3]Sichuan University, China

1364 | Bidirectional AC/DC Converter using GaN HEMT based Non-Isolated DAB for Battery Emulation
Sanchit Mishra, T. Sreekanth, Ned Mohan
University of Minnesota, United States

Virtual 3

Thursday, October 15 **11:00AM-11:30AM**

S51 | Power Converter Control

Chairs: Frede Blaabjerg, Marco Liserre

0620 | Global Optimization for Dual Active Bridge Converters to Minimize RMS Current
Ruoyu Li, Linghui Meng, Rongxin Chen, Han Yan, Zeliang Shu
Southwest Jiaotong University, China

1322 | Three-Phase-Four-Wire Three-Level Inverter with Neutral Inductor and Neutral Module for Saving AC-Filter-Inductances and DC-Link-Capacitances
Li Zhang, Donghan Shi, Wentao Jiang, Tianbo Yang, Chi Jin, Wai Kuan Loh, Yi Tang
Nanyang Technological University, Singapore

1363 | Systematic Finite-Control-Set Model Predictive Control Design with Unified Model for Isomorphic and Dual Power Converters
Cheng Xue, Yuzhuo Li, Yunwei Li
University of Alberta, Canada

1561 | Optimized Cascaded Controller Design for a 10 kW/100 kHz Large Signal Bandwidth AC Power Source
Florian Krismer, Varsha N. Behrunani, Pascal S. Niklaus, Johann W. Kolar
ETH Zürich, Switzerland

1612 | Inverter Nonlinearity Compensation of Discontinuous PWM Considering Voltage Drop of Power Semiconductor and Dead Time Effect
Joon-Hee Lee, Seung-Ki Sul
Seoul National University, Korea

0861 | Design of Harmonic Tolerant Mock-Up-Load for Distribution System Testbed
Hitesh Kumar, Santanu K. Mishra, Mandeep Singh Rana
Indian Institute of Technology Kanpur, India

0133 | PI Controller Tuning Optimization for Grid-Connected VSC using Space Mapping
Wesam Taha, Mohamed Bakr, Ali Emadi
McMaster University, Canada

0219 | Subsynchronous Resonance Analysis in Multi-Bus Multi-VSC Power System based on Two-Port Network Modeling Method
Shih-Feng Chou, Xiongfei Wang, Frede Blaabjerg
Aalborg University, Denmark

1303 | Design of Control Architecture for Stacked Low-Inertia Converters with Fast Dynamic Control
Xiangyu Han, Liran Zheng, Zheng An, Rajendra Prasad Kandula, Maryam Saeedifard
Georgia Institute of Technology, United States

Virtual 4

Thursday, October 15 **11:00AM-11:30AM**

S52 | Multilevel Converters 4

Chairs: John Shen, Hui Li

0789 | Optimized Circulating Current Control Method based on Proportional Resonant and Proportional Integral Controllers for Modular Multi-Level Converter Applications
Semih Isik, Mohammed Alharbi, Subhashish Bhattacharya
North Carolina State University, United States

1449 | Modeling of MMC based High Power DC-DC Converter Controlled using Trapezoidal Modulation
Mohd Shadab Ansari, Anshuman Shukla, Himanshu J. Bahirat
Indian Institute of Technology Bombay, India

0321 | Computationally Efficient Optimization Method for Model Predictive Pulse Pattern Control of Modular Multilevel Converters
Wei Tian, Yuebin Pang, Xiaonan Gao, Qifan Yang, Ralph Kennel
Technical University of Munich, Germany

0625 | A Level-Increased MMC Topology and Modulation Strategy in DC Distribution Grids
Jianye Tao, Chen Wang, Yi Wang, Tong Xu
North China Electric Power University, China

0529 | A New High-Frequency Multilevel Boost Power Factor Correction Approach with GaN Semiconductors
Kevin C. Hodge, Erick I. Pool-Mazun, Jorge Ramos-Ruiz, Prasad Enjeti
Texas A&M University, United States

0668 | Flying Capacitor Voltages Estimation in Flying Capacitor Multilevel DC-DC Converters based on Peak Inductor Current Detection and Output Voltage Measurement
Hongxiang Chen, Sai Tang, Zhong Zeng, Jun Wang
Hunan University, China

0681 | A Simplified Model Predictive Control Strategy for a Nine-Level Hybrid Multilevel Converter
Yufei Li[1,2], Fei Diao[2], Yue Zhao[2]
[1]Northwestern Polytechnical University-Xi'an, China; [2]University of Arkansas, United States

0420 | A Five-Level Flying-DC-Source Multilevel Inverter with Self-Regulated Voltages and Boosting Capability
Antonio Venancio de M. Filho[1], André Elias L. da Costa[1], Edison Roberto C. da Silva[1,2], Cursino Brandão Jacobina[1], Nady Rocha[2]
[1]Federal University of Campina Grande, Brazil; [2]Federal University of Paraíba, Brazil

Virtual 1

Thursday, October 15 **11:35AM-12:05PM**

S53 | Design and Control of Electric Drives

Chairs: Jul-Ki Seok, Kevin Lee

0386 | Analysis and Design of Spatial Six-Step Controllers for Permanent Magnet Synchronous Machines
Marc S. Petit[1], Hao Zeng[2], Bulent Sarlioglu[2]
[1]Miller Electric Manufacturing, LLC, United States; [2]University of Wisconsin-Madison, United States

1569 | NVH Performance of Direct Flux Controlled Switched Reluctance Machine
Okan Boler, Omer Gundogmus, Abdul Wahab Bandarkar, Yilmaz Sozer
The University of Akron, United States

1116 | Deadbeat Control for AC Drive Systems with Optimal Dynamic Performance
Wei Tian[1], Qifan Yang[1], Xinyue Li[1,2], Xiaonan Gao[1], Xiao Chen[1], Ralph Kennel[1]
[1]Technical University of Munich, Germany; [2]Bosch Rexroth AG, Germany

0610 | Design of a SiC-Based Switched CCM/TCM Inverter for High-Speed Machine Drive with Low PWM-Induced Current Ripple
Yunlei Jiang, Yanfeng Shen, Luke Shillaber, Teng Long
University of Cambridge, United Kingdom

1332 | Optimal Super-Twisting Sliding-Mode Control using Adaptive Dynamic Programming for Uncertain Linear-Stage Considering PMSM Servo Drive Dynamics
Fayez F.M. El-Sousy[1], Mahmoud M. Amin[2], Ghada A. Abdel Aziz[3], Ahmed Al-Durra[4], Osama A. Mohammed[5]
[1]Prince Sattam bin Abdulaziz University, Saudi Arabia; [2]Manhattan College, United States; [3]Electronics Research Institute, Egypt; [4]Khalifa University, United Arab Emirates; {5}Florida International University, United States

1276 | Power Converter Topology and Control Strategy for Novel Two-Phase DC-Biased Vernier Reluctance Machine
Shaofeng Jia, Binke Li, Xiaozhuang Dong, Deliang Liang, Jinjun Liu
Xi'an Jiaotong University, China

0474 | Auto Tuning Method to Identify Motor Stator and Rotor Parameter in Field-Orientation-Controlled Induction Motor
Masaki Nagataki[1], Keiichiro Kondo[1], Osamu Yamazaki[2], Kazuaki Yuki[2], Yosuke Nakazawa[2]
[1]Waseda University, Japan; [2]Toshiba Infrastructure Systems and Solutions Corp., Japan

1290 | Winding Inductance Estimations in Air-Cored Resonant Induction Machines
Zhao Jin[1], Matteo F. Iacchetti[1], Alexander C. Smith[1], Rajesh P. Deodhar[2], Yoshiyuki Komi[3], Chiaki Umemura[3]
[1]The University of Manchester, United Kingdom; [2]IMRA Europe S.A.S. UK Research Centre, United Kingdom; [3]Aisin Seiki Co., Ltd., Japan

0360 | A Non-Invasive Dual-EKF-Based Rotor Temperature Estimation Technique for Permanent Magnet Machines
Tianze Meng, Pinjia Zhang
Tsinghua University, China

1365 | On-Line Stator Resistance Estimation of Vector-Controlled Synchronous Reluctance Motors using Inductance Information
Shu Yamamoto[1], Hideaki Hirahara[1], Ryotaro Eto[2]
[1]Polytechnic University, Japan; [2]Wakayama Polytechnic Center, Japan

1172 | Accurate Capacitance Calculation of Multi-Layer Foil Windings in a Medium/High-Frequency High-Power Transformer
Annoy Kumar Das, Baylon G. Fernandes
Indian Institute of Technology Bombay, India

Virtual 2

Thursday, October 15 **11:35AM-12:05PM**

S54 | Power Converter EMI

Chairs: David Perreault, Bilal Akin

1526 | Electromagnetic Interference Spectrum Steering Technique using Switching Angle Modulation in DC-DC Converters
Le Yang, Shuo Wang
University of Florida, United States

0980 | Modeling, Design, and Implementation of a Novel Transformer-Less Feedforward-Controlled Active EMI Filter for AC-DC Power Converters
Zhe Zhang[1], Ali M. Bazzi[1,2]
[1]University of Connecticut, United States; [2]American University of Beirut, Lebanon

1070 | Design and Implementation of Selective Active EMI Filter with Digital Resonant Controller
Hongwu Peng, Balaji Narayanasamy, Asif Imran Emon, Zhao Yuan, Mustafeez Ul Hassan, Fang Luo
University of Arkansas, United States

0862 | A Novel Simulation Model for Common-Mode Inductors based on the Permeance-Capacitance Analogy
Shotaro Takahashi[1], Satoshi Ogasawara[2]
[1]Tokyo Metropolitan University, Japan; [2]Hokkaido University, Japan

0179 | Analysis of Conducted Electromagnetic Noise Spectra Reduction for Flyback Converter using Frequency Dithering Technique
Rong Huang[1], Qing Ji[1], Lihong Xie[2], Min Cheng[1]
[1]Soochow University, China; [2]Bristol University, United Kingdom

0178 | Conducted EMI Suppression using Power Semiconductor Filter in Fixed-Frequency Operation
Kun Zhang, John Wing-To Fan, Chung-Pui Tung, Henry Shu-Hung Chung
City University of Hong Kong, China

0030 | Near Field Coupling's Impact on Radiated EMI and Mitigation Techniques for Power Converters in Automotive Applications
Juntao Yao[1], Shuo Wang[1], Zheng Luo[1]
[1]University of Florida, United States; [2]Monolithic Power Systems, Inc., United States

1492 | Investigation and Reduction of Near Electric Field Emitted from a Helical Inductor
Mohamed El-Sharkh, Shuo Wang, Boyi Zhang
University of Florida, United States

Virtual 3

Thursday, October 15 **11:35AM-12:05PM**

S55 | Predictive Control

Chairs: Sheng Zheng, Yuhua Du

1552 | Proportional Integral Finite Set Model Predictive Control for a Transformer-Less Compact Multilevel Active Power Filter
Mohammad Babaie, Mohammad Sharifzadeh, Kamal Al-Haddad
École de Technologie Supérieure, Canada

1330 | A New Constant Switching Frequency Model Predictive Control Method for Grid Connected 5-level ANPC Inverter with Capacitors Sensor-less Voltage Balancing
Mostafa Abarzadeh[1], Nathan Weise[1], Liuchen Chang[2], Kamal Al-Haddad[3]
[1]Marquette University, United States; [2]University of New Brunswick, Canada; [3]École de Technologie Supérieure, Canada

0543 | Model Predictive Control of Step-Up Matrix Converters
Vladimir Blasko[1], Mahmoud El Chamie[1], Boran Fan[2], Rolando Burgos[2]
[1]Raytheon Technologies Research Center, United States; [2]Virginia Polytechnic Institute and State University, United States

0578 | Model-Free Predictive Current Control for Three-Phase Power Converters with LCL Filter
Xiang Liu[1], Yongchang Zhang[1], Haitao Yang[1], Jose Rodriguez[2]
[1]North China University of Technology, China; [2]Universidad Andres Bello, Chile

0294 | Large Signal Stability Analysis of DAB Converter using Moving Discretized Control Set – Model Predictive Control
Luca Tarisciotti[1], Linglin Chen[2], Shao Shuai[3], Tomislav Dragicevic[4]
[1]Universidad Andres Bello, Chile; [2]Huawei Technologies, China; [3]Zhejiang University, China; [4]Technical University of Denmark, Denmark

0840 | A High Performance Feedback Quantized Predictive Control of Induction Machine Drives
S.M. Muslem Uddin, Galina Mirzaeva
The University of Newcastle, Australia

0909 | A Two-Step Reference Prediction Method for Predictive Current Control of Active Power Filters
Haitao Yang, Bingyu Li, Yongchang Zhang
North China University of Technology, China

0471 | Model-Free Predictive Current Control of PWM Rectifier under Unbalanced and Distorted Network
Yongchang Zhang, Li Bingyu, Jie Liu, Xiang Liu
North China University of Technology, China

Virtual 4

Thursday, October 15 **11:35AM-12:05PM**

S56 | Dual Active Bridge

Chairs: Qingyun Huang, Qiang Li

1337 | An Alternative Dual Active Bridge Modulation to Minimize RMS Current and Extend ZVS Range
Faizah Zahin[1], Alireza Abasian[2], S. Ali Khajehoddin[1]
[1]University of Alberta, Canada; [2]University of Lorraine, France

1043 | Small Signal Model of Dual Active Bridge Converter for Multi-Phase Shift Modulation
Md Safayatullah, Issa Batarseh
University of Central Florida, United States

1462 | Internal Model based PID Tuning of a Phase-Shift Control in a Single-Phase Bidirectional Dual Active Bridge DC-DC Converter
Sara Yazdani, Mehdi Ferdowsi, Pourya Shamsi
Missouri University of Science and Technology, United States

0546 | Design Considerations for PPS Controlled Current-Fed DAB Converter to Achieve Full Load Range ZVS with Low Inductor RMS Current
Jing Guo, Hua Han, Guo Xu, Zhiqiang Cai, Hui Wang, Mei Su
Central South University, China

1554 | Adaptive Modulation of a CLC-Resonant DAB Converter for Wide Range ZVS Operation with Minimum Reactive Circulating Power
C.A. Teixeira, R.H. Wilkinson, L.D. James, B.P. McGrath, D.G. Holmes
RMIT University, Australia

1477 | Analytical Modelling and Control of Dual Active Bridge Converter Considering all Phase-Shifts
Muhammad Faisal Fiaz[1], Sandro Calligaro[1], Roberto Petrella[2]
[1]Free University of Bolzano-Bozen, Italy; [2]University of Udine, Italy

1523 | A Medium Voltage Dual Active Bridge Converter based on Gen-3 10 kV SiC MOSFETs
Anup Anurag[1], Nithin Kolli[1], Sayan Acharya[2], Subhashish Bhattacharya[1], Todd R. Weatherford[3], Andrew Parker[3]
[1]North Carolina State University, United States; [2]ABB US Corporate Research Center, United States; [3]Naval Postgraduate School, United States

1150 | Design of 1500V/200kW 99.6% Efficiency Dual Active Bridge Converters based on 1700V SiC Power MOSFET Module
Wei Xu, RuiYang Yu, Zhicheng Guo, Alex Q. Huang
The University of Texas at Austin, United States

0752 | Design Optimization for Weighted Conduction Loss Minimization in a Dual-Active-Bridge-Based PV Microinverter
Michael D'Antonio, Shiladri Chakraborty, Alireza Khaligh
University of Maryland, United States

Virtual 5

Thursday, October 15 **11:35AM-12:05PM**

S57 | Protection Devices and Solid State Circuit Breakers

Chairs: John Shen, Oscar Lucia

1409 | Main Breaker Switching Control and Design Optimization for a Progressively Switched Hybrid DC Circuit Breaker
Md Rifat Kaisar Rachi, Iqbal Husain
North Carolina State University, United States

0506 | Accelerated Aging Test of Solid-State DC Circuit Breaker based on 2.5kV Reverse Blocking IGCT
Rostan Rodrigues[1], Utkarsh Raheja[1], Pietro Cairoli[1], Luca Raciti[2], Antonello Antoniazzi[2]
[1]ABB Inc., United States; [2]ABB S.p.A, Italy

1604 | Optimal Design of a Novel High-Power Thyristor-Based DC Circuit Breaker
Siavash Beheshtaein, Mandana Saravani, Farzad Banihashemi, Robert Cuzner
University of Wisconsin-Milwaukee, United States

0521 | Experimental Validation of Parallel Connection of RB-IGCTs for High Efficiency Solid State Circuit Breaker
Yuzhi Zhang[1], Utkarsh Raheja[1], Rostan Rodrigues[1], Pietro Cairoli[1], Luca Raciti[2], Antonello Antoniazzi[2]
[1]ABB Inc., United States; [2]ABB S.p.A., Italy

1402 | Evaluate I^2t Capability of SiC MOSFETs in Solid State Circuit Breaker Applications
Zhou Dong[1], Ren Ren[1], Fred Wang[1,2]
[1]The University of Tennessee, United States; [2]Oak Ridge National Laboratory, United States

1292 | High Current Medium Voltage Bidirectional Solid State Circuit Breaker using SiC JFET Super Cascode
Utkarsh Mehrotra, Bahji Ballard, Douglas C. Hopkins
North Carolina State University, United States

0547 | Lightning Impulse Protection for Grid-Connected Solid-State Transformers
Chunmeng Xu, Jia Wei, Liran Zheng, Xiangyu Han, Maryam Saeedifard, Karthik Kandasamy, Deepak Divan, Lukas Graber
Georgia Institute of Technology, United States

1182 | Smart Plug 2.0: Solid State Smart Plugs Preventing Fire and Shock Hazards in Smart Homes and Offices
Zhixi Deng, Yuanfeng Zhou, Risha Na, Z. John Shen
Illinois Institute of Technology, United States

Virtual 1

Thursday, October 15 **12:10PM-12:40PM**

S58 | IPM and PM Motor Drives

Chairs: David Diaz Reigosa, Paolo Pescetto

0644 | Analysis of Implementation Methodologies of Deadbeat Direct-Torque and Flux Control (DB-DTFC) for IPMSMs in Stationary and Rotatory Reference Frames
Daniel E. Gaona[1], Hadi El Khatib[2], Teng Long[1], Michael Saur[3]
[1]University of Cambridge, United Kingdom; [2]Bundeswehr University-Munich, Germany; [3]Audi AG, Germany

1156 | MTPA Tracking Algorithms for IPMSMs and SynRMs: Accurate Evaluation and Adaptive Tuning of Real Signal Injection and Virtual Signal Injection
Sandro Calligaro[1], Davide Marzona[2], Roberto Petrella[2], Amir Shahdadi[2]
[1]Free University of Bozen, Italy; [2]University of Udine, Italy

0645 | Overmodulation Strategy for Deadbeat-Flux and Torque Control of IPMSM with Flux Trajectory Control in the Stationary Reference Frame
Daniel E. Gaona[1], Hadi El Khatib[2], Teng Long[1], Michael Saur[3]
[1]University of Cambridge, United Kingdom; [2]Bundeswehr University-Munich, Germany; [3]Audi AG, Germany

0016 | A Novel Method for Measuring High Frequency DQ-Axis and Cross-Coupling Inductances in Interior Permanent Magnet Synchronous Machines
B. Shuang, Z.Q. Zhu
University of Sheffield, United Kingdom

0490 | Enhancement of Disturbance Rejection Capability in Dual Three Phase PMSM System by using Virtual Impedance
Luocheng Yan[1], Ziqiang Zhu[1], Ji Qi[1], Yuan Ren[2], Chengwei Gan[2], Chris Hilton[2]
[1]University of Sheffield, United Kingdom; [2]Protean Electric, United Kingdom

0592 | Magnet Temperature Estimation in Variable Leakage Flux Permanent Magnet Synchronous Machines using the Magnet Flux Linkage
Diego F. Laborda[1], David Díaz Reigosa[1], Daniel Fernández[1], Kensuke Sasaki[2], Takashi Kato[2], Fernando Briz[1]
[1]University of Oviedo, Spain; [2]Nissan Motor Co. Ltd., Japan

0411 | Power Hardware-in-the-Loop based Emulation of an Open-Winding Permanent Magnet Machine
K.S. Amitkumar, Pragasen Pillay
Concordia University, Canada

1466 | Electric Drives with Wide Bandgap Devices for Two-Phase Very Low Inductance Machines
Yibin Zhang, Damien Lawhorn, Peng Han, Aaron M. Cramer, Dan M. Ionel
University of Kentucky, United States

Virtual 2

Thursday, October 15 **12:10PM-12:40PM**

S59 | Modelling and Stability of Converters and Systems

Chairs: Ke Ma, Yi Tang

0832 | Soft Startup Strategies for DAB-Based DCX in Composite Converters
Yucheng Gao, Vivek Sankaranarayanan, Robert W. Erickson, Dragan Maksimovic
University of Colorado-Boulder, United States

0530 | Small-Signal Dynamic and High-Bandwidth Design of LLC Resonant Converter
Yi-Hsun Hsieh, Fred C. Lee
Virginia Polytechnic Institute and State University, United States

1013 | Scalable State-Space Model of a Voltage Source Converter for Low-Frequency Stability Analysis
Federico Cecati[1], Rongwu Zhu[1], Marius Langwasser[1], Marco Liserre[1], Xiongfei Wang[2]
[1]Christian-Albrechts-Universität Kiel, Germany; [2]Aalborg University, Denmark

0395 | A Master-and-Slave Resonant Tank Switch approach to Effectively Reduce Frequency Range in LCC Converter
Zhipeng Cheng[1], Han Peng[1], Jimin Chen[1], Yong Kang[1], Jinglin Wu[2], Xu Chu[2]
[1]Huazhong University of Science and Technology, China; [2]United Imaging Healthcare Co., China

0747 | A General Interpolated Model for Voltage Source Converters in Real-Time Simulation and HIL Test Applications
Wei Li, Fei Zhang
OPAL-RT Technologies, Canada

1549 | Holistic Small-Signal Modeling and AI-Assisted Region-Based Stability Analysis of Autonomous AC and DC Microgrids
Yuxi Men[1], Lizhi Ding[1], Yuhua Du[1], Xiaonan Lu[1], Dongbo Zhao[2], Yue Cao[3]
[1]Temple University, United States; [2]Argonne National Laboratory, United States; [3]Oregon State University, United States

0857 | Transfer Learning for Identifying Impedance Estimation in Voltage Source Inverters
Mengfan Zhang[1], Xiongfei Wang[1], Dongsheng Yang[2], Zihao Cui[1], Mads Græsbøll Christensen[1]
[1]Aalborg University, Denmark; [2]Eindhoven University of Technology, Netherlands

0583 | Stability-Oriented Resonant Parameter Design for CLLC-Type Resonant Dual Active Bridge Converter with Swarm Intelligence
Fanfan Lin[1], Xin Zhang[2], Xinze Li[1]
[1]Nanyang Technological University, Singapore; [2]Zhejiang University, China

1000 | AC Impedance Characterization of a PV Inverter with Grid-Forming Control
Rebecca Rye, Rolando Burgos, Ye Tang, Qing Lin, Dushan Boroyevich
Virginia Polytechnic Institute and State University, United States

0298 | Data-Driven based Control Applied to DC Network Converters for Voltage Bus Stabilization
J. Loranca-Coutiño[1], C.V. Villarreal-Hernandez[1], O.F. Ruiz-Martinez[2], J.C. Mayo-Maldonado[1], J.E. Valdez-Resendiz[1], J.C. Rosas-Caro[2], Daniel Guillen[1]
[1]Tecnologico de Monterrey, Mexico; [2]Universidad Panamericana, Mexico

1344 | Analysis and Minimization of Neutral Point Current Deviation in Grid Tied 3-Level NPC Converter under Various Grid Fault Conditions
Jaehoon Choi, Yongsug Suh
Chonbuk National University, Korea

1485 | Small Signal Stability Analysis of Parallel Connected Grid-Tied Inverters with Direct and Self Synchronisation of the Phase Locked Loop
Peishuo Mu, Brendan McGrath, Donald Grahame Holmes, Carlos Teixeira
RMIT University, Australia

1260 | Accurate PWM Model of Multi-Updated L-filtered Voltage-Source Converters
Yangwen Wang, Zheming Jin, Xiongfei Wang
Aalborg University, Denmark

Virtual 3

Thursday, October 15 **12:10PM-12:40PM**

S60 | Multilevel Converter Control

Chairs: Tiefu Zhao, Kyo-Beum Lee

0764 | Dead-Time Effect Compensation of a 5-Level ANPC WBG Inverter for High Power Density Aviation Applications
Dongwoo Han[1], Bokang Zhou[1], Fang Z. Peng[1], Suman Dwari[2]
[1]Florida state University, United States; [2]Raytheon Technologies Research Center, United States

1056 | Dual-Loop High Speed Voltage Balancing Control for High Frequency Four-Level GaN Totem-Pole PFC with Small Flying Capacitors
Qingxuan Ma, Qingyun Huang, Alex Q. Huang
The University of Texas at Austin, United States

1229 | WBG Fractional Power Processing: A New Si-SiC Hybrid Voltage Source Inverter Design
Aritra Kundu, Risha Na, Asim Amir, Yuanfeng Zhou, Ian P. Brown, John Shen
Illinois Institute of Technology, United States

1520 | Hybrid Modulation Method for Nearest-Level-Control-Based MMC to Suppress DC Power Fluctuation when Enabling Circulating Current Suppression
Bin He, Ke Ma, Xikai Xin, Weiyao Wang
Shanghai Jiao Tong University, China

1416 | Improvement of the Commandability Zones of a Modular DC-DC Converter based on a Three-Level Boost Converter
Mohammad Afkar[1], Roghayeh Gavagsaz-Ghoachani[1], Matheepot Phattanasak[2], Jean-Philippe Martin[3], Serge Pierfederici[3]
[1]Shahid Beheshti University, Iran; [2]King Mongkut's University of Technology North Bangkok, Thailand; [3]Université de Lorraine, France

0863 | Indirect Model Predictive Control for a Grid-Tied Three-Level Neutral Point Clamped Converter with an *LCL* Filter
Mattia Rossi[1], Petros Karamanakos[2], Francesco Castelli-Dezza[1]
[1]Politecnico di Milano, Italy; [2]Tampere University, Finland

0014 | New Modulation Technique for Five-Level Interleaved T-Type Inverters for Switching Loss Reduction
Dereje Woldegiorgis, Yuqi Wei, Haider Mhiesan, Alan Mantooth
University of Arkansas, United States

1037 | Multilevel Converter for Variable Speed Medium-Voltage Switched Reluctance Motor Drives
Ahmed Shehada[1], R. Krishnan[2], Abdul R. Beig[1]
[1]Khalifa University, United Arab Emirates; [2]Virginia Polytechnic Institute and State University, United States

Virtual 4

Thursday, October 15 **12:10PM-12:40PM**

S61 | Digital Control Implementation and Testing

Chairs: Issa Batarseh, Daniel Costinett

0203 | A Digital Single Period Control Method for Single-Inductor Dual-Output DC-DC Buck Converter
Daying Sun, Chao Huang, Chong Wang, Cong Xu, Wenhua Gu
Nanjing University of Science and Technology, China

0988 | Control Strategies for a Unified Power Quality Conditioner with Hybrid Energy Storage in a Low-Voltage Distribution Network
Jose M. Piedra[1], Pablo Garcia2, Ramy Georgious[2], Miguel Crespo[3], Gesinne S.L.[1]
[1]Spain; [2]University of Oviedo, Spain; [3]Cegasa Energía, S.L.U., Spain

1199 | Robust Control based on Flatness Properties for a DC-DC Switching Power Converter
Roghayeh Gavagsaz-Ghoachani[1], Matheepot Phattanasak[2], Jean-Philippe Martin[3], Serge Pierfederici[3]
[1]Shahid Beheshti University, Iran; [2]King Mongkut's University of Technology North Bangkok, Thailand; [3]Université de Lorraine, France

0946 | Reduction of Capacitance in Four-Switch Quasi-Switched Boost Inverter using Low-Frequency Ripple Damping Scheme
Pramit Nandi, Ravindranath Adda
Indian Institute of Technology Guwahati, India

0811 | Overall Interleaved Boost Converter Multiple-Objective Optimization Design based on NSGA2 Algorithm
Guanliang Liu, Weiyang Zhou, Qunfang Wu, Mengqi Wang
University of Michigan-Dearborn, United States

1480 | Design Issues for Real-Time PMSM Power-Hardware-in-the-Loop: Analysis at Switching Frequency
L. Bigarelli[1], M. di Benedetto[1], A. Lidozzi[1], F. Crescimbini[1], P.J. Grbović[2]
[1]Roma Tre University, Italy; [2]University of Innsbruck, Austria

1483 | Design Issues for a Real-Time PMSM Power-Hardware-in-the-Loop: Analysis at Fundamental Frequency
L. Bigarelli[1], M. di Benedetto[1], A. Lidozzi[1], L. Solero[1], P.J. Grbović[2]
[1]Roma Tre University, Italy; [2]University of Innsbruck, Austria

1181 | Accurate Small-Signal Discrete-Time Model of Dual Active Bridge using Saltation Matrices
Rahul Mallik, Andrew M. Pace, Samuel A. Burden, Brian Johnson
University of Washington, United States

Virtual 5

Thursday, October 15 **12:10PM-12:40PM**

S62 | Electric Drivetrains

Chairs: Prerit Pramod, Taehyung Kim

0624 | Optimum PWM Switching Mode Selection of Dual Inverter-Fed Open Winding IPMSM Drive System for High-Power Premium Class EV
Hiroaki Matsumori[1], Yuki Makimura[1], Soshi Morishita[1], Yuto Maeda[1], Takashi Kosaka[1], Naoto Saito[2], Yoshinobu Ito[2], Subrata Saha[2], Nobuyuki Matsui[1]
[1]Nagoya Institute of Technology, Japan; [2]Aisin-AW Co., Ltd., Japan

1433 | Discrete-Time Torque Control of High-Speed SPM Machine for Aircraft Electric Propulsion
Hao Zeng, James Swanke, Dheeraj Bobba, Bulent Sarlioglu, Thomas M. Jahns
University of Wisconsin-Madison, United States

0937 | An Improved Direct Torque Control with Battery Power Management of Open-End Winding Induction Motor Drive for Electric Vehicles
Utkal Ranjan Muduli[1,2], Abdul R. Beig[2], Khaled Al Jaafari[2], Jamal Y. Alsawalhi[2], Ranjan Kumar Behera[1]
[1]Indian Institute of Technology Patna, India; [2]Khalifa University, United Arab Emirates

1452 | Comparison of IGBT and SiC Inverter Loss for 400V and 800V DC Bus Electric Vehicle Drivetrains
Alexander Allca-Pekarovic[1], Phillip J. Kollmeyer[1], Parisa Mahvelatishamsabadi[1], Tissa Mirfakhrai[2], Payam Naghshtabrizi[2], Ali Emadi[1]
[1]McMaster University, Canada; [2]Eaton Research Laboratories, United States

0076 | Control of Boost Converter Module for Open-End Winding Permanent Magnet Motor Based, Dual Inverter Drive
Ryan Brody, Brandon M. Grainger
University of Pittsburgh, United States

1282 | Half Bridge Sub-module Based Modular Multilevel Converter in 50Hz/50Hz Railway Continuous Co-phase Power Supply Application
Ziming Li[1], Xiaoqian Li[1], Yingdong Wei[1], Chao Lu[1], Zhuoxuan Shen[1], Yunzhi Lin[2], Zengqin Li[3]
[1]Tsinghua University, Dept. of Electrical Eng., China; [2]China Railway Electrification Engineering Group, China; [3]China Railway Electric Industry Co., Ltd, China

1270 | A Turboelectric Distributed Propulsion based on Brushless Doubly-Fed Machines
Peng Peng[1], Julia Zhang[1], Adam Brugmann[2], Lloyd Utt[2], Xiaodan Wang[1], Eric Kline[2], Longya Xu[1], Jin Wang[1], Boxue Hu[1]
[1]The Ohio State University, United States; [2]Safran Group, United States

0305 | Modeling of Negative Resistance Converter Traction Power System
Zhan Shang, Xiaofeng Yang, Jingda Gu, Trillion Q. Zheng
Beijing Jiaotong University, China

0976 | On-Line Detection of Dc Arc Faults using Hurst Exponents for Hybrid-Electric Vehicles
Benjamin Shaffer[1], Yousef Abdullah[1], Jin Wang[1], Babak Arfaei[2], Matt Volpone[2]
[1]Ohio State University, United States; [2]Ford Motor Co., United States

0493 | Disturbance Rejection Ability Enhancement using a Repetitive Observer in Phase-Locked Loop for More Electric Aircraft
Mi Tang[1], Stefano Bifaretti[2], Sabino Pipolo[1], Andrea Formentini[1], Shafiq Odhano[3], Pericle Zanchetta[1,4]
[1]University of Nottingham, United Kingdom; [2]University of Rome Tor Vergata, Italy; [3]University of Newcastle, United Kingdom; [4]University of Pavia, Italy

0819 | Machine Learning Enabled Fast Multi-Objective Optimization for Electrified Aviation Power System Design
Derek Jackson[1], Syrine Belakaria[2], Yue Cao[1], Janardhan Rao Doppa[2], Xiaonan Lu[3]
[1]Oregon State University, United States; [2]Washington State University, United States; [3]Temple University, United States

1115 | Recoverability of Shipboard MVdc Architectures
Jacob Gudex, Mark Vygoder, Rounak Siddaiah, Robert Cuzner
University of Wisconsin-Milwaukee, United States

POSTER SESSIONS

The following Digital Poster Sessions are all video on demand.
See live "meet the author" times in the Live/Simu-Live Session Schedules.

Virtual 1

Tuesday, October 13 **9:00AM-9:30AM**

P1 | NVH, Reliability and Machine Diagnostics

Chairs: Jose Antonino-Daviu, Francisco Paz

0688 | Irreversible Demagnetization Fault Prognosis in a Permanent Magnet Type Machines
Zia Ullah, Jin Hur
Incheon University, Korea

0688 | Online Detection of Irreversible Demagnetization Fault with Non-Excited Phase Voltage in Brushless DC Motor Drive System
Doo-Ho Kim, Jun-Hyuk Im, Ullah Zia, Jin Hur
Incheon National University, Korea

0043 | Insulation Design of a High Frequency Electrical Machine for More Electric Aircraft Propulsion
Yalin Wang[1], Xuan Yi[2], Xiaolong Zhang[2], Yi Yin[1], Tao Han[1], Kiruba Haran[2]
[1]Shanghai Jiao Tong University, China; [2]University of Illinois at Urbana-Champaign, United States

0458 | Vibration Prediction using the Relative Permeance of IPMSM
Seung-Hyeon Lee[1], In-Jun Yang[1], Won-Ho Kim[1], Ik Sang Jang[2]
[1]Gachon University, Korea; [2]Hyundai Mobis, Korea

1422 | Stray Flux-Based Incipient Stage Bearing Fault Detection for Induction Machines via Noise Cancellation Techniques
Genyi Luo[1], Thomas G. Habetler[1], Jed Hurwitz[2]
[1]Georgia Institute of Technology, United States; [2]Analog Devices, Inc., United Kingdom

0446 | Investigation of Mode 0 Acoustic Noise Reduction of Interior Permanent Magnet Motor with a Principle of Radial Force Sum Flattening
Leping Wang, Ryo Umeoka, Akira Chiba
Tokyo Institute of Technology, Japan

0363 | Winding Condition Monitoring of Inverter-Fed PMSM using High-Frequency Current Injection
Zheng Xu, Jianzhong Zhang, Yaqian Zhang, Jin Zhao
Southeast University, China

1534 | Wide Speed Range NVH Performance Optimization in Permanent Magnet Synchronous Machines for Automotive Application using Vibration Synthesis
Shuvajit Das[1], Anik Chowdhury[1], Zhao Wan[2], Mojtaba Bahrami Kouhshahi[2], Alejandro Pina Ortega[2], Yilmaz Sozer[1]
[1]The University of Akron, United States; [2]Nexteer Automotive, United States

0642 | Design of Experiments for Stator Windings Insulation Degradation under High dv/dt and High Switching Frequency
Fernando Alvarez-Gonzalez[1], David Hewitt[1], Antonio Griffo[1], Jiabin Wang[1], Mohamed Diab[2], Xibo Yuan[2]
[1]The University of Sheffield, United Kingdom; [2]University of Bristol, United Kingdom

0299 | Detection of Early Inter-Turn Stator Faults in Induction Motors via Symmetrical Components – Current vs Stray Flux Analysis
Konstantinos N. Gyftakis
University of Edinburgh, United Kingdom

1533 | Sensitivity Analysis based NVH Performance Evaluation in Permanent Magnet Synchronous Machines using Lumped Unit Force Response
Shuvajit Das[1], Anik Chowdhury[1], Zhao Wan[1], Mojtaba Bahrami Kouhshahi[2], Alejandro Pina Ortega[2], Yilmaz Sozer[1]
[1]The University of Akron, United States; [2]Nexteer Automotive, United States

0425 | Remote Monitoring and Diagnostics of Blade Health in Commercial MW-Scale Wind Turbines using Electrical Signature Analysis (ESA)
Lijun He[1], Mohammad Attia[2], Liwei Hao[1], Biao Fang[1], Karim Younsi[1], Honggang Wang[1]
[1]GE Research, United States; [2]GE Renewable Energy, United States

Virtual 2

Tuesday, October 13 **9:00AM-9:30AM**

P2 | EV Charging Infrastructure

Chairs: Mohammed Alam, Rashmi Prasad

0790 | Medium Voltage Contactless Power Transfer for EV Fast Charging
Isaac Wong, Suvendu Samanta, Subhashish Bhattacharya
North Carolina State University, United States

0149 | Research on 11kW Wireless Charging System for Electric Vehicle based on LCC-SP Topology and Current Doubler
Yunhui Wang[1], Meng Xiong[1], Xun Wang[1], Qile Li[2], Zhao Jiang[2], Xuezhe Wei[1], Haifeng Dai[1]
[1]Tongji University, China; [2]Ningbo Preh Joyson Automotive Electronics, China

0717 | A Sensorless Coil Detection Scheme based on Dead-Time Effect in Dynamic Wireless Power Transfer Systems
Utkarsh D. Kavimandan[1], Veda P. Galigekere[2], Burak Ozpineci[2], Jason Pries[2], Omer Onar[2], Satish M. Mahajan[1]
[1]Tennessee Technological University, United States; [2]Oak Ridge National Laboratory, United States

1047 | Vehicle-to-Vehicle Inductive Power Transfer: Design Analysis and Topology Selection
Van Thuan Nguyen[1], Van Binh Vu[2], Vaibhav Uttam Pawaskar[1], Rakesh Krishna Katakam[1], Ghanshyamsinh Gohil[1]
[1]The University of Texas at Dallas, United States; [2]Newcastle University, United Kingdom

1524 | Shield Design for 50 kW Three-Phase Wireless Charging System
Mostak Mohammad, Jason L. Pries, Omer C. Onar, Veda P. Galigekere, Gui-Jia Su
Oak Ridge National Laboratory, United States

0058 | An Automated Component-Based Hardware Design of a Three-Phase Dual-Active Bridge Converter for a Bidirectional On-Board Charger
Ryota Kondo[1], Philipp Schülting[2], Arne Hendrik Wienhausen[2], Rik W. De Doncker[2]
[1]Mitsubishi Electric Corp., Japan; [2]RWTH Aachen University, Germany

0872 | An Improved PQ Zeta Converter with Reduced Switch Voltage Stress for Electric Vehicle Battery Charger
Radha Kushwaha[1], Bhim Singh[1], Vinod Khadkikar[2]
[1]Indian Institute of Technology Delhi, India; [2]Khalifa University-Abu Dhabi, United Arab Emirates

0865 | Dynamic Process Analysis of a High-Power Bidirectional DC/DC Converter for Electric Vehicles
Liyan Zhu[1], Hua (Kevin) Bai[1], Alan Brown[2], Matt McAmmond[2]
[1]The University of Tennessee-Knoxville, United States; [2]Hella Electronics Corp., United States

0902 | Improved Power Quality Charging System based on High Step Down Gain Bridgeless SEPIC APFC for Light Electric Vehicles
Jitendra Gupta[1], Radha Kushwaha[1], Bhim Singh[1], Vinod Khadkikar[2]
[1]Indian Institute of Technology Delhi, India; [2]Khalifa University, United Arab Emirates

1252 | Reducing the Impact of Plug-In Electric Vehicles on Distribution Transformers
Akansha Jain, Masoud Karimi-Ghartemani
Mississippi State University, United States

0100 | Design and Control of OBC-LDC Integrated Circuit with Variable Turns Ratio for Electric Vehicles
Issac Kim, Sunho Lee, Jung-Wook Park
Yonsei University, Korea

0787 | High Frequency AC Power Distribution Network for Electric Vehicle Auxiliary Electrical System
Qunfang Wu[1], Mengqi Wang[1], Weiyang Zhou[1], Yanghe Liu[2]
[1]University of Michigan-Dearborn, United States; [2]Toyota Research Institute North America, United States

0032 | Electric Vehicle (EV) Chassis Dynamometer Testing
Annette von Jouanne, Jimi Adegbohun, Ryan Collin, Madeline Stephens, Brian Thayil, Caleb Li, Emmanuel Agamloh, Alex Yokochi
Baylor University, United States

0894 | Estimation of Peukert Constant of Lithium-Ion Batteries and its Application in Battery Discharging Time Prediction
Yadong Gong, Xiaoyong Zhang, Heng Li, Hongtao Liao, Zhiqiang Meng, Yongjie Liu, Zhiwu Huang
Central South University, China

Virtual 3

Tuesday, October 13 **9:00AM-9:30AM**

P3 | DC-DC Converters 1

Chairs: Manuel Arias, Hidemine Obara

1379 | Intercell Transformer Coupled Buck Converter in One-of-Three Rectifier
Yuxiang Shi, Jing Xu, Goran Mandic, Sandeep Bala
ABB US Corporate Research Center, United States

1224 | A Merged-Two-Stage LEGO-PoL Converter with Coupled Inductors for Vertical Power Delivery
Youssef Elasser, Jaeil Baek, Minjie Chen
Princeton University, United States

0115 | High Step-Down ZCS Buck Converter with Switched Capacitor
Jingjing Qi[1], Xuezhi Wu[1], Yuming Zhao[2], Jingdou Liu[2]
[1]Beijing Jiaotong University, China; [2]Shenzhen Power Supply Co., China

1550 | A Quasi Output Voltage Regulation Technique for the Zero Inductor-Voltage Converter
Samuel Webb, Yan-Fei Liu
Queen's University, Canada

0239 | Loss Model and Output Impedance Analysis of a 48V-to-1V High Current Point-of-Load Converter
Alexander Fiore, Qingyun Huang, Alex Q. Huang
The University of Texas-Austin, United States

0567 | Comparative Topology and Power Loss Analysis on 48V-to-1V Direct Step-Down Non-Isolated DC-DC Switched-Mode Power Converters
Jin Woong Kwak, D. Brian Ma
The University of Texas at Dallas, United States

0924 | Pre-Charge, Discharge, and Mini-UPS Circuits in Auxiliary Power Network Architecture for 10 kV SiC-Based Power Electronics Building Blocks
Keyao Sun, Jun Wang, Xiang Lin, Rolando Burgos, Dushan Boroyevich
Virginia Polytechnic Institute and State University, United States

1338 | Synthesizing a Comprehensive Set of Converter Topologies for a Specified Voltage Gain
Ramanuja Panigrahi, Santanu K. Mishra, Avinash Joshi
Indian Institute of Technology Kanpur, India

0844 | Low-Ripple High-Voltage DC Generation using a Serially Segmented Multiphase Voltage Multiplier
Sanghyeon Park, Juan Rivas-Davila
Stanford University, United States

0841 | Modulation Strategy to Minimise RMS and Peak Currents in Dual Active Bridge Converter
Dibakar Das, Kaushik Basu
Indian Institute of Science, India

Virtual 4

Tuesday, October 13 **9:00AM-9:30AM**

P4 | Emerging Technologies and Applications

Chairs: Huai Wang, Mark J Scott

0591 | A Planar PCB based Energy Harvester with Voltage Multiplier
Yong Chen, Han Peng, Zhijie Feng, Zhipeng Cheng, Qiaoling Tong, Yong Kang
Huazhong University of Science and Technology, China

1081 | Embedded Implementation of Rainflow-Counting for On-Line Predictive Maintenance
Carlo Concari, Giada Bettini
University of Parma, Italy

0646 | A Ground Clamped Solid-State Circuit Breaker for DC Distribution Systems
Tiancan Pang, Muhammad Foyazur Rahman, Madhav D. Manjrekar
University of North Carolina-Charlotte, United States

1441 | A Dynamic Efficiency Optimization Method under ZVS Conditions in the Series-Series Type Wireless Power Transfer System
Yongbin Jiang, Xipei Yu, Chenxu Zhao, Ruibang Li, Min Wu, Longyang Yu, LaiLi Wang
Xi'an Jiaotong University, China

0986 | A Three Stage Architecture for a High Voltage Step-Down Wireless Charging System
Apurv Kumar Yadav, Arun Sankar, Alireza Khaligh
University of Maryland, United States

1209 | Analysis and Design Considerations of a Compact Transmitter Topology in Low Power Wireless Power Transfer System with Extremely Low Coupling Factor
S. Zhang
Power Electronics, United States

0288 | Application of SWPDT in the Feedback Control of Wireless EV Charging
Hao Chen, Zeqian Cheng, Zhongnan Qian, Jiande Wu, Xiangning He
Zhejiang University, China

0658 | Modelling and Analysis of Total Harmonic Distortion in Series-Series Wireless Power Transfer System for 6.78 MHz
Lixin Shi, J.C. Rodriguez, Pedro Alou
Universidad Politécnica de Madrid, Spain

0117 | Transferring Driving Pulses to Implement Dual-Side Phase-Shift Control of Wireless Power Transfer on Primary Side using Driving Windings
Yiming Zhang, Xin Li, Shuxin Chen, Yi Tang
Nanyang Technological University, Singapore

0330 | A Study of High Electrical Power and High Efficiency Antenna in 13.56 MHz Wireless Power Transfer
Masanori Watanabe, Kan Akatsu
Shibaura Institute of Technology, Japan

1513 | Transmitter Coil Design for Multi-Load Wireless Power Transfer Systems
Jie Li, Jingjing Sun, Ruiyang Qin, Daniel Costinett
The University of Tennessee, United States

0053 | Design and Implementation of Paralleled Inverters with *LCLC* Resonant Tanks to Generate Plasma for Surface Treatment Applications
Tsai-Fu Wu, Anumeha Kumari, Ling-Chia Yu, Kuan-Chung Chen
National Tsing Hua University, Taiwan

Virtual 1

Tuesday, October 13 **9:35AM-10:05AM**

P5 | Electric Machines Materials, Losses, Thermal, Manufacturing, Modelling Issues

Chairs: Rajeev Vyas, Edwin Xiaki Sun

1200 | A Simplified Efficiency Estimation approach for Converter-Fed Induction Motors
John Mushenya, Azeem Khan, Paul Barendse
University of Cape Town, South Africa

1602 | Multilayer Bonded Magnets in Surface-Mounted PM Synchronous Machines
Mostafa Ahmadi Darmani, Emir Poskovic, Silvio Vaschetto, Fausto Franchini, Luca Ferraris, Andrea Cavagnino
Politecnico di Torino, Italy

0407 | Loss Modeling for Interlocked Magnetic Cores
Zbigniew Gmyrek[1], Andrea Cavagnino[2], Silvio Vaschetto[2], Gerd Bramerdorfer[3]
[1]Lodz University of Technology, Poland; [2]Politecnico di Torino, Italy; [3]Johannes Kepler University Linz, Austria

1091 | Modeling of the Temperature Dependence of Soft Magnetic Material
Gereon Goldbeck[1], Gerd Bramerdorfer[1], Wolfgang Amrhein[1], Josef Hinterdorfer[2], Bernhard Weiß
[1]Johannes Kepler University Linz, Austria; [2]Voestalpine Stahl GmbH, Austria

0660 | Off-Line Efficiency Mapping of Induction Motors Operated in Wide Torque-Speed Ranges
Ornella Stiscia, Sandro Rubino, Silvio Vaschetto, Andrea Cavagnino, Alberto Tenconi
Politecnico di Torino, Italy

0979 | Winding Embedded Liquid Cooling for High Power Density Slotless Motor
Ritvik Chattopadhyay[1], Md Sariful Islam[1], Rajib Mikail[2], Iqbal Husain[1]
[1]North Carolina State University, United States; [2]ABB US Corporate Research Center, United States

1539 | Multi-Physics Analysis to Effectively Evaluate Thermal Performance of Liquid-Cooled Electric Machines
Abdul Wahab Bandarkar[1], Md Tawhid Bin Tarek[1], Lavanya Vadamodala[1], Yilmaz Sozer[1], David Colavincenzo[2], Fernando Venegas[2], Jeffrey Geither[2]
[1]The University of Akron, United States; [2]Bendix Commercial Vehicle Systems, United States

0801 | Coupled Electromagnetic and Thermal Optimisation Strategies for Direct-Drive Linear Permanent Magnet Synchronous Motors
Soroosh Haji Hosseinnejad[1], Thor F. Besier[2], Andrew J. Taberner[2], Bryan P. Ruddy[2]
The University of Auckland, New Zealand

0918 | Thermal Modelling of a Permanent Magnet Synchronous Machine through FEM Simulation with Experimental Validation
Alejandro L. Rodriguez[1], Patrick Lombard[1], Vincent Leconte[1], Philippe Wendling[1], Irma Villar[2]
[1]Altair Engineering France, France; [2]Basque Research and Technology Alliance, Spain

0423 | Analysis of Axial Temperature Variation Effect on the Performance of Five-Phase Permanent Magnet Assisted Synchronous Reluctance Motor
Md. Khurshedul Islam, Seungdeog Choi
Mississippi State University, United States

0070 | Physically Meaningful Linear Electric Machine Frequency Analysis and Modeling Technique without a Constant Speed Assumption
Austin E.N. Gaspar
University of Wisconsin-Madison, United States

Virtual 2

Tuesday, October 13 **9:35AM-10:05AM**

P6 | Direct Drive, Actuators, Magnetic Gearing, Axial Flux, Non-Conventional Machines

Chairs: Udochukwu Akuru, Lijian Wu

0441 | Eddy Current Loss Reduction in 3D-Printed Axial Flux Motor using 3D-Printed SMC Core
Hyun-Jo Pyo[1], Jae Won Jeong[2], Jihun Yu[2], Dong-Woo Nam[1], Seo-Hee Yang[1], Won-Ho Kim[1]
[1]Gachon University, Korea; [2]Korea Institute of Material Science, Korea

0454 | Basic Characteristics of an Axial-Gap Type Magnetic Resonant Coupling Machine with Different Numbers of Poles
Kazuto Sakai, Takanobu Akiyama
Toyo University, Japan

0897 | A Robust Position Control System based on Load Force Observer for RotLin Machine
Lang Bu, Yasutaka Fujimoto
Yokohama National University, Japan

0907 | A Motor Design based on Wireless Magnetic Resonance Coupling Technology
Besong John Ebot, Yasutaka Fujimoto
Yokohama National University, Japan

0174 | Design and Testing of a High Force Density Linear Electromagnetic Actuator
Zhengmeng Liu, Jiabin Wang
The University of Sheffield, United Kingdom

0871 | Design and Analysis of a Vernier Motor Considering Series Compensation
Abdur Rehman, Byungtaek Kim, Young Hoon Joo
Kunsan National University, Korea

1109 | Comparative Analysis of Outer-Rotor Flux-Modulated Permanent Magnet Generator Topologies
John Mushenya, Azeem Khan
University of Cape Town, South Africa

0498 | Analysis and Optimization of Radial Flux Modular Stator Permanent Magnet Synchronous Machines
Werner Jara[1], Gerd Bramerdorfer[2], Carlos Madariaga[1], Javier Riedemann[1], Juan Tapia[3], Gordan Segon[4], Werner Koppelstätter[4], Siegfried Silber[4]
[1]Pontificia Universidad Catolica, Chile; [2]Johannes Kepler University Linz, Austria; [3]University of Concepcion, Chile; [4]Linz Center of Mechatronics, Austria

0956 | Analysis of a Five-Phase PM Vernier Machine Topology with Two-Slot Pitch Winding
Shaohong Zhu, Tom Cox, Zeyuan Xu, Chris Gerada
University of Nottingham, United Kingdom

Virtual 3

Tuesday, October 13 **9:35AM-10:05AM**

P7 | DC-DC Converters 2

Chairs: Grant Pitel, Luca Solero

0467 | A Wide Range Output Voltage Gain Operation with Mode Transition of Single Input Dual Output LLC Converter
Yuki Kinoshita, Hitoshi Haga
Nagaoka University of Technology, Japan

1495 | ZVS Analysis of Half Bridge LLC-DCX Converter Considering the Influence of Resonant Parameters and Loads
Guoliang Deng, Yao Sun, Guo Xu, Xiaoying Chen, Shiming Xie, Shutian Yan, Mei Su, Yuefeng Liao
Central South University, China

1038 | LLC Resonant Converter with Reconfigurable Voltage Rectifier for Wide Input Voltage Applications
Fahad Alaql, Issa Batarseh
University of Central Florida, United States

1046 | Review and Comparison of Resonant DC-DC Converters for Wide-Output Voltage Range Applications
Fahad Alaql, Issa Batarseh
University of Central Florida, United States

0512 | Multiple-Output LLC Resonant Converter with Magnetic Control
Yuqi Wei[1], Quanming Luo[2], Dereje Woldegiorgis[1], Alan Mantooth[1]
[1]University of Arkansas, United States; [2]Chongqing University, China

0110 | Comparison of a Dual Active Bridge and CLLC Converter for On-Board Vehicle Chargers using GaN and Time Domain Modeling Method
Konstantin Siebke, Regine Mallwitz
Technische Universität Braunschweig, Germany

0693 | Efficiency Optimization of Dual Active Bridge DC-DC Converter with Triple Phase-Shift Control
Garry Jean-Pierre[1], Necmi Altin[2], Ahmad El Shafei[1], Adel Nasiri[1]
[1]University of Wisconsin-Milwaukee, United States; [2]Gazi University, Turkey

0935 | An Optimized Scheme for Current Stress Reduction with Zero-Voltage Switching in Dual-Active-Bridge Converters under Varying Input Voltage
Haoyu Zhang, Motoki Akihiro, Tomoyuki Mannen, Takanori Isobe
University of Tsukuba, Japan

1478 | Hardware Design of SiC-Based Four-Port DAB Converter for Fast Charging Station
M. di Benedetto[1], A. Lidozzi[1], L. Solero[1], F. Crescimbini[1], S. Bifaretti[2]
[1]Roma Tre University, Italy; [2]Tor Vergata University, Italy

0825 | Integrated Planar Transformer Design of 3-kW Auxiliary Power Module for Electric Vehicles
Ramadhan Muhammad[1], Sangjin Kim[1], Chaeyoung Suk[1], Sewan Choi[1], Byeongu Yu[2], Sanghun Park[2]
[1]Seoul National University of Science and Technology, Korea; [2]LG Electronics, Korea

1501 | Design and Optimization of a High Power Density Low Voltage DC-DC Converter for Electric Vehicles
Yang Chen, Wenbo Liu, Andrew Yurek, Xiang Zhou, Bo Sheng, Yan-Fei Liu
Queen's University, Canada

0746 | Modulation Strategy for a Multilevel DC-DC Converter Interfacing EV Battery and Propulsion Inverter during Regenerative Mode
Vinay Rathore[1], Kaushik Rajashekara[1], Parthasarathy Nayak[2]
[1]University of Houston, United States; [2]Emerson Commercial and Residential Solutions, United States

0524 | A Novel Topology for an Extendable Isolated DC-DC Multi-Port Power Converter with a Multipurpose Hybrid Energy Storage System
Sina Vahid, Ayman El-Refaie
Marquette University, United States

0104 | A Family of High Frequency Isolated Impedance Source DC-DC Converters for Distributed Power Generation Systems
Zeeshan Aleem, Hyoung-Kyu Yang, Jung-Wook Park
Yonsei University, Korea

0791 | High Frequency Active-Clamped Zero-Current Switching Current-Fed Push-Pull Converter for Micro-Converter Applications
Qunfang Wu[1], Mengqi Wang[1], Weiyang Zhou[1], Can Huang[2], Guanliang Liu[1], Xiaoming Wang[3]
[1]University of Michigan-Dearborn, United States; [2]Lawrence Livermore National Laboratory, United States; [3]Somion Global LLC, United States

Virtual 4

Tuesday, October 13 **9:35AM-10:05AM**

P8 | Converters for AC and DC Microgrids

Chairs: Ali Marzoughi, Qiang Wei

1232 | A 4kV/100A SiC MOSFETs-Based Solid State DC Circuit Breaker with Low Stray Inductances and Powered by a Load-Independent Wireless Power Transfer System
Zhonghao Dongye[1], Yao Wang[1], Hua Zhang[1], Sheng Zheng[2], Xiaonan Lu[3], Fei Lu[1]
[1]Drexel University, United States; [2]Oak Ridge National Laboratory, United States; [3]Temple University, United States

1305 | A Distributed approach for Secondary and Tertiary Layer Control in DC Microgrids
Ashray Manur, Maitreyee Marathe, Giri Venkataramanan
University of Wisconsin-Madison, United States

1392 | Current Derivative Assisted Protection Coordination System for Faster Fault Isolation in a Radial DC Microgrid
Md Rifat Kaisar Rachi, Mehnaz Akhter Khan, Iqbal Husain
North Carolina State University, United States

0804 | A Dynamic Diffusion Algorithm for Distributed Secondary Control of DC Microgrids
Dawei Liao[1], Fei Gao[1], Yutong Zhao[1], Daniel Rogers[2]
[1]Shanghai Jiao Tong University, China; [2]University of Oxford, United Kingdom

1146 | A New approach for Hybrid AC-DC Circuit Fault Analysis
Mohammad Mehdi Rezvani, Shahab Mehraeen
Louisiana State University, United States

0850 | Modular Hybrid DC Circuit Breaker for Medium-Voltage DC System
Dong-Uk Kim, Sungmin Kim
Hanyang University, Korea

0744 | A Rule based EMS for Fast Charging Station with CHIL Implementation
Dhruv Kler, Asal Zabetian Hosseini, Sony Varghese, Chu Sun, Geza Joos
McGill University, Canada

1048 | Impedance Estimator for Multi-Source DC Microgrids with Islanding Detection Capabilities
Cristian Blanco, Pablo Garcia, Andres Suarez, Irene Pelaez
University of Oviedo, Spain

0125 | An Emulation Platform for Mimicking Unbalanced Loads and Sources
A.S. Vijay, Suryanarayana Doolla, Mukul C. Chandorkar
Indian Institute of Technology-Bombay, India

0805 | An Improved Distributed Secondary Control Scheme for Islanded AC Microgrids
Jiahao Yu, Fei Gao, Shanshan Wei, Junzhong Xu, Dawei Liao, Yutong Zhao
Shanghai Jiaotong University, China

0818 | Distributed Averaging Optimization-Based Technique for Microgrid Secondary Control
Fahad Alshammari, Ayman El-Refaie
Marquette University, United States

Virtual 1

Tuesday, October 13 **10:10AM-10:40AM**

P9 | Electric Machines (IPMSM and Synchronous Reluctance)

Chairs: Takashi Kosaka, Ignacio Galiano

0762 | Induction Motor Performance Prediction using Static FEA: Method Description and Comparison with Time-Domain Approach
Matteo Carbonieri[1], Lino Di Leonardo[2], Marco Tursini[2], Marco Villani[2], Mircea Popescu[3]
[1]University of Padova, Italy; [2]University of L'Aquila, Italy; [3]Motor Design Ltd., United Kingdom

1361 | Influence of Airgap Length on Performance of High Power PM-Assisted Syn-Rel Machines
Tianjie Zou[1], David Gerada[1], Adam Walker[1], Gaurang Vakil[1], Salvatore La Rocca[1], Antonino La Rocca[1], Krzysztof Paciura[2], Richard Barden[2], Emil Ernest[2], Shaohong Zhu[2], Naila Qayyum[2], Alastair McQueen[2], Anuvav Bardalai[1], R.M. Ram Kumar[1], Alessandro Marfoli[1], Chris Gerada[1]
[1]University of Nottingham, United Kingdom; [2]Cummins Corporate R&T, United Kingdom

0463 | Improvement in Torque Density by Ferrofluid Injection into Interior Permanent Magnet Synchronous Motor
In-Jun Yang[1], Seung-Hyeon Lee[1], Dong-Ho Kim[2], Kwang-Soo Kim[3], Ik Sang Jang[4], Won-Ho Kim[1]
[1]Gachon University, Korea; [2]Hanyang University, Korea; [3]Halla University, Korea; [4]Hyundai Mobis, Korea

0613 | Design of High-Speed Wet-Type Permanent Magnet Synchronous Motor Considering Oil Frictional Loss
Wenbo Jin, Hong Guo, Jinquan Xu
Beihang University, China

1194 | Experimental Test on Dual Three-Phase Synchronous Reluctance Motor
Jun-Kyu Park[1], Chaelim Jeong[2], Alberto Bellini[3], Claudio Bianchini[4], Nicola Bianchi[2]
[1]Korea Electrotechnology Research Institute, Korea; [2]University of Padova, Italy; [3]University of Bologna, Italy; [4]University of Modena and Reggio Emilia, Italy

0882 | The Study on Improving Reluctance Torque and Preventing Irreversible Demagnetization by Modified the Shape of Conventional Ferrite Flux-Concentrated Motor
Min-Jae Jeong[1], Hyun-Jo Pyo[1], Dong-Woo Nam[1], Seo-Hee Yang[1], KangBeen Lee[2], Won-Ho Kim[1]
[1]Gachon University, Korea; [2]Hyundai Kia Namyang Institute, Korea

1538 | Design Optimization of a Novel Axial Flux Ferrite Magnet Assisted Synchronous Reluctance Motor
Md Tawhid Bin Tarek, Yilmaz Sozer
The University of Akron, United States

1279 | Magneto-Structural Combined Dimensional and Topology Optimization of Interior Permanent Magnet Synchronous Machine Rotors
Feng Guo, Ian P. Brown
Illinois Institute of Technology, United States

0403 | Detection Technique for Manufacturing Imperfection of Rare-Earth Magnets on IPMSM
Deok-Jae Kwon, Jun-Hyuk Im, Mudassir Raza Siddiqi, Jin Hur
Incheon National University, Korea

0966 | Finite Element-based Multi-objective Design Optimization of IPM Considering Saturation Effects for Constant Power Region of Operation
Qingqing Ma, Ayman El-Refaie
Marquette University, United States

1171 | A Unified Model for Field Weakening Operation of Synchronous AC Machines
Dheeraj Bobba, Bulent Sarlioglu
University of Wisconsin-Madison, United States

0761 | Simple Robust Rotor 5 MW Synchronous Reluctance Generator
Jandré Dippenaar, Maarten J. Kamper
Stellenbosch University, South Africa

0417 | Parameter Measurements and Modeling of a Novel Hybrid Variable Flux Machine with Series Rare-Earth and AlNiCo Magnets
Rajendra Thike, Pragasen Pillay
Concordia University, Canada

1184 | Hybrid Excitation Method for Higher Pole Number Grid-Tie Synchronous Generators
Dillan K. Ockhuis, Maarten J. Kamper, Andrew T. Loubser
Stellenbosch University, South Africa

Virtual 2

Tuesday, October 13 **10:10AM-10:40AM**

P10 | Transportation Electrification and Battery Management Systems

Chairs: Hassan Hossam Hassan Eldeeb, Rafael Pena Alzola

0147 | Position Sensorless PMSM Drive for Solar PV-Battery Light Electric Vehicle with Regenerative Braking Capability
Sreejith R., Bhim Singh
Indian Institute of Technology Delhi, India

0091 | A Comparative Study of Technologies for Wayside Energy Storage in DC Rail Transportation Systems
Oindrilla Dutta, Ahmed Mohamed
City College of New York, United States

0905 | Short Current Protection Circuit for Automotive Motor Inverters Application based on GaN Transistors
Jacob Parnes, David Shapiro, Gleb Vetakh, Yuri Gitelmakher, Gregory Bunin
VisIC Technologies, Israel

0773 | Speed Planning for Autonomous Driving in Dynamic Urban Driving Scenarios
Mingqiang Wang[1], Zhenpo Wang[1], Lei Zhang[1], D.G. Dorrell[2]
[1]Beijing Institute of Technology, China; [2]University of Witwatersrand, South Africa

0540 | Active Voltage Balancing of Integrated Modular Drive with Series DC-Link Capacitors
Fan Wu[1], Ayman M. El-Refaie[1], Thomas M. Jahns[2]
[1]Marquette University, United States; [2]University of Wisconsin-Madison, United States

1287 | Four-Port Modular Multilevel AC/AC Converter in Continuous Co-Phase Traction Power Supply Application
Mingrui Li[1], Xiaoqian Li[1], Yunzhi Lin[2], Yingdong Wei[1], Chao Lu[1], Zhuoxuan Shen[1], Ziming Li[1], Zengqin Li[3]
[1]Tsinghua University, China; [2]China Railway Electrification Engineering Group, China; [3]China Railway Electric Industry Co., Ltd, China

1110 | Stray Inductance-Based Current Sensing Considering Temperature-Dependent DCR Effect
Sang Min Kim, Taesuk Kwon
Hyundai Mobis, Korea

0235 | Zero-Sequence Current Control in a Back to Back Inverter with Pump Back Test Configuration
Yuzhi Zhang[1], Zhongjing Wang[2], Yu Du[1]
[1]ABB Corporate Research Center, United States; [2]University of Arkansas, United States

0575 | A Two-Stage Multiple-Output Automotive LED Driver Architecture
Satyaki Mukherjee[1], Alihossein Sepahvand[2], Vahid Yousefzadeh[2], Montu Doshi[2], Dragan Maksimović[1]
[1]University of Colorado, United States; [2]Texas Instruments, Inc., United States

0138 | Integrated Motor and Two-Speed Gearbox Powertrain System Development for Electric Vehicle
Puhui Liu, Shun Feng
New Energy Vehicle Propulsion Engineering Center, China

0671 | Energy Loss Analysis in a SiC/IGBT Propulsion Inverter over Drive Cycles Considering Blanking Time, MOSFET's Reverse Conduction and the Effect of Thermal Feedback
Sepideh Amirpour[1], Torbjörn Thiringer[2], Dan Hagstedt[1]
[1]China Euro Vehicle Technology AB, Sweden; [2]Chalmers University of Technology, Sweden

0895 | Sizing of DC-Link Capacitor Considering Voltage and Current Ripple Requirements for a 3-Phase Voltage Source Inverter
Ali Safayet, Mohammad Islam, Tomy Sebastian
Halla Mechatronics, United States

0729 | Evaluation of Parameter Variations of Equivalent Circuit Model of Lithium-Ion Battery under Different SOH Conditions
Zhiyong Xia, Jaber A. Abu Qahouq
University of Alabama, United States

0098 | A Novel Neural Network with Gaussian Process Feedback for Modeling the State-of-Charge of Battery Cells
Abdallah Chehade[1], Ala A. Hussein[2]
[1]University of Michigan-Dearborn, United States; [2]Prince Mohammad Bin Fahd University, Saudi Arabia

1414 | Dual Side Control of Wireless Power Transfer with Mutual Inductance Estimation
MinJae Sung, Geon-Hong Min, Junk-Ik Ha
Seoul National University, Korea

1619 | Novel Load Independent Control Structures for a Resonant LCC EV Wireless Charging Converter
Antonio Menchana, Christopher Duke, Dan Gelfer, Pang Vang, Van Xiong, Ali Arbabi, Isabelle Badall, Justin Ortiz, Mohamed Badawy
San Jose State University, United States

0107 | Harmonic Optimization Method by SHEPWM for Contactless Power Transfer System with Series-Series Compensation
Jichang Yang, Dong Jiang, Yuanzhi Zhang, Ronghai Qu
Huazhong University of Science and Technology, China

0361 | Dynamic Response Analysis based on Multiple-Phase-Shift in Dual-Active-Bridge
Yu Yan, Hua Bai
The University of Tennessee, United States

0686 | Hybrid Power Electronics Architecture to Implement the Fuel Cell Management System
Milad Bahrami, Jean-Philippe Martin, Gael Maranzana, Serge Pierfederici, Farid Meibody-Tabar, Mathieu Weber
Université de Lorraine, France

Virtual 3

Tuesday, October 13 **10:10AM-10:40AM**

P11 | AC-DC Converters and AC-AC Converters (Topology, Modulation, Control)

Chairs: John Lam, Carl Ho

0286 | Optimal Design of Integrated Planar Inductor for a Hybrid Totem-Pole PFC Converter
Jun Zou, Hongfei Wu, Yue Liu, Liu Yang, Xingyu Xu
Nanjing University of Aeronautics and Astronautics, China

1352 | High-Performance Single-Stage Universal-Input Isolated AC-DC Converter Utilizing an Impedance Control Network
Mausamjeet Khatua[1], Ashish Kumar[2], Saad Pervaiz[2], Sombuddha Chakraborty[2], Khurram K. Afridi[1]
[1]Cornell University, United States; [2]Texas Instruments Inc., United States

1390 | Load-Independent Self-Tuned Parallel Resonant Power Oscillator
Shuya Matsuhashi[1], Yoshiro Hara[1], Kien Nguyen[1], Hiroo Sekiya[1], Takeshi Uematsu[2], Shingo Nagaoka[2], Taichi Mishima[2]
[1]Chiba University, Japan; [2]Omron Corp., Japan

0413 | A New Modular SPWM Strategy for Parallel Isolated Matrix Rectifiers to Improve Current Quality
Fanxiu Fang, Yuzhuo Li, Yunwei Li
University of Alberta, Canada

1606 | AC-DC Isolated Matrix Converter Charger: Topology and Modulation
Luca Rovere, Sabino Pipolo, Andrea Formentini, Pericle Zanchetta
University of Nottingham, United Kingdom

1271 | Unified Power Quality Conditioner with Shared Legs and High-Frequency Transformer
Alan S. Felinto, Cursino B. Jacobina
Federal University of Campina Grande, Brazil

1188 | Hybrid Converter with Reduced DC-Link Voltage using an H-Bridge Cell for Split-Phase Power System
Bruna S. Gehrke[1], Cursino B. Jacobina[1], Italo R.F.M.P. da Silva[2], Reuben P.R. Sousa[1]
[1]Federal University of Campina Grande, Brazil; [2]Federal Rural University of Pernambuco, Brazil

1255 | Single-Phase AC-DC-AC Multilevel Converter based on Three-Leg Modules Series-Connected to H-Bridges through Transformers
Rodrigo P. de Lacerda[1], Cursino B. Jacobina[1], Edgard L.L. Fabricio[2]
[1]Federal University of Campina Grande, Brazil; [2]Federal Institute of Paraíba, Brazil

1381 | Energy Density Enhancement of a Merged-Energy-Buffer based Two-Stage AC-DC Converter
Firehiwot Gurara, Maida Farooq, Mausamjeet Khatua, Danish Shahzad, Khurram K. Afridi
Cornell University, United States

Virtual 4

Tuesday, October 13 **10:10AM-10:40AM**

P12 | Solid State Transformers, V2G, and Power Converter Control

Chairs: Akanksha Singh, Mona Ghassemi

0603 | Protection Coordination Challenges for Microgrid Distribution Network with High Penetration Inverter-Based Resources
Vincentius Raki Mahindara[1], Ardyono Priyadi[1], Margo Pujiantara[1], Mauridhi Hery Purnomo[1], Ahmed Y. Saber[2], Eduard Muljadi[3]
[1]Institut Teknologi Sepuluh Nopember, Indonesia; [2]ETAP, United States; [3]Auburn University, United States

0077 | Power and Voltage Regulation of a Solid-State Transformer based Quad-Active Bridge DC-DC Converter using Adaptive Linear Quadratic Regulator and Nonlinear Model Predictive Control
Mohammed Hatatah, Brandon M. Grainger
University of Pittsburgh, United States

0558 | Study on DC-Voltage Rising of Blocked Port in High-Frequency-Link Converters
Chunpeng Zhang, Huaru Li, Wusong Wen, Xin Mo, Zhengming Zhao
Tsinghua University, China

1083 | Dynamic DC-Link Current Minimization Control to Improve Current-Source Solid-State Transformer Efficiency
Liran Zheng, Xiangyu Han, Rajendra Prasad Kandula, Deepak Divan
Georgia Institute of Technology, United States

1432 | 500kVA Hybrid Solid State Transformer (HSST): Design and Implementation of the SST
Sanjay Rajendran, Soumik Sen, Liqi Zhang, Zhicheng Guo, Qingyun Huang, Alex Q. Huang
The University of Texas at Austin, United States

0560 | Quasi-Proportional-Resonant Control Strategy for the Hybrid Distribution Transformer with LCL-Type Converters
Yibin Liu, Deliang Liang, Shaofeng Jia, Kun Zhou, Yachen Gao, Shengliang Cai, Dawei Li, Shuai Feng
Xi'an Jiaotong University, China

1512 | A Manitoba Converter based Bi-Directional On-Board charger for Plug-In Electric Vehicles
Avishek Ghosh, Carl Ngai Man Ho, Ken King Man Siu
University of Manitoba, Canada

0166 | Improvement of Transient Current Response of a Single-Phase Inverter in a V2G System using Disturbance Rejection and Command Feedforward Control
Horyeong Jeong, Jae Suk Lee
Jeonbuk National University, Korea

0331 | Inertia Emulation in Power Converters with Communication Delays
Ngoc Bao Lai[1], Andres Tarraso[2], Gregory N. Baltas[1], Leonardo Marin[2], Pedro Rodriguez[2]
[1]Universidad Loyola, Spain; [2]Universitat Politecnica de Catalunya, Spain

1142 | Bifurcation Analysis of Converter-Dominated Electrical Distribution Systems
Dionysios Moutevelis[1], Javier Roldán-Pérez[1], Milan Prodanovic[1], Santiago Sanchez Acevedo[2]
[1]IMDEA Energy Institute, Spain; [2]SINTEF Energy Research, Norway

0313 | DQ Impedance Reshaping of Three-Phase Power-Controlled Grid-Connected Inverter for Low-Frequency Stability Improvement under Weak Grid Condition
Weihua Zhou[1], Yanbo Wang[1], Raymundo E. Torres-Olguin[2], Zhe Chen[1]
[1]Aalborg University, Denmark; [2]SINTEF Energy Research Institute, Norway

1401 | An RL-Type Active Damper for Stabilizing Wide Band Oscillations in Grid-Tied Inverter Systems
Li Cheng, Zeng Liu, Jinjun Liu, Yiming Tu
Xi'an Jiaotong University, China

0702 | Power Emulator of Variable Speed Drive with Grid Frequency Support in Multi-Converter based Power Grid Emulation System
Shuyao Wang, Yiwei Ma, Taylor Short, Leon M. Tolbert, Fred Wang
The University of Tennessee, United States

0788 | Vulnerability Assessments for Power-Electronics-Based Smart Grids
Jinan Zhang, Jin Ye, Lulu Guo, Fangyu Li, Wenzhan Song
University of Georgia, United States

0940 | Optimal Design of PV Systems Considering Levelized Cost of Energy and Power Density
Dongsen Sun[1], Xiaonan Lu[1], Liang Du[1], Yue Cao[2]
[1]Temple University, United States; [2]Oregon State University, United States

Virtual 1

Tuesday, October 13 **11:00AM-11:30AM**

P13 | Electric Machine Applications in Automotive, Aerospace, Renewable, Robotics

Chairs: Alireza Fatemi, Rajesh Deodhar

0323 | Design and Evaluation of Air-Flow Cooling System for High-Power-Density Motor for Robotic Applications
Awungabeh F. Akawung, Yasutaka Fujimoto
Yokohama National University, Japan

0903 | An Accuracy Study of Finite Element Analysis-based Efficiency Map for Traction Interior Permanent Magnet Machines
Katsuyuki Narita[1], Hiroyuki Sano[1], Nicolas Schneider[1], Kazuki Semba[1], Koji Tani[1], Takashi Yamada[1], Ryosuke Akaki[2]
[1]JSOL Corp., Japan; [2]SUZUKI Motor Corp., Japan

1527 | Design of a PM-Assist Synchronous Reluctance Machine for High Performance Applications
Amina Shrestha[1], Mazharul Chowdhury[2], Mohammad Islam[1], Christian Ross[1]
[1]Halla Mechatronics, United States; [2]North Carolina State University, United States

1603 | A Novel Design for a High Specific Power Interior Permanent Magnet Machine for Aerospace Applications
Rasul Hemmati, Sina Vahid, Ayman El-Refaie
Marquette University, United States

1530 | Design and Analysis of a High Saliency Transverse Flux Machine with a Novel Rotor Structure for Traction Applications
Anik Chowdhury[1], Shuvajit Das[1], Teppei Tsuda[2], Naoto Saito[2], Subrata Saha[2], Yilmaz Sozer[1]
[1]The University of Akron, United States; [2]Aisin AW Co LTD, Japan

0647 | Integrated, Eddy-Current-Based Sensing of Rotor Position for Magnetic Levitation
Patricio Peralta, Sean Thomas, Yves Perriard
École Polytechnique Fédérale de Lausanne, Switzerland

0683 | Design of a Multiphase Coreless Axial Flux Permanent Magnet Machine for Unmanned Aerial Vehicle Propulsion
Federico Marcolini[1], Giulio De Donato[1], Fabio Giulii Capponi[1], Maurizio Incurvati[2], Federico Caricchi[1]
[1]Sapienza University of Rome, Italy; [2]Management Center Innsbruck MCI, Austria

0596 | Enhanced Torque Estimation in Variable Leakage Flux PMSM Combining High and Low Frequency Signal Injection
Diego F. Laborda[1], David Díaz Reigosa[1], Daniel Fernández[1], Kensuke Sasaki[2], Takashi Kato[2], Fernando Briz[1]
[1]University of Oviedo, Spain; [2]Nissan Motor Co., Ltd., Japan

1113 | Design of an Axial Flux Machine with an Integrated Hydraulic Pump for Off-Highway Vehicle Electrification
Fnu Nishanth[1], Garrett Bohach[2], Md Minal Nahin[2], James Van de Ven[2], Eric L. Severson[1]
[1]University of Wisconsin-Madison, United States; [2]University of Minnesota, United States

0741 | Demagnetization Performance Enhancement of Heavy Rare Earth Free Permanent Magnet Machines
Md Sariful Islam[1], Rajib Mikail[2], Iqbal Husain[1]
[1]North Carolina State University, United States; [2]ABB US Corporate Research Center, United States

0864 | High Voltage Direct Driven Wind Turbine Generator
Michela Diana, Sonja Tidblad Lundmark, Torbjörn Thiringer
Chalmers University of Technology, Sweden

0376 | Emulation of an Isolated Induction Generator under Unbalanced Conditions
Yupeng Liu, Mohammad A. Masadeh, Pragasen Pillay
Concordia University, Canada

0786 | Comparative Analysis of Different Halbach Array Structures in the Design Optimization of an In-Wheel Permanent Magnet Machine for Land Speed Racing
Guoyu Chu[1], Howard Lovatt[2], M.F. Rahman[1], Rukmi Dutta[1]
[1]University of New South Wales, Australia; [2]CSIRO, Australia

1404 | High Torque Density Spoke-Type Ferrite Permanent Magnet Synchronous Machine Assisted by Rare-Earth Magnets for Traction Applications
Zhiwei Zhang
The Ohio State University, United States

1426 | Dual Three Phase Rare-Earth Free Spoke-Type Permanent Magnet Synchronous Traction Motor using Ferrite Magnets
Zhiwei Zhang
The Ohio State University, United States

Virtual 2

Tuesday, October 13 **11:00AM-11:30AM**

P14 | Converters for Renewable Energy

Chairs: Gerry Moschopoulos, Qiang Wei

0375 | Scalable Thirteen-Level Hybrid Multilevel Inverter using Reduced Components
Abhinandan Routray, Shri Prakash Sonkar, Rajeev Kumar Singh, Ranjit Mahanty
Indian Institute of Technology (BHU), India

0379 | Hybrid Modular Multilevel Converter with Self-Balancing Structure
Yaqian Zhang, Jianzhong Zhang, Zheng Xu, Fujin Deng, Jin Zhao
Southeast University, China

1006 | Evaluation of Modular AC Filter Building Blocks for Full SiC based Grid-Tied Three Phase Converters
Ripun Phukan[1], Sungjae Ohn[1], Dong Dong[1], Rolando Burgos[1], Gopal Mondal[2], Sebastian Nielebock[2]
[1]Virginia Polytechnic Institute and State University, United States; [2]Siemens Corporate Research, Germany

0839 | DC/AC Voltage Sourced Converter with Auxiliary DC Port for Renewable Energy Applications
Chatumal Perera, John Salmon, Gregory J. Kish
University of Alberta, Canada

1503 | Design for Reliability of SiC-MOSFET-Based 1500-V PV Inverters with Variable Gate Resistance
Jinkui He, Ariya Sangwongwanich, Yongheng Yang, Francesco Iannuzzo
Aalborg University, Denmark

0054 | A New Switched-Capacitor based Boost Seven-Level ANPC (7L-ANPC) Boost Inverter Topology
Atif Iqbal[1], Marif Daula Siddique[1], Mohammed Al-Hitmi[1], Saad Mekhilef[2]
[1]Qatar University, Qatar; [2]University of Malaya, Malaysia

1160 | Design of a Non-Isolated Three-Switch Inverter for Renewable Energy Systems, featuring Simple Circuit, Continuous Output Current, Common Ground and Buck-Boost Operation
Ashraf Ali Khan[1], Shehab Ahmed[2], Usman Ali Khan[3]
[1]The University of British Columbia, Canada; [2]King Abdullah University of Science and Technology, Saudi Arabia; [3]Yonsei University, Korea

0950 | Current Ripple Reduction for the Quasi-Z-Source Inverter with Modified Space-Vector PWM Strategy
Wenjie Liu, Yongheng Yang, Tamas Kerekes, Frede Blaabjerg
Aalborg University, Denmark

0776 | A State-of-the-Art Strategy to Implement Nonlinear Model Predictive Controller with Non-Quadratic Piecewise Discontinuous Cost Index for Ocean Wave Energy Systems
Ali Shahbaz Haider[1], Ted K.A. Brekken[1], Alan McCall[2]
[1]Oregon State University, United States; [2]Ecomerit Technologies, LLC, United States

0858 | SOH Diagnostic and Prognostic of High Energy Application by the Relationship of Health Indicators
Pyeong-Yeon Lee[1], SangUk Kwon[1], Deokhun Kang[1], SeungYun Han[1], Woonki Na[2], Jonghoon Kim[1]
[1]Chungnam National University, Korea; [2]California State University-Fresno, United States

1001 | Bi-Directional 3.3 kW On-Board Battery Charger
Tanya Gachovska, Gabriel Scarlatesu, Nikolay Radimov, Mahdi Tude Ranjbar
Solantro Semiconductor Corp., Canada

1034 | A New Configuration for Wind/Solar Water Pumping System based on a Doubly Fed Induction Generator
Zahra Mousavi[1], Roohollah Fadaeinedjad[1], Hojjatullah Moradi[1], Mohammadali Bagherzadeh[1], Gerry Moschopoulos[2]
[1]Graduate University of Advanced Technology, Iran; [2]Western University, Canada

0334 | Modified EPS Control with Magnetizing Current Injection to Achieve Full Load Range ZVS for Dual Active Bridge Converters
Liting Li[1], Guo Xu[1], Wenjing Xiong[1], Hanbing Dan[1], Yonglu Liu[1], Mei Su[1], Dong Liu[2]
[1]Central South University, China; [2]Aalborg University, Denmark

Virtual 3

Tuesday, October 13 **11:00AM-11:30AM**

P15 | DC-AC Converters

Chairs: Suzan Eren, Dong Cao

0362 | Transformerless Active Isolation in Common-Ground Photovoltaic Microinverter Applications for Reduced Ground Leakage Currents
Clint Halsted, Somasundaram Essakiappan, Madhav Manjrekar
University of North Carolina-Charlotte, United States

1011 | Analysis and Control of Grid-Tied Quad-PV LLC Converter with MPPT
Sumana Ghosh, Reza Rezaii, Abdullah Alhatlani, Issa Batarseh
University of Central Florida, United States

0623 | Derivation of a Single-Phase Single-Stage Inverter based on Minimum Indirect Power
Diego Serrano, Regina Ramos, Edwin Peredo, Pedro Alou, Jesús A. Oliver, José A. Cobos
Universidad Politécnica de Madrid, Spain

0383 | A General Dead Time Compensation Method based on Current Ripple Prediction and Pulse Delay Measurement for Voltage Source Inverter
Zewei Shen, Dong Jiang, Jianan Chen, Zicheng Liu
Huazhong University of Science and Technology, China

1551 | Common Mode Voltage Cancellation using SHM-PAM for 3Phase Compact Multilevel Inverters
Mohammad Sharifzadeh, Mohammad Babaie, Gabriel Chouinard, Kamal Al-Haddad
École de Technologie Supérieure, Canada

0622 | Three-Phase Hybrid Multi-Output Converter with Single DC and Multi AC Outputs for Hybrid Microgrid Application
Shri Prakash Sonkar, V.N. Lal, R.K. Singh
Indian institute of Technology-Varanasi, India

0754 | Three-Phase DC Capacitor-Less Solid-State Variable Capacitor
Yunting Liu[1], Leon M. Tolbert[1], Fred Wang[1], Fang Z. Peng[2]
[1]The University of Tennessee-Knoxville, United States; [2]Florida State University, United States

0685 | Nine-Switch Current-Source Inverter-Fed Asymmetrical Six-Phase Machines based on Vector Space Decomposition
Ahmed Salem, Mehdi Narimani
McMaster University, Canada

Virtual 4

Tuesday, October 13 **11:00AM-11:30AM**

P16 | Statistical Methods Applied to Power Electronics System Applications

Chairs: Burak Ozpineci, Osama Mohammad

1343 | An Observer based Intrusion Detection Framework for Smart Inverters at the Grid-Edge
Zhen Zhang[1,2], Mitchell Easley[1], Mohsen Hosseinzadehtaher[1,2], George Amariucai[1], Mohammad B. Shadmand[1,2], Haitham Abu-Rub[3]
[1]Kansas State University, United States; [2]University of Illinois at Chicago, United States; [3]Texas A&M University at Qatar, Qatar

0697 | A Growing Self-Organising Maps Implementation for Coherency Identification in a Power Electronics Dominated Power System
Gregory N. Baltas[1], Ngoc-Bao Lai[2], Leonardo Marin[2], Andres Tarraso[2], Pedro Rodriguez[2]
[1]Universidad Loyola, Spain; [2]Universitat Politecnica de Catalunya, Spain

0722 | State of Health Estimation of Lithium-Ion Batteries using Neuron Network and 1kHz Impedance Data
Zhiyong Xia, Jaber A. Abu Qahouq
University of Alabama, United States

1174 | A Machine Learning Clustering Algorithm for Sensorless Multilevel Converters
Faete J.T. Filho[1], Parker Zieg[1], Burak Ozpineci[2], Nicholas Hill[1], Leon M. Tolbert[3]
[1]East Carolina University, United States; [2]Oak Ridge National Laboratory, United States; [3]The University of Tennessee, United States

0270 | A Machine Learning Approach for Understanding Power Distribution System Congestion
Emin Ucer[1], Mithat Kisacikoglu[1], Ali Gurbuz[2], Shahinur Rahman[1], Murat Yuksel[3]
[1]The University of Alabama, United States; [2]Mississippi State University, United States; [3]University of Central Florida, United States

0123 | Physical Design Automation for High-Density 3D Power Module Layout Synthesis and Optimization
Imam Al Razi, Quang Le, H. Alan Mantooth, Yarui Peng
University of Arkansas, United States

1051 | Bridging Gaps in Paper Design Considering Impacts of Switching Speed and Power-Loop Layout
Ren Ren[1], Zhou Dong[1], Fred Wang[1,2]
[1]The University of Tennessee-Knoxville, United States; [2]Oak Ridge National Laboratory, United States

1099 | Short-Term Solar Irradiance Forecasting based on Multi-Branch Residual Network
Saeedeh Ziyabari, Liang Du, Saroj Biswas
Temple University, United States

1560 | Medium Voltage Supply Directly to Data-Center-Servers using SiC-Based Single-Stage Converter with 20kW Experimental Results
Suvendu Samanta[1], Isaac Wong[1], Subhashish Bhattacharya[1], Birger Pahl[2]
[1]North Carolina State University, United States; [2]EATON, United States

Virtual 1

Tuesday, October 13 **11:35AM-12:05PM**

P17 | Electric Machines (Synchronous, Induction, Switched Reluctance, Flux-Switching)

Chairs: Andrea Cavagnino, Alireza Fatemi

1073 | Design and Evaluation of a Power Hardware-in-the-Loop Machine Emulator
John Noon[1], He Song[1], Bo Wen[1], Igor Cvetkovic[1], Srdjan Srdic[2], Gernot Pammer[2], Rolando Burgos[1]
[1]Virginia Polytechnic Institute and State University, United States; [2]EGSTON Power Electronics GmbH, Austria

0359 | Method of Expanding Operating Range for Three-Phase Series-End Winding Motor Drive
An Li, Dong Jiang, Xiangwen Sun, Zicheng Liu
Huazhong University of Science and Technology, China

1297 | Design and Construction of a Foil Winding Permanent Magnet Machine
Michael Rios, Giri Venkataramanan
University of Wisconsin-Madison, United States

1415 | Consequent Pole Toroidal Winding Dual Rotor Permanent Magnet Synchronous Machines
Zhiwei Zhang
The Ohio State University, United States

0606 | Study on Performance Improvement by Rotating Working Bar of Double-Cage Induction Motor
Dong-Ho Kim[1], Kwang Soo Kim[2], Ju Lee[1], In-Jun Yang[3], Si-Woo Song[3], Won-Ho Kim[3]
[1]Hanyang University, Korea; [2]Halla University, Korea; [3]Gachon University, Korea

0928 | Improved Rotor Bar Structure in High-Voltage High-Power Induction Motors to Eliminate Local thermal Spot and Avoid Broken Bar Faults
Haisen Zhao[1], Xinglan Guo[1], Xin Dai[2], Hassan H. Eldeeb[3], Yang Zhan[1], Guorui Xu[1], Osama Mohammed[3]
[1]North China Electric Power University, China; [2]Inner Mongolian Baotou Donghua Thermal Power Plant, China; [3]Florida International University, United States

1443 | Modeling and Control of a 4-Pole/8-Pole Induction Motor for Smooth Torque Production during Electronic Pole Changing
Taohid Latif[1], Mohamed Zubair M. Jaffar[2], Iqbal Husain[1]
[1]North Carolina State University, United States; [2]FEV NA, Inc., United States

0083 | Evaluation of the Detectability of Damper Cage Damages in Synchronous Motors through the Advanced Analysis of the Stray Flux
Habib Castro-Coronado, Jose Antonino-Daviu, Alfredo Quijano-Lopez, Vicente Fuster-Roig, Pedro Llovera-Segovia
Universitat Politecnica de Valencia, Spain

0570 | Optimum Design of Line-Start Permanent-Magnet Synchronous Motor using Mathematical Method
Mousalreza Faramarzi Palangar[1], Amin Mahmoudi[1], Solmaz Kahourzade[2], Wen L. Soong[3]
[1]Flinders University, Australia; [2]University of South Australia, Australia; [3]University of Adelaide, Australia

0405 | Research on Vibration Reduction of Switched Reluctance Motor
Ying Xie, Zexin Ma, Yuwen Xu, William Cai, Zhaoyang Ning, Shengming Hu
Harbin University of Science and Technology, China

1500 | Alternative Methods for Electric Machine Rated Load Temperature Tests
Emmanuel Agamloh[1], Silvio Vaschetto[2], Andrea Cavagnino[2], Annette von Jouanne[1], Alexandre Yokochi[1]
[1]Baylor University, United States; [2]Politecnico di Torino, Italy

0532 | Sinusoidal Shaped Surface Permanent Magnet Motor using Cold Spray Additive Manufacturing
Sumeet Singh, Pragasen Pillay
Concordia University, Canada

Virtual 2

Tuesday, October 13 **11:35AM-12:05PM**

P18 | Controls in Alternative Energy Applications

Chairs: Qiang Wei, Mehdi Narimani

1541 | A Novel Decentralized Adaptive Droop Control Technique for DC Microgrids based on Integrated Load Condition Processing
Mohammad Noor Bin Shaheed, Yilmaz Sozer, Sifat Chowdhury, J. Alex De Abreu-Garcia
The University of Akron, United States

1266 | Reviews on Inertia Emulation Technology with Power Electronics
Shimiao Chen, Hua Han, Xinyu Chen, Yao Sun, Xiaochao Hou
Central South University, China

0350 | Sequence-Impedance-Based Stability Comparison between VSGs With and Without Inner Loops Control
Yang Peng, Yue Wang, Yonghui Liu, Hang Liu
Xi'an Jiaotong University, China

0303 | Reactive Power Modulation Strategy of a Single-Stage Buck-Boost-Type Inverter
Ken King Man Siu, Carl Ngai Man Ho
University of Manitoba, Canada

0285 | Optimal RSC Control for Loss Reduction in Wind Turbine Driven DFIG-Grid System
Sambasivaiah Puchalapalli, Bhim Singh
Indian Institute of Technology Delhi, India

0687 | Ground Leakage Current in Modified Three-Phase Current Source Inverters Depending on Power Semiconductors Parasitic Capacitances
Giovanni Migliazza, Emilio Carfagna, Fabio Bernardi, Emilio Lorenzani
University of Modena and Reggio Emilia, Italy

0101 | Constant Power Generation Method for Grid-Connected Photovoltaic Systems with Fast Response under Dynamic Irradiance Condition
Hyoung-Kyu Yang, Zeeshan Aleem, Junhyuk Lee, Jung-Wook Park
Yonsei University, Korea

0438 | Online Condition Monitoring of Photovoltaic (PV) Cells by Implementing Electrical Impedance Spectroscopy using a Switch-Mode DC-DC Converter
Linda Shelembe, Paul Barendse
University of Cape Town, South Africa

1201 | Risk Assessment of Smart Buildings Equipped with Solar Generation using Information Gap Decision Theory
Sima Aznavi[1], Poria Fajri[1], Eric M. Wilcox[2], Mohammad B. Shadmand[3]
[1]University of Nevada-Reno, United States; [2]Desert Research Institute, United States; [3]University of Illinois at Chicago, United States

1272 | Coordinated Power Balance Scheme for a Wind-to-Hydrogen Set in Standalone Power Systems
Echezona Ezeodili, Jinho Kim, Eduard Muljadi, Robert M. Nelms
Auburn University, United States

0206 | Flux Adaptive RelSync Motor Driven Single Stage Photovoltaic Water Pumping System
Anshul Varshney, Utkarsh Sharma, Bhim Singh
Indian Institute of Technology Delhi, India

0929 | Design and Implementation of Lithium-Ion Battery based Smart Solar Powered Street Light System
Immad Shams[1], Prashant Shrivastava[1], Kok Soon Tey[1], Saad Mekhilef[1,2]
[1]University of Malaya, Malaysia; [2]Swinburne University of Technology, Australia

Virtual 3

Tuesday, October 13 **11:35AM-12:05PM**

P19 | Multilevel Converters (Topology, Modulation, Control)

Chairs: Seung-Hwan Lee, Richard Lukaszewski

1575 | Optimized DV/DT Filter Design for SiC based Modular Multilevel Converters
Xiao Li, Jianyu Pan, Ziwei Ke, Rui Liu, Junchong Fan, Yue Zhang, Boxue Hu, Risha Na, Longya Xu, Jin Wang
The Ohio State University, United States

1277 | Three-Phase AC-DC-AC Converter with Shared Legs and Floating H-Bridges
Alan S. Felinto, Cursino B. Jacobina
Federal University of Campina Grande, Brazil

0315 | Model Predictive Control of 5L-ANPC Converters with Level-Shifted Pulse-Width-Modulation
Dehong Zhou[1], Zhongyi Quan[2], Yunwei (Ryan) Li[2]
[1]University of Electronic Science and Technology of China, China; [2]University of Alberta, Canada

1220 | Dual Vienna Rectifiers with a Single DC-Link for Wind Energy Conversion System Applications
Amanda P. Monteiro[1], Cursino B. Jacobina[1], Filipe A.C. Bahia[2], Reuben P.R. Sousa[1]
[1]Federal University of Campina Grande, Brazil; [2]Federal University of Bahia, Brazil

1228 | Single-Phase AC-DC-AC Multilevel Converter using High-Frequency Link to Improve Power Quality
Rodrigo P. de Lacerda[1], Cursino B. Jacobina[1], Edgard L.L. Fabricio[2], Alan Santana Felinto[1]
[1]Federal University of Campina Grande, Brazil; [2]Federal Institute of Paraíba, Brazil

1278 | Full Power Range Seamless Control of Three-Phase Unidirectional Vienna Rectifier including Partial DCM/CCM Operation with Low Harmonic Current Distortion even under Highly Distorted Grid
Massimiliano Biason[1], Roberto Petrella[1], Sandro Calligaro[2], Mattia Morandin[3], Marco Zordan[3]
[1]University of Udine, Italy; [2]Free University of Bozen, Italy; [3]CAREL Industries s.p.a., Italy

0453 | A Novel Voltage Balancing Strategy for Four-Level Hybrid-Clamped Converters under Selective Harmonic Elimination PWM
Mingzhe Wu[1], Hao Tian[1], Yun Wei Li[1], Kui Wang[2]
[1]University of Alberta, Canada; [2]Tsinghua University, China

0434 | The Active Gate Driver for Switching Loss Reduction of Inverter
ByongJo Hyon, Joon-Sung Park, Jin-Hong Kim
Korea Electronics Technology Institute, Korea

0635 | A Novel Hybrid Modulation for Photovoltaic Three-Level T-Type Inverter to Simultaneously Eliminate Neutral-Point Voltage Ripple and Interact with Maximum Power Point Tracking Process
Mohammadreza Lak, Bing-Rong Chuang, Ting-Lien Wu, Tzung-Lin Lee
National Sun Yat-Sen University, Taiwan

1525 | Optimal Selection of the Voltage Modulation Strategy for an Open Winding Multilevel Inverter
A. Testa[1], S. Foti[1], S. De Caro[1], L.D. Tornello[2], G. Scelba[2], G. Scarcella[2]
[1]University of Messina, Italy; [2]University of Catania, Italy

Virtual 4

Tuesday, October 13 **11:35AM-12:05PM**

P20 | Grid Interactive Converters

Chairs: Dongbo Zhao, Pedro Rodriguez

0718 | Application of Model Predictive Pulse Pattern Control to Control a PMSM
Ageda Guerra[1], Roberto García Rochín, Patrick W. Cross[2]
[1]John Deere, Mexico; [2]John Deere, United States

0201 | A Fixed-Frequency Synchronous Boost Converter based on Adaptive On-Time Control with a New Reverse Phase Ripple Injection Compensation
Dam Yun, Haneul Kim, Dongwoo Baek, SangIk Cho, Jehyung Yoon, Jungbong Lee
Samsung Electronics, Korea

0187 | Optimal Design of Control Strategy for Full-Bridge LLC Converter
Aiyun Zhu, Yundong Ma, Zisen Liu, Huijun Lu, Fuchun Zhang
Nanjing University of Aeronautics and Astronautics, China

1519 | Virtual Impedance based Control Scheme for Stability Emulation of Grid-Connected Converters
Jiashi Wang, Ke Ma
Shanghai Jiao Tong University, China

1261 | LCOE Design Optimization using Genetic Algorithm with Improved Component Models for Medium-Voltage Transformerless PV Inverters
Kyle J. Goodrick[1], Gab-Su Seo[2], Satyaki Mukherjee[1], Jinia Roy[2], Rahul Mallik[3], Branko Majmunovic[1], Soham Dutta[3], Dragan Maksimovic[1], Brian Johnson[3]
[1]University of Colorado-Boulder, United States; [2]National Renewable Energy Laboratory, United States; [3]University of Washington, United States

1323 | Optimization and Design of a High-Voltage Supply for Electrostatic Precipitators
Xing Wei[1], Zhan Shen[2], Yuyuan Ye[3], Jingwen Leng[1], Zhike Xu[1], Long Jin[1]
[1]Southeast University, China; [2]Aalborg University, Denmark; [3]State Grid Jiangsu Electric Power Co., Ltd., China

0573 | A Dual-Objective Modulated Model Predictive Control Scheme for the Point-of-Load Inverter in DC Microgrid with Dichotomy Algorithm
Jinsong He[1], Xin Zhang[2]
[1]Nanyang Technological University, Singapore; [2]Zhejiang University, China

0640 | Optimization of a SiC MOSFET Behavioural Circuit Model by using a Multi-Objective Genetic Algorithm
Gaetano Bazzano[1], Alessandra Raffa[1], Santi Agatino Rizzo[2], Nunzio Salerno[2], Giovanni Susinni[2], PierPaolo Veneziano[1]
[1]STMicroelectronics, Italy; [2]University of Catania, Italy

0450 | Development of 3-Phase Current-Fed Dual Active Bridge Converter for Bi-Directional Battery Charger Application
Yong-Su Noh, Dongmyoung Joo, Byong Jo Hyon, Joon Sung Park, Jin-Hong Kim, Jun-Hyuk Choi
Korea Electronics Technology Institute, Korea

0122 | Passivity-Based Parameter Design of Passive Power Filter for the Grid-Current-Controlled VSC
Jiancheng Zhao, Chuan Xie, Kai Li
University of Electronic Science and Technology of China, China

1111 | Novel Modulation Strategy to Eliminate Device Overvoltage Stress and Enable True ZVS Operation in the Soft-Switching Solid-State Transformer
Mickael J. Mauger, Prasad Kandula, Deepak Divan
Georgia Institute of Technology, United States

1609 | Three-Phase Unified Power Quality Conditioner based on H-Bridge and High-Frequency Link
Maxsuel F. Cunha, Cursino B. Jacobina, Alan S. Felinto
Federal University of Campina Grande, Brazil

1102 | A Plug-and-Play Design Suite of Converters for the Electric Grid
Michael Starke[1], Pankaj Bhowmik, Steven Campbell, Madhu Chinthavali, Bailu Xiao, Radha Sree Krishna Moorthy, Benjamin Dean, Jongchan Choi
[1]Oak Ridge National Laboratory, United States; [2]The University of Tennessee, United States

0758 | Decoupling Capacitor Design for Multi-Inverter based Grid Emulator System
Yunting Liu, Haiguo Li, Yiwei Ma, Jingxin Wang, Leon M. Tolbert, Fred Wang, Kevin L. Tomsovic
The University of Tennessee-Knoxville, United States

Virtual 1

Tuesday, October 13 **12:10PM-12:40PM**

P21 | New Technologies, Sensors, Reliability and Testing for Electric Drives

Chairs: Mahesh Swamy, Jul-Ki Seok

0277 | Four-Module Three-Phase Permanent-Magnet Synchronous Motor based PWM Modulation Strategy for Suppressing Vibration and Common Mode Current
Kang Liu[1], Zicheng Liu[1], Dong Jiang[1], Qiyuan Wang[1], Zhongxiang He[2]
[1]Huazhong University of Science and Technology, China; [2]Wuhan Institute of Marine Electric Propulsion, China

0526 | A Dual Modular Multilevel Converter with High-Frequency Circulating Current Injection for MV Open-End Stator Winding Machine Drives
Mohamed S. Diab[1], Xibo Yuan[1], Barry W. Williams[2]
[1]University of Bristol, United Kingdom; [2]University of Strathclyde, United Kingdom

0628 | Magnetic Resolver using Hall-Effect Sensors
Ye Gu Kang, Diego F. Laborda, Daniel Fernández, David Reigosa, Fernando Briz
University of Oviedo, Spain

0698 | Induction Machine Emulation under Asymmetric Grid Faults
Gayatri Tanuku, Pragasen Pillay
Concordia University, Canada

0933 | Gigahertz Current Measurement for Wide Band-Gap Devices
Luke Shillaber, Li Ran, Yanfeng Shen, Teng Long
University of Cambridge, United Kingdom

1074 | Three-Phase Bidirectional-Flyback Differential-Inverter for Synchronous Electrostatic Machines
Peter Killeen, Daniel C. Ludois
University of Wisconsin-Madison, United States

1180 | Integrated Motor Drive using Soft-Switching Current-Source Inverters with SiC- and GaN-Based Bidirectional Switches
Hang Dai, Renato A. Torres, Woongkul Lee, Thomas M. Jahns, Bulent Sarlioglu
University of Wisconsin-Madison, United States

1246 | Synchronous Frame Current Estimation Inaccuracies in Permanent Magnet Synchronous Motor Drives
Prerit Pramod
Nexteer Automotive Corp., United States

1262 | Evaluation of Sensorless Techniques for Surface Permanent-Magnet Integrated Motor Drive using Current-Source Inverter
Renato A. Torres, Hang Dai, Woongkul Lee, Thomas M. Jahns, Bulent Sarlioglu
University of Wisconsin-Madison, United States

1418 | A Novel Model based Development of a Motor Emulator for Rapid Testing of Electric Drives
Visweshwar Chandrasekaran[1], Benjamin Sykora[1], Sanchit Mishra[2], Ned Mohan[2]
[1]Trane Technologies, United States; [2]University of Minnesota, United States

1615 | High-Frequency Evaluation of Two-Level Voltage-Source and Current-Source Inverters with Different Output Cables
Hang Dai, Renato A. Torres, Woongkul Lee, Thomas M. Jahns, Bulent Sarlioglu
University of Wisconsin-Madison, United States

1196 | Symmetric DQ Control of Saturated Salient AC Machines – Utilizing Targeted Time Constant Virtual Resistance and Complex Vector Flux-Linkage Regulation
Caleb W. Secrest, Dwarakanath V. Simili, Yochan Son
BorgWarner Inc., United States

0617 | Input-Output Feedback Linearization Control of a Linear Induction Motor Taking into Consideration its Dynamic End-Effects and Iron Losses
Angelo Accetta[1], Maurizio Cirrincione[2], Filippo D'Ippolito[3], Marcello Pucci[1], Antonino Sferlazza[3]
[1]National Research Council of Italy, Italy; [2]University of the South Pacific, Fiji; [3]University of Palermo, Italy

1618 | Stator Resistance Estimation using DC Injection Robust to Inverter Nonlinearity in Induction Motors
Joohyun Lee, Jiwon Yoo, Seung-Ki Sul
Seoul National University, Korea

Virtual 2

Tuesday, October 13 **12:10PM-12:40PM**

P22 | Microgrid Applications

Chairs: Jingxin Wang, Yaosuo Xue

1547 | Control Hardware-in-the-Loop for Voltage Controlled Inverters with Unbalanced and Non-Linear Loads in Stand-Alone Photovoltaic (PV) Islanded Microgrids
Mehmet Emin Akdogan, Sara Ahmed
The University of Texas at San Antonio, United States

0564 | An Intelligent Fuzzy Control Approach for a Back-Pressure Autonomous Industrial Microgrid
Rahmat Khezri[1], Amin Mahmoudi[1], Sajjad Golshannavaz[2]
[1]Flinders University, Australia, Australia; [2]Urmia University, Iran

0410 | Distributed Control and Dynamic Optimization of a Microgrid
Jameel Ahmad[1], Muhammad Aqil Aslam[2], Muhammad Tahir[2], Sudip K. Mazumder[3]
[1]University of Management and Technology-Lahore, Pakistan; [2]University of Engineering and Technology-Lahore, Pakistan; [3]University of Illinois-Chicago, United States

1162 | Influence of PLL Parameters on Small-Signal Stability of Microgrids with Synchronous Generators
Diana Patricia Morán-Río[1], Javier Roldán-Pérez[1], Milan Prodanovic[1], Aurelio García-Cerrada[2]
[1]IMDEA Energy Institute, Spain; [2]Comillas Pontifical University, Spain

1464 | Design Optimization of the Snubber Circuit for Three-Level NPC Converter Pole for Hard Switching Application
Sanket Parashar, Nithin Kolli, Raj Kumar Kokkonda, Subhashish Bhattacharya
North Carolina State University, United States

0742 | Control of a Grid-Tied Multiport Inverter for a Microgrid with Renewable Energy Sources
Dianzhi Yu, Xia Du, Jianwu Zeng, Zhaoxia Yang
Minnesota State University-Mankato, United States

0222 | A Modular Generic Microgrid Controller Adaptive to Different Compositions
Chu Sun[1], Syed Qaseem Ali[2], Geza Joos[1], Francois Bouffard[1]
[1]McGill University, Canada; [2]Opal-RT Technologies Inc., Canada

0124 | A Real-Time De-Risked Emulation based Testing Platform for AC Microgrids
A.S. Vijay, Suryanarayana Doolla, Mukul C. Chandorkar
Indian Institute of Technology-Bombay, India

Virtual 3

Tuesday, October 13 **12:10PM-12:40PM**

P23 | Power Quality, Reliability, Diagnostics and Fault Analysis

Chairs: Yue Cao, Malik Elbuluk

1284 | Analysis of AC-DC-AC Converter with Shared Legs under Unbalanced Conditions
Alan S. Felinto, Cursino B. Jacobina
Federal University of Campina Grande, Brazil

1021 | Asymmetric Voltage Sag Compensation Capability of Dual Voltage Source Inverter
Jefferson R.P. de Assis[1], Darlan A. Fernandes[1], Fabiano F. Costa[2], P.C. Ribeiro[1], Rogério G. de Almeida[1]
[1]Federal University of Paraíba, Brazil; [2]Federal University of Bahia, Brazil

0131 | Series Arc Fault Detection and Localization in DC Distribution based on Master Controller
Vu Le[1], Xiu Yao[1], Chad Miller[2], Tsao-Bang Hung[2]
[1]State University of New York at Buffalo, United States; [2]Wright Patterson Air Force Base, United States

1334 | An Ultra-Fast and Non-Invasive Short Circuit Protection Strategy for a WBG Power Electronics Converter with Multiple Half-Bridge Legs
Chondon Roy, Namwon Kim, Hossein Niakan, Ali Parsa Sirat, Babak Parkhideh
University of North Carolina at Charlotte, United States

1454 | Open-Circuit Fault Reconfiguration of Multi-Phase Interleaved DC-DC Converter
Abbas Hassan, Ali Bazzi
American University of Beirut, Lebanon

0849 | Analytical Modelling and Resilient Operation Design for Capacitor Voltage Ascent in MMC Distributed Control System with Communication Interruption
Shunfeng Yang[1], Haiyu Wang[1], Haiyu Chen[2], Wensheng Song[2]
[1]Southwest Jiaotong University, China; [2]Xi'an Jiaotong University, China

0200 | A New Procedure for Switched Mode Power Supplies Development by using Virtual Tests
Jack Hu, Srinivas Gude
Delta Electronics, Inc., Taiwan

0393 | A Novel In Situ IGBT and FWD Junction Temperature Estimation Technique for IGBT Module based on On-State Voltage Drop Measurement
Yanyong Yang, Pinjia Zhang
Tsinghua University, China

0306 | Diagnosis of Power Device Failures using Discrete Fourier Transform for DC-AC Flying Capacitor Multilevel Converters
Ruqiang Zheng[1], Xin Yin[1], Sai Tang[1], Chao Zhang[1], Daming Wang[1], Jun Wang[1], Z. John Shen[2], Zishun Peng[1]
[1]Hunan University, China; [2]Illinois Institute of Technology, United States

1136 | Measure Theory-Based approach for Remaining Useful Lifetime Prediction in Power Converters
Amin Rahnama Sadat, Harish Sarma Krishnamoorthy
University of Houston, United States

0300 | Energy-Based Stabilizing Controllers for DC-DC Converters Feeding Constant Power Loads
C.A. Villarreal-Hernandez[1], J. Loranca-Coutino[1], O.F. Ruiz-Martinez[2], J.C. Mayo-Maldonado[1], J.E. Valdez-Resendiz[1], J.C. Rosas-Caro[2], G. Escobar[1], Daniel Guillen[1]
[1]Tecnologico de Monterrey, Mexico; [2]Universidad Panamericana, Mexico

Virtual 4

Tuesday, October 13 **12:10PM-12:40PM**

P24 | Converter Control and Modeling 1

Chairs: Jin Tan, Hanchao Liu

0765 | A GaN-Based CRM Totem-Pole PFC Converter with Fast Dynamic Response and Noise Immunity for a Multi-Receiver WPT System
Jingjing Sun, Jie Li, Daniel J. Costinett, Leon M. Tolbert
The University of Tennessee-Knoxville, United States

1245 | Operation of a Three-Phase Standalone Inverter with Online Parameter Update by Instantaneous Charge Transfer Estimation
Vikram Roy Chowdhury, Jonathan W. Kimball
Missouri University of Science and Technology, United States

0755 | PWM and PFM Hybrid Modulation Scheme for Dual-Input LLC Resonant Converter
Xi Chen, Issa Batarseh
University of Central Florida, United States

1428 | Transient Mitigation in Mode Transitions for Composite DC-DC Converters
Aritra Ghosh, Vivek Sankaranarayanan, Robert W. Erickson
University of Colorado-Boulder, United States

0292 | Predictive Zero-Sequence Control of Parallel Three-Phase Active Rectifiers
Luca Tarisciotti[1], Claudio Burgos[2], Cristian Garcia[3], Jose Rodriguez[1]
[1]Universidad Andres Bello, Chile; [2]University of Nottingham, United Kingdom; [3]Universidad de Talca, Chile

0795 | A Novel Control Method for a Primary Triple Bridges Dual Active Bridge DC-DC Converter with Minimum RMS Current Optimization
Deliang Chen[1], Junjun Deng[1], Wenbo Wang[1], Zhenpo Wang[1], Shuo Wang[1], David G. Dorrell[2]
[1]Beijing Institute of Technology, China; [2]University of Witwatersrand, South Africa

1506 | Analytical Control System Synthesis for Dual-Loop Cascaded Stationary Frame Voltage Regulators
H. Siraj[1], B.P. McGrath[1], I.U. Nutkani[1], Y. Liao[2], X. Wang[2]
[1]RMIT University, Australia; [2]Aalborg University, Denmark

0387 | A Novel SVPWM Method for NPC Three-Level Interleaved H-Bridge Inverter
Weichao Li, Jinyang Han, Liang Zhou, Chen Deng, Ming Yan
National Key Laboratory for Vessel Integrated Power System Technology, China

1063 | Adaptive Sliding Mode Control based on a Hyperbolic Tangent Function for DC-to-DC Buck-Boost Power Converter
J. Linares-Flores, R. Heredia-Barba, O. Castro-Heredia, G. Curiel-Olivares, J.A. Juárez-Abad
Universidad Tecnológica de la Mixteca, Mexico

0626 | Input Shaping Control of Paralleled DC-DC Converters
Shishir Patel, Wayne Weaver
Michigan Technological University, United States

0430 | Operation and Control of Converters having Integrated Capacitor Blocked Transistor Cells
Jianghui Yu, Rolando Burgos
Virginia Polytechnic Institute and State University, United States

1342 | A CCM based Average Current Control Technique for Chopper Integrated Single-Phase ANPC Inverter to Minimize Voltage Ripple
Jagath Vallabhai Missula, Ravindranath Adda, Praveen Tripathy
Indian Institute of Technology Guwahati, India

Virtual 1

Tuesday, October 13 **1:30PM-2:00PM**

P25 | Control of Electric Drives

Chairs: Luca Zarri, Behrooz Mirafzal

0316 | A Constant Current based Interior Permanent Magnet (IPM) Synchronous Motor Drive Control Strategy
Yunpeng Si, Yifu Liu, Chunhui Liu, Zhengda Zhang, Mengzhi Wang, Qin Lei
Arizona State University, United States

0353 | Overmodulation Strategy for Inverters with a Single DC-Link Current Sensor
Bumun Jung, Taeyeon Lee, Kwanghee Nam
POSTECH, Korea

0445 | Reduction of Voltage Harmonics in an Open-End Winding Induction Motor Driven by a Dual-Inverter with Floating-Capacitor in the Low-Speed Region
Akihito Mizukoshi, Hitoshi Haga
Nagaoka University of Technology, Japan

0468 | Low-Speed Operation of a Motor Drive System using Dual Inverters to Reduce Input Current Harmonics
Ren Okumura, Hitoshi Haga
Nagaoka University of Technology, Japan

0483 | Growing Neural Gas-Based Maximum Torque per Ampere (MTPA) Technique for SynRMs
Angelo Accetta[1], Maurizio Cirrincione[2], Maria Carmela Di Piazza[1], Giuseppe La Tona[1], Massimiliano Luna[1], Marcello Pucci[1]
[1]National Research Council of Italy, Italy; [2]University of South Pacific, Fiji

0496 | Adaptive PI Parameter of Flux-Weakening Controller based on Voltage Feedback for Model Predictive Control of SPMSM
Yongchang Zhang[1], Jialin Jin[1], Hao Jiang[1], Dong Jiang[2]
[1]North China University of Technology, China; [2]Huazhong University of Science and Technology, China

0523 | Model Predictive Saturation Controller-Based Direct Torque Control of Permanent-Magnet Synchronous Machines
Matthew Penne[1], Wei Qiao[1], Liyan Qu[1], Lizhi Qu[1], Jiyao Wang[2], Silong Li[2]
[1]University of Nebraska-Lincoln, United States; [2]Ford Motor Co., United States

0669 | Development of SiC-Based Motor Drive using Typhoon HIL 402 as System-Level Controller
Ryan Collin, Madeline Stephens, Annette von Jouanne
Baylor University, United States

0780 | An Improved Virtual Signal Injection Control of MTPA for an IPMSM
Hao Jiang, Yongchang Zhang, Haitao Yang
North China University of Technology, China

0906 | Model Predictive Flux Control based on Synchronous Pulse-Width Modulation
Haitao Yang[1], Peng Huang[1], Yongchang Zhang[1], Jianguo Zhu[2]
[1]North China University of Technology, China; [2]The University of Sydney, Australia

1088 | Generalized Optimal SVPWM for the Switched-Capacitor Voltage Boost Converter
Shukai Wang, Ameer Janabi, Bingsen Wang
Michigan State University, United States

1331 | Precise Rotor Speed Measurement Method with Sinusoidal Coded Gearwheel Encoder for Spindle Motor Drive
Jaehong Kim[1], Muhammad Usama[1], Kwanghee Nam[2]
[1]Chosun University, Korea; [2]POSTECH, Korea

0033 | Motor Bearing Current Characterization in SiC-Based Variable Frequency Drive Applications
Annette von Jouanne, Ryan Collin, Madeline Stephens, Yu Miao, Brian Thayil, Caleb Li, Emmanuel Agamloh, Alex Yokochi
Baylor University, United States

0078 | Energy Efficiency Performance Evaluation of Direct Torque and Flux Control in Induction Machines Driven by Adjustable Speed Drives
Kevin Lee, Jimmy Qi
Eaton Corp., United States

0130 | A Unique Way to Address Component Breakdown Guidelines Set in UL 61800-5-1 for Variable Frequency Drives
Mahesh Swamy[1], Nathan Seipel[2]
[1]IEEE, United States; [2]Yaskawa America, Inc., United States

0165 | A V/Hz based Maximum Torque per Volt Control in Flux-Weakening Region for Interior Permanent Magnet Synchronous Motors
Zhihao Song[1], Wenxi Yao[1], Kevin Lee[2]
[1]Zhejiang University, China; [2]Eaton Corp., United States

Virtual 2

Tuesday, October 13 **1:30PM-2:00PM**

P26 | Distributed Energy Resources and Utility Interactions

Chairs: Lina He, Yaosuo Xue

1210 | An Intelligent Overcurrent Protection Algorithm of Distribution Systems with Inverter based Distributed Energy Resources
Lina He[1], Shuaiang Rong[1], Chengwei Liu[2]
[1]University of Illinois at Chicago, United States; [2]Huazhong University of Science and Technology, China

0132 | Group-Based Control for Domestic Electric Water Heaters using Quantum-Inspired Evolutionary Algorithm
Sheng Xiang[1], Liuchen Chang[1], Bo Cao[1], Yigang He[2]
[1]University of New Brunswick, Canada; [2]Hefei University of Technology, China

0569 | Two-Stage Optimal Sizing of Standalone Hybrid Electricity Systems with Time-of-Use Incentive Demand Response
Rahmat Khezri[1], Amin Mahmoudi[1], Mohammed H. Haque[2]
[1]Flinders University, Australia; [2]University of South Australia, Australia

0090 | Autonomous Control Strategy for Reliable OLTC Operation under PV Power Fluctuation with Effective Voltage Regulation
Ali Elrayyah, Nand Kishor Singh
Hamad Bin Khalifa University, Qatar

1218 | Virtual Synchronous Generator with Limited Current – Impact on System Transient Stability and its Mitigation
Yiwei Ma[1], Fred Wang[1,2], Leon M. Tolbert[1,2]
[1]The University of Tennessee, United States; [2]Oak Ridge National Laboratory, United States

0690 | Simple Tuning Method of Virtual Synchronous Generators Reactive Control
Fabio Mandrile, Enrico Carpaneto, Eric Armando, Radu Bojoi
Politecnico di Torino, Italy

0236 | A New Method to Improve the Transient Performance of Virtual Synchronous Generator with the Extended Virtual Impedance
Zhengmao Yang, Shuai Lu
Chongqing University, China

1434 | Analysis of Output Impedance Constraints for Grid-Connected Virtual Synchronous Generators Considering Large-Disturbance Stability
Mingxuan Li, Yue Wang, Sirui Shu, Yonghui Liu, Yang Peng
Xi'an Jiaotong University, China

0577 | VSS-DNSE Adaptive Control Algorithm for Enhancing Performance of PV-Grid Interfaced System
Kripa Tiwari, Seema Kewat, Bhim Singh, Gaurav Modi
Indian Institute of Technology-Delhi, India

1280 | On Stability of Hybrid Power Ramp Rate Control for High Photovoltaic Penetrated Grid
Silvanus D'Silva[1], Ahmad Khan[1,2], Muhammad Farooq[1,2], Mohammad B. Shadmand[1,2], Haitham Abu-Rub[3]
[1]Kansas State University, United States; [2]University of Illinois at Chicago, United States; [3]Texas A&M University at Qatar, Qatar

Virtual 3

Tuesday, October 13 **1:30PM-2:00PM**

P27 | Wide-Bandgap Semiconductors

Chairs: Cong Li, Francesco Iannuzzo

0146 | An Adaptive Driving Signals Delay Control for Voltage Balancing of Series-Connected SiC MOSFETs
Min Zhao, Hua Lin, Tao Wang
Huazhong University of Science and Technology, China

0256 | An Active Clamping Control Method for DC Solid State Circuit Breaker based on Cascaded SiC JFETs
Hong Duan[1], Wei Wang[1], Dong He[2], Zhikang Shuai[1], Xue Yang[1], Z. John Shen[3]
[1]Hunan University, China; [2]Hunan University of Technology, China; [3]Illinois Institute of Technology, United States

0477 | A Step-by-Step Modelling approach for SiC MOSFETs Half-Bridge Modules Considering Temperature Characteristics
Peng Yang, Wenlong Ming, Jun Liang
Cardiff University, United Kingdom

0170 | Analytical Modeling of SiC MOSFETs Short-Circuit Behavior Considering Parasitic Parameters
Pengfei Xiang, Ruixiang Hao, Xiaojie You, Siwei Liu, Honglin Jiao, Fang Li
Beijing Jiaotong University, China

1055 | Analysis and Gate Driver Design Considerations of 10 kV SiC MOSFETs under Flashover Fault Due to Insulation Failure
Xingxuan Huang[1], Shiqi Ji[1], Dingrui Li[1], Cheng Nie[1], Leon M. Tolbert[1,2], Fred Wang[1,2], William Giewont[3]
[1]The University of Tennessee-Knoxville, United States; [2]Oak Ridge National Laboratory, United States; [3]EPC Power, United States

0373 | In-Circuit Shoot-through-Based Characterization of SiC MOSFET TSEP Curves for Junction Temperature Estimation
Alessandro Soldati, Roberto Menozzi, Carlo Concari
University of Parma, Italy

0731 | A GaN and Si Hybrid Solution for 48V-12V Automotive DC-DC Application
Lei Kou, Juncheng Lu
GaN Systems Inc., Canada

1400 | Current Distribution Monitoring of Paralleled GaN HEMTs
Hossein Niakan, Ali Parsa Sirat, Babak Parkhideh
University of North Carolina at Charlotte, United States

0652 | Body Diode Reverse Recovery Effects on SiC MOSFET Half-Bridge Converters
Mario Pulvirenti[1], Angelo G. Sciacca[1], Luciano Salvo[1], Massimo Nania[1], Giacomo Scelba[2], Giuseppe Scarcella[2]
[1]STMicroelectronics, Italy; [2]University of Catania, Italy

0341 | Turn-On Performance Comparison of SiC Single-Driver Module (SDM) and Multi-Driver Module (MDM)
Pengkun Liu[1], Ruiyang Yu[1], Alex Q. Huang[1], Johan Strydom[2], Stephanie W. Butler[2]
[1]The University of Texas-Austin, United States; [2]Texas Instruments Inc., United States

Virtual 4

Tuesday, October 13 **1:30PM-2:00PM**

P28 | Converter Control and Modeling 2

Chairs: Liang Du, Zhiqiang (Jack) Wang

0636 | Observers for Discrete-Time Current Control of Converters Equipped with an LCL Filter
F.M. Mahafugur Rahman[1], Jarno Kukkola[1], Ville Pirsto[1], Mikko Routimo[1,2], Marko Hinkkanen[1]
[1]Aalto University, Finland; [2]ABB Drives, Finland

0514 | Control Strategies Generation Mechanism for LLC Resonant Converter
Yuqi Wei[1], Quanming Luo[2], Dereje Woldegiorgis[2], Alan Mantooth[1]
[1]University of Arkansas, United States; [2]Chongqing University, China

0394 | Soft-Switching Auxiliary Current Control for Faster Load Transient Response of Buck Converter
Dongwook Kim[1], Myeongjae Hong[2], Jongun Baek[1], Jisu Lee[1], Joonho Shin[1], Jong-Won Shin[1]
[1]Chung-Ang University, Korea; [2]Samsung, Korea

0198 | H-Bridge MMCs with Symmetrical Half-Bridge Submodules
Jingyang Fang[1], Zhongxi Li[1], Stefan M. Goetz[1], Shunfeng Yang[2], Haiyu Wang[2]
[1]Duke University, United States; [2]Southwest Jiaotong University, China

0278 | Modular Multilevel Converter Device-Level Loss Balancing Control for Better Lifetime
Huan Qiu, Jinyu Wang, Yi Tang
Nanyang Technological University, Singapore

0771 | Finite Control Set – Model Predictive Control Applied to Dual-Converter-Based Rectifiers
Victor F.M.B. Melo, Ruan C.V. dos Santos, Gleice M. da Silva Rodrigues, Nady Rocha, Edison R.C. da Silva
Federal University of Paraíba, Brazil

0400 | A Simplified Modulated Model Predictive Control for Direct Matrix Converter
Xifei Liu, Xin Yin, Zhong Zeng, Sai Tang, Jun Wang
Hunan University, China

0836 | Computational Cost Efficient Model of Losses for Multi-Port Active-Bridge Converters
Soleiman Galeshi, David Frey, Yves Lembeye
Universite Grenoble Alpes, CNRS, France

0181 | A Constant Current Digital Control Method for Primary-Side Regulation Active-Clamp Flyback Converter
Chong Wang, Xiang Zhang, Daying Sun, Wenhua Gu
Nanjing University of Science and Technology, China

0535 | Development of a Two-Level VSC based DC Impedance Measurement Unit
Le Kong[1], Nattapat Praisuwanna[1], Liang Qiao[1], Fred Wang[1,2]
[1]The University of Tennessee-Knoxville, United States; [2]Oak Ridge National Laboratory; United States

0999 | DC Link Voltage Balancing of the Active Front-End for the Extreme Fast Charging Stations
Amirhossein Moeini, Sai Hemanth Kankanala, Jonathan W. Kimball
Missouri University of Science and Technology, United States

0188 | Small Signal Modeling of Switched Tank Converter with Partial Power Voltage Regulation
Zisen Liu, Yundong Ma, Fuchun Zhang, Huijun Lu
Nanjing University of Aeronautics and Astronautics, China

0822 | Capacitor Voltage Round-Robin Transmission Modes with Voltage-Ripple-Filtering Capability for an MMC Distributed Control System
Shunfeng Yang, Shun Liu, Hang Su, Wensheng Song, Bo Zhan
Southwest Jiaotong University, China

Virtual 1

Tuesday, October 13 **2:05PM-2:35PM**

P29 | Drive Applications

Chairs: Bilal Akin, Giacono Scelba

0176 | Optimisation and Design Performance of a Small-Scale DC Vernier Reluctance Machine for Direct-Drive Wind Generator Drives
Udochukwu B. Akuru[1], Maarten J. Kamper[2], Mkhululi Mabhula[2]
[1]Tshwane University of Technology, South Africa; [2]Stellenbosch University, South Africa

0372 | Analysis of Double-Output CLL Resonant Converter for All-Electric UAV Applications
Erdem Asa[1], Kerim Colak[2], Omer C. Onar[1], Dariusz Czarkowski[3], Burak Ozpineci[1]
[1]Oak Ridge National Laboratory, United States; [2]Hevo Power Inc., United States; [3]New York University, United States

0480 | Model Reference Adaptive Control of Pulse Amplitude Modulated PM Motor Drive for High Power Transport Drone Applications
Ching-Lon Huang, Chi-Jun Wu, Shih-Chin Yang
National Taiwan University, Taiwan

0961 | Investigation of a Reduced Cost Solution to implement integrated Safe Torque-OFF Function in Cascaded H-Bridge Motor Drives
Ahmed Abuelnaga[1], Mehdi Narimani[1], Marius Chis[2], Karthik Kandasamy[1], Navid Reza Zargari[2]
[1]McMaster University, Canada; [2]Rockwell Automation Canada, Canada

1465 | An Analytical Solution-Based Hybrid Operation of a Three-Level Converter Drive System for a Dynamic Load
Harish Pulakhandam, Subhashish Bhattacharya
North Carolina State University, United States

1542 | Modeling and Analysis of Sensor Error Effects on DC-Link Current Ripple in Switched Reluctance Machine Drives
Md Ehsanul Haque[1], Sifat M. Chowdhury[1], Omer Gundogmus[1], Anik Chowdhury[1], Yilmaz Sozer[1], Fernando Venegas[2], David Colavincenzo[2]
[1]The University of Akron, United States; [2]Bendix Commercial Vehicle Systems, United States

1141 | Comprehensive Efficiency Analysis of Current Source Inverter based SPM Machine Drive System for Traction Applications
Feida Chen, Wenda Feng, Hao Ding, Sangwhee Lee, Thomas M. Jahns, Bulent Sarlioglu
University of Wisconsin-Madison, United States

0311 | Model-Free Predictive Current Control of Doubly Fed Induction Generator
Tao Jiang[1], Yongchang Zhang[1], Jian Jiao[1], Wei Xu[2]
[1]North China University of Technology, China; [2]Huazhong University of Science and Technology, China

0817 | Resonant Frequency Tracking Control for a Linear Compressor with Assist Springs
Takahiro Suzuki[1], Masaki Koyama[1], Shuhei Nagata[1], Wataru Hatsuse[1], Masatsugu Takemoto[2], Satoshi Ogasawara[3]
[1]Hitachi, Ltd., Japan; [2]Okayama University, Japan; [3]Hokkaido University, Japan

0067 | PMSM Six-Step Operation and Dynamic Performance Analysis
Zhendong Zhang, Ahmed Sayed Ahmed, Jacob M. Lamb
Rockwell Automation, United States

0194 | Minimizating Pulsating Torque in PMSM Drives by using Feedforward-Based Compensation and Flux-Harmonic Estimation
Noriya Nakao[1], Kazuaki Tobari[1], Tomohiro Sugino[2], Yoshiki Ito[2], Mitsuhiro Mishima[2], Daisuke Maeda[2]
[1]Hitachi, Ltd., Japan; [2]Hitachi Power Semiconductor Device, Ltd., Japan

0422 | Optimal LCL Filter Design for a Regenerative Cascaded H-Bridge (CHB) Motor Drive
Zhituo Ni[1], Mehdi Narimani[1], Navid Reza Zargari[2]
[1]McMaster University, Canada; [2]Rockwell Automation Canada, Canada

1042 | Standstill Self-Commissioning of an Induction Motor Drive
Eemeli Mölsä[1], Lauri Tiitinen[1], Seppo Saarakkala[1], Luca Peretti[2], Marko Hinkkanen[1]
[1]Aalto University, Finland; [2]KTH Royal Institute of Technology, Sweden

1060 | Zero-Sequence Current Suppression with Dead-Time Compensation Control in Open-End Winding PMSM
Jae-Hoon Shim[1], Hyeon-gyu Choi[2], Jung-Ik Ha[1]
[1]Seoul National University, Korea; [2]Garrett Motion, Korea

1555 | Modulation Schemes for Balanced Inverter under Single Upper/Lower Switch Fault Conditions
Zhouzhou Wang, Hao Zeng, Bulent Sarlioglu
University of Wisconsin-Madison, United States

Virtual 2

Tuesday, October 13 **2:05PM-2:35PM**

P30 | Renewables and Energy Storage

Chairs: Zhiqiang (Jack) Wang, Yaosuo Xue

0614 | Solar PV Battery based System for Telecom Tower Application
Gaurav Modi, Bhim Singh
Indian Institute of Technology-Delhi, India

0460 | Grid-Integrated Solar PV fed SRM Water Pump Drive for Small-Scale Irrigation and Household Supply
Amarnath Yalavarthi, Bhim Singh
Indian Institute of Technology-Delhi, India

1357 | FACTS-Based Grid Interface Design with Embedded Energy Storage for Ocean Wave Power
Ali Shahbaz Haider, Ted K.A. Brekken, Yue Cao, Mario E. Magana
Oregon State University, United States

0710 | Evaluation of Wireless Communication Networks on Secondary Control in Underwater Microgrid
Luocheng Wang, Yongjie Guan, Tianze Chen, Ephraim Moges, Tao Han, Tiefu Zhao
University of North Carolina-Charlotte, United States

1064 | Optimization-Based Design of Power Architecture for 5G Small Cell Base Stations
Jorge Alejandro May Alvarez, Francisco Paz, Ignacio Galiano Zurbriggen, Martin Ordonez
The University of British Columbia, Canada

1258 | Lyapunov Energy Function based Control of a Soft Switching Solid State Transformer for Three-Phase Standalone Application
Vikram Roy Chowdhury, Rajendra Prasad Kandula, Deepak Divan
Georgia Institute of Technology, United States

1594 | Frequency Scanning-Based Contributions Identification of Current Control Loop and PLL on DQ Impedance Characteristics of Three-Phase Grid-Connected Inverter
Weihua Zhou[1], Yanbo Wang[1], Raymundo E. Torres-Olguin[2], Zhe Chen[1]
[1]Aalborg University, Denmark; [2]SINTEF, Norway

1336 | Optimization based Integrated Adaptive Control Architecture for Grid Connected Inverter (GCI)
Anuprabha Ravindran Nair, Michael Smith, Sukumar Kamalasadan
University of North Carolina at Charlotte, United States

Virtual 3

Tuesday, October 13 **2:05PM-2:35PM**

P31 | Gate Drivers, Modules and Packaging

Chairs: Tanya Gachovska, Hengzhao Yang

0947 | Large Signal Stability Analysis of Self-Turn-On in Switching Transients
Wen Zhang[1], Fred Wang[1,2]
[1]The University of Tennessee, United States; [2]Oak Ridge National Laboratory, United States

1375 | Voltage Balancing Control with Capacitor Charging Method for Series Connected SiC MOSFET Submodules
Inhwan Lee, Xiu Yao
University at Buffalo, United States

0189 | Novel GaN GIT Gate Driving Technique using Two-Step Turn-Off Fashion
Noriyuki Nosaka, Wataru Okada, Takeshi Uematsu, Toshiyuki Zaitsu
OMRON Corp., Japan

0696 | Reduction of the Crosstalk Conduction Effect of Parallel GaN HEMTs in Half-Bridge
Jean-Sylvio Ngoua Teu Ngoua Teu, Thanh-Long Le
Safran Tech, France

1206 | Gate Drive Power Supply for On-Board Marx Circuit using only Charging Path of Marx Capacitor
Keisuke Kusaka, Yosuke Ouchi, Jun-ichi Itoh
Nagaoka University of Technology, Japan

0082 | A Novel Double-Sided Cooling Inverter Leg for High Power Density EV based on Customized SiC Power Module
Xinmin Liu, Yiyang Yan, Cai Chen, Zongheng Wu, Yong Kang
Huazhong University of Science and Technology, China

1263 | Optimization of Common Source Inductance and Gate-Drain Capacitance for Reducing Gate Voltage Fluctuation after Turn-Off Transition
Yusuke Hatakenaka[1], Kazuhiro Umetani[2], Masataka Ishihara[1], Eiji Hiraki[1]
[1]Okayama University, Japan; [2]Tohoku University, Japan

1090 | High Performance Gate-Driver Power Supply for Multilevel-Based 1500 V Converters
Emanuel Serban, Mohammad Ali Saket, Martin Ordonez
The University of British Columbia, Canada

0459 | Current-Bunch: A Fast and Accurate Tool to Extract and Optimize Parasitics of Power Packaging
Liang Wang, Zheng Zeng, Yue Yu, Kaihong Ou, Jin Wang
Chongqing University, China

0164 | Enhancing Lifetime of Power Electronic Modules via Thermal Buffers
Alexander Stippich, Christoph H. van der Broek, Rik W. De Doncker
RWTH Aachen University, Germany

0367 | An Integrated approach to Developing Thermal Models for Automotive Electric Drives
Neelakantan Padmanabhan, Abraham Gebregergis, Santhosh Veigas
Veoneer US Inc., United States

Virtual 4

Tuesday, October 13 **2:05PM-2:35PM**

P32 | Converter Control and Modeling 3

Chairs: Yongheng Yang, Wei Du

0038 | Multifrequency Vibration Suppression of Magnetic Bearing Systems Applied Variable Step-Size Automatic Learning Control
Hongbo Sun, Dong Jiang, Jianfu Ding, Jichang Yang
Huazhong University of Science and Technology, China

0038 | A Reinforcement Learning-Based Data-Driven Voltage Regulator for Wireless Chargers of Electric Vehicles
Jiaxin Teng[1], Lizhi Qu[2], Dariusz Czarkowski[1]
[1]New York University, United States; [2]Toshiba International Corp., United States

0848 | A Double-Loop Maximum Power Point Tracking Algorithm for Dual-Input Phase-Shifted LLC Converter
Ala A. Hussein[1], Abdullah Alhatlani, Sumana Ghosh, Issa Batarseh
[1]Prince Mohammad Bin Fahd University, Saudi Arabia; [2]University of Central Florida, United States

0890 | Optimal Asymmetric Duty Modulation to Minimize Inductor Peak-to-Peak Current for a Dual Active Bridge Converter Over a Wide Voltage Range
Di Mou[1], Quanming Luo[1], Jia Li[1], Zhiqing Wang[1], Yuqi Wei[2], Jian Huang[1]
[1]Chongqing University, China; [2]University of Arkansas, United States

0555 | An Inductor Current Estimation Approach for DC/DC Converters based on Bisection Method
Zhe Zhao, Fei Diao, Yuheng Wu, Nan Lin, Yue Zhao
University of Arkansas, United States

0443 | Accelerated Model of Static Power Converter for Co-Phase Traction Power System
Zhuoxuan Shen[1], Xiaoqian Li[1], Yingdong Wei[1], Ziming Li[1], Mingrui Li[1], Haiping Guo[2], Qirong Jiang[1], Yunzhi Lin[2]
[1]Tsinghua University, China; [2]Electric Power Research Institute China Southern Power Grid, China; [3]China Railway Electrification Engineering Group Co., Ltd., China

1024 | Analysis of Rapid Control Prototyping Performance for Power Conversion Applications
Andrés Rón[1], Andrés Tarrasó[1], Álvaro Luna[1], Pedro Rodríguez[2]
[1]Universitat Politècnica de Catalunya, Spain; [2]Universidad Loyola Andalucía, Spain

0346 | Extended Two-Terminal Network Model of Parallel VSMs for Analysis of Active Power-Frequency Response
Jiaoxin Jia[1], Xiangwu Yan[1], Benshuang Qin[1], Abubakar Siddique[2], Bo Zhang[1]
[1]North China Electric Power University, China; [2]Khwaja Fareed University of Engineering & Information Technology, Pakistan

0715 | Extended Kalman Filter based State and Parameter Estimation Method for a Buck Converter Operating in a Wide Load Range
Muhammed Yusuf Candan[1,2], Mustafa Mert Ankarali[1]
[1]Middle East Technical University, Turkey; [2]Aselsan Inc., Turkey

1170 | Harmonic Filter with Low Coupling Capacitance for Medium Voltage, High DV/DT PWM Converters
Vaibhav Uttam Pawaskar, Van Thuan Nguyen, Ghanshyamsinh Gohil, Poras T. Balsara
The University of Texas at Dallas, United States

1558 | Estimation of the Internal Junction Temperatures of Resin Encapsulated IGBT Power Modules
Matteo Gregorio[1], Fausto Stella[1], Radu Bojoi[1], Fabio Pagani[2]
[1]Politecnico di Torino, Italy; [2]Prima Electro S.p.a., Italy

0612 | Modeling and Control of a Discontinuous Quasi-Switched Boost Cascaded Multilevel Inverter for Grid-Tied Applications
Truong-Duy Duong[1], Minh-Khai Nguyen[2], Young-Cheol Lim[1], Joon-Ho Choi[1], Caisheng Wang[2], Mahinda Vilathgamuwa[3]
[1]Chonnam National University, Korea; [2]Wayne State University, United States; [3]Queensland University of Technology, Australia

Virtual 1

Tuesday, October 13 **2:40PM-3:10PM**

P33 | Magnetic and Insulating Materials and Thermal Management

Chairs: Maeve Duffy, Zhiqiang (Jack) Wang

1456 | Low-Latency High-Speed Saturable Transformer based Zero-Crossing Detector for High-Current High-Frequency Applications
Dhrubo Rahman, M.A. Awal, Md Sariful Islam, Wensong Yu, Iqbal Husain
North Carolina State University, United States

1314 | Analysis and Prediction of AC Resistance of Litz Wire with Rectangular Cross-Section
Shota Kawahara[1], Kazuhiro Umetani[2], Eiji Hiraki[1]
[1]Okayama University, Japan; [2]Tohoku University, Japan

1474 | Design and Performance Evaluation of an Air-Core Inductor for a Point-of-Load (POL) Converter
Saket Jha, Sonam Acharya, Sanatnu Mishra
Indian Institute of Technology Kanpur, India

0713 | Evaluation of Temperature Effect on Inductance Computation in Variable Magnetic Components for Dual-Active-Bridge Application
Sarah Saeed[1], Jorge Garcia[1], Marina S. Perdigão{2,3}, Valter S. Costa{2,4}, Ramy Georgious{1,5}
[1]University of Oviedo, Spain; [2]Instituto de Telecomunicações, Portugal; [3]Coimbra Polytechnic-ISEC, Portugal; [4]University of Coimbra, Portugal; [5]Port Said University, Egypt

1601 | Investigation of Low-Pressure Condition Impact on Partial Discharge in Micro-Voids using Finite-Element Analysis
Moein Borghei, Mona Ghassemi
Virginia Polytechnic Institute and State University, United States

0653 | Reducing Local Concentrated Gap Loss of a Nanocrystalline Core by Applying Alloy Gap
Xuan Guo[1], Li Ran[1], Peter Tavner[2]
[1]University of Warwick, United Kingdom; [2]Durham University, United Kingdom

0466 | An Active Junction Temperature Control Method based on Thermoelectric Coolers
Xiaofeng Ding, Xinrong Song, Zhenyu Shan
Beihang University, China

1015 | Active Thermal Management for Enhancing Peak-Current Capability of Three-Phase Inverters
Christoph H. van der Broeck, Rik W. De Doncker
RWTH Aachen University, Germany

0044 | Expediting Transient Thermal Frequency Response Characterization and Sensitivity Analysis
Timothy A. Polom[1], Robert D. Lorenz[2]
[1]Silicon Austria Labs, Austria; [2]University of Wisconsin-Madison, United States

1420 | Power Module Design for Integrated Three-Phase Current Sensing using a Single 3-D Point Field Detector
Muhammad H. Alvi[1], Minhao Sheng[2], Robert D. Lorenz[2], Thomas M. Jahns[2]
[1]General Motor Research and Development, United States; [2]University of Wisconsin-Madison, United States

Virtual 2

Tuesday, October 13 **2:40PM-3:10PM**

P34 | HVDC, FACTS, Implementation and Reliability of Power Converters

Chairs: Ghanshyamsinh Gohil, Eduard Muljadi

0912 | Elimination of 2f Ripple in a Current Shared Interleaved Current Fed Switched Inverter
Sonam Acharya, Anil Gambhir, Santanu Mishra
Indian Institute of Technology Kanpur, India

0103 | Scalar Approach based PWM Strategy for Two-Level Three-Phase VSIs to Reduce Switching Losses and RMS Current in DC-Link Capacitors
Junhyuk Lee, Hyoung-Kyu Yang, Jung-Wook Park
Yonsei University, Korea

0064 | An Integrated Control Method for Improving the Input Current of Paralleled Vienna Rectifiers
Jiawei Ji[1], Zhao Liu[1], Jianshou Kong[2], Jie Yu[1], Yiyan Lu[1], Kui Xu[3]
[1]Nanjing University of Science and Technology, China; [2]Changshu Intelligent Laser Equipment Research Institute, China; [3]Jiangsu Nicetown Electric Power Automation Co., China

0021 | Post Production PMSM Position Sensor Offset Error Quantification via Voltage Estimation
Sandun S. Kuruppu, Yu Zou
Saginaw Valley State University, United States

0031 | Advances of Modeling and Reduction of Conducted and Radiated EMI in Flyback Converters
Juntao Yao, Yiming Li, Zhedong Ma, Shuo Wang
University of Florida, United States

0344 | Fault-Tolerant Control Strategy for Reduced Torque Ripple of Independent Twelve-Phase BLDC Motor Drive System under Open-Circuit Faults
Hyeoncheol Park, Yongsug Suh
Jeonbuk National University, Korea

0378 | Investigation of Dynamic Temperature-Sensitive Electrical Parameters for Medium-Voltage Low-Current Silicon Carbide and Silicon Devices
Ze Ni[1,2], Sheng Zheng[1], Madhu Sudhan Chinthavali[1], Dong Cao[3]
[1]Oak Ridge National Laboratory, United States; [2]North Dakota State University, United States; [3]University of Dayton, United States

0060 | An Overvoltage-Less Protection Method for Pole-to-Ground Faults in Symmetrical Monopole HVDC Systems by Half-Bridge MMC
Kenichiro Sano, Hiro Nakayama
Tokyo Institute of Technology, Japan

0499 | Research on a Multi-Line Electromagnetic Sen Transformer Suitable for Distribution Network
Shunkai Xu, Jiaxin Yuan, Shan Yin
Wuhan University, China

0062 | High Power Density Power Electronic Transformers using ISOS Multi-Cell Full-Wave Rectifier with GaN TCM Virtual Capacitor Converters
Yusuke Hayashi, Hongliang Su, Kazuto Takao
Toshiba Corp., Japan

1301 | Sorting-Selecting Modulation Technique for Double-Capacitor Sub-Modules based Modular Multi-Level Converters
G. Veera Bharath, Ghanshyamsinh Gohil
University of Texas at Dallas, United States

1559 | Backstepping Control for Multilevel STATCOM
A.M. Saif[1,2], M. Tinari[1,2], P. Ciammaichella[2], C. Buccella[1,2], S. Di Gennaro[1], C. Cecati[1,2]
[1]University of L'Aquila, Italy; [2]DigiPower srl, Italy

0116 | Coordinated Control of Power and Current of MMC-HVDC and Circulation Suppression in Unbalanced Power Grid
Hongbin Pan, Jiale Zhang, Cheng Deng, Haohao Ruan, Shixiang Ma
Xiangtan University, China

1100 | Over-Current Protection for Series-Connected IGBTs based on Desaturation Detection
Lu Yue, Muhammad Abubakr Saeed, Inhwan Lee, Xiu Yao
State University of New York at Buffalo, United States

0533 | Active Damping Control of Multi-Port DC Power Flow Controller for Suppressing Power Oscillation of MMC-MTDC under Unbalanced Grid
Wen Wu, Xuezhi Wu, Long Jing
Beijing Jiaotong University, China

Virtual 3

Tuesday, October 13 **2:40PM-3:10PM**

P35 | Other Devices, Components, and Materials

Chairs: Mona Ghassemi, Ramanujam Ramabhadran

0507 | A Data-Based IGBT Model for Efficient and Accurate Electro-Thermal Analysis
Jianpeng Wang[1], Meng Xu[1], Jin Zhang[1], Laili Wang[1], Yongmei Gan[1], Tomoyuki Yamazaki[2]
[1]Xi'an Jiaotong University, China; [2]Fuji Electric Co., Ltd., Japan

0335 | Accurate Temperature-Dependent IGBT Model for Predicting Commutation Voltage Overshoot in MW-Level Power Converters
Ariya Sangwongwanich[1], Francesco Iannuzzo[1], Rui Wu[2], Morten Hygum[2], Frede Blaabjerg[1]
[1]Aalborg University, Denmark; [2]Vestas Wind Systems A/S, Denmark

1395 | Enabling High Efficiency in Low-Voltage Soft-Switching Current Source Converters
Aniruddh Marellapudi, Mickael J. Mauger, Prasad Kandula, Deepak Divan
Georgia Institute of Technology, United States

0827 | High Current, High Bandwidth Current Measurement Techniques
Tianqi Zhang[1], Edward Shelton[2], Luke Shillaber[1], Patrick Palmer[3]
[1]University of Cambridge, United Kingdom; [2]Cambridge Design Partnership, United Kingdom; [3]Simon Fraser University, Canada

0753 | Design of a 200 kW Medium-Frequency Transformer (MFT) with High Insulation Capability
Zhicheng Guo, Soumik Sen, Sanjay Rajendran, Qingyun Huang, Xianyong Feng, Alex Q. Huang
University of Texas-Austin, United States

0247 | A Passive Integration Unit for Current-Feed Single-Switch Resonant Converter
Cheng Deng[1,2], Jiang Bo[1], Andrés Escobar-Mejía[3]
[1]Xiangtan University, China; [2]Hunan Province Cooperative Innovation Center for Wind Power Equipment and Energy Conversion, China; [3]Universidad Tecnológica de Pereira, Colombia

0618 | Design and Optimization Methodology of Transformer for 700/400 V Series Resonant DC/DC Converters with Enhanced Power Density
Alex Buus Nielsen{1,3}, William Gerard Hurley[2], Pooya Davari[1], Maeve Catherine Duffy[2], Frede Blaabjerg[1], Bo Vork Nielsen[3]
[1]Aalborg University, Denmark; [2]National University of Ireland-Galway, Ireland; [3]Illinois Tool Works Ground Support Equipment, Denmark

0756 | Design of Insulation System in High-Frequency Auxiliary Power Supply for Medium Voltage Applications
Ning Yan[1], Qin Chen[2], Dong Dong[1], Rolando Burgos[1]
[1]Virginia Polytechnic Institute and State University, United States; [2]Applied Materials, United States

0141 | Effects of Supercapacitor State of Charge on its Maximum Charge Delivery Capability
Hengzhao Yang
New Mexico Institute of Mining and Technology, United States

0308 | A Thermal Management Strategy for Smoothing the Mission Profile Thermal Cycle of Power Device in the Wind Power Converter
Jun Zhang[1], Xiong Du[2], Heng-Ming Tai[3]
[1]Hohai University, China; [2]Chongqing University, China; [3]University of Tulsa, United States

0284 | Comparison of Two Hollow-Shaft Liquid Cooling Methods for High Speed Permanent Magnet Synchronous Machines
Runyu Wang, Xinggang Fan, Dawei Li, Ronghai Qu
Huazhong University of Science and Technology, China

0942 | Enhanced Inductance and Winding Loss Model for Coupled Inductors
Han Cui[1], Lingxiao Xue[2], Khai Ngo[3]
[1]The University of Tennessee, United States; [2]Oak Ridge National Laboratory, United States; [3]Virginia Polytechnic Institute and State University, United States

0821 | High-Precision Simulation for Structure and Efficiency Optimization of High-Power High-Frequency Transformer
Zheyuan Yi[1], Kai Sun[1], Shilei Lu[1], Guoen Cao[2], Yongdong Li[1], Jung-Ik Ha[3]
[1]Tsinghua University, China; [2]Chinese Academy of Sciences, China; [3]Seoul National University, Korea

1345 | Virtual Prototyping of MV and HV Modular Multilevel Power Converter using Evolutionary Optimization based on ρ and η
Rounak Siddaiah, William J. Koebel, Robert M. Cuzner
University of Wisconsin-Milwaukee, United States

Virtual 4

Tuesday, October 13 **2:40PM-3:10PM**

P36 | Power Converter EMI and Stability

Chairs: Min Chen, Malik Elbuluk

0366 | Common Mode EMI Mitigation at a Power Converter Network
Ashik Amin, Seungdeog Choi
Mississippi State University, United States

0392 | An EMI Suppression Strategy for Si/SiC Hybrid Switch based Single-Phase Inverter
Ling Ou, Zishun Peng, Zeng Liu, Xiaogui Peng, Jun Wang, Shuaige Zhu, Qihui Fu
Hunan University, China

1537 | Reduction of Electromagnetic Interference (EMI) in Interleaved DC-DC Converters
Mohammad Arifur Rahman, Yilmaz Sozer, J. Alexis De Abreu-Garcia
The University of Akron, United States

1425 | Common-Mode EMI Examination of Three-Phase Voltage-Source and Current-Source Converters Systems using WBG Devices
Hang Dai, Renato A. Torres, Jerome Gossmann, Woongkul Lee, Thomas M. Jahns, Bulent Sarlioglu
University of Wisconsin-Madison, United States

0934 | CAN Signal Processing for EMI Reduction Cooperating with Switched-Mode Power Supply
Ryo Shirai, Keiji Wada, Toshihisa Shimizu
Tokyo Metropolitan University, Japan

1211 | Comparison of High-Frequency Impedance of AC Machines with Circumferential and Toroidal Winding Topologies for SiC MOSFET Machine Drives
Sangwhee Lee, Mingda Liu, Woongkul Lee, Bulent Sarlioglu
University of Wisconsin-Madison, United States

0648 | A Condition to Get Rid of Slope Compensation in Peak Current-Mode Controllers
Hideaki Funaki[1], Atsushi Mishima[1], Masahito Shoyama[1], Yuichi Noge[1], Tomonori Kimura[2], Takahiro Yamada[2], Gamal M. Dousoky[3]
[1]Kyushu University, Japan; [2]MIRISE Technologies Corp., Japan; [3]Minia University, Egypt

0824 | Accurate *dq* Frame Modeling of a Three-Phase PWM Converter with Digital Control Delay
Bo Zhan, WenSheng Song, Jinhui Chen, Shunfeng Yang, Shun Liu
Southwest Jiaotong University, China

0964 | Positive-Negative Sequence SRF-PLL Model for Accurate Stability Analysis in Grid-Tied Converters
Sante Pugliese, Yongdae Kwon, Marco Liserre
Christian-Albrechts-Universität Kiel, Germany

Products and Services Sessions

These half-hour, industry-driven sessions, provide an in-depth look from our exhibitors, showcasing their innovative products and services.

ROHM PRODUCTS & SERVICES SESSION

MATHWORKS PRODUCTS & SERVICES SESSION

EGSTON POWER PRODUCTS & SERVICES SESSION

ON PRODUCTS & SERVICES SESSION

Student Demonstrations

Student Demonstrations provide an opportunity for students from various universities and countries to showcase their emerging technology research outcomes and interact with academia and industry.

Since 2011, ECCE has organized the hardware demo event for students to showcase their research outcomes and interact with academia and industry.

This year's event will be fully virtual. Instead of presenting demos in-person, project teams will submit 5-minute videos showcasing their demos using slides with voiceover and live footage. **Video available for viewing on the ECCE virtual platform to ECCE attendees October 9 - November 16, 2020.**

Each project demonstration will be evaluated by a judging panel comprising members from the industry and the academia. The panel members will select the top three project demonstrations based on originality/creativity, engineering design, value to practical applications, presentation, and audience appeal.

Mentors + Advocates: How to be one + How to find one

Sponsored by **IEEE PELS**

Date: **October 14, 2020**

Time: **10am EST** or **9pm EST** *(participants choose one time)*

A successful career typically has benefited from coaches, mentors, advocates and sponsors. Do you know the difference between them? Do you know when you need one or how you can be one? In this virtual event, you will learn the difference between these different roles, as well as how you can find or be a part of the career evolution process for yourself and others. This event includes facilitated small group discussions applicable to everyone at all career levels.

To launch the discussion, this event includes a pre-event screening of the award-winning documentary, Pioneers in Skirts. This film provides a unique focus on the challenges in achieving gender parity in our culture.

Come be part of a transformative conversation supporting inclusion at all levels of our Power Electronics community. Leave the event with new tools to fully engage everyone in our community and achieve the full potential of Power Electronics' impact on the world.

Registration Link:
https://app.smartsheet.com/b/form/e637ed14562748fc95396b5c48eb6dfc

Women in Engineering (WiE) Discussion Event

Exhibitor Listing

EGSTON POWER

HOW2POWER.COM
Answering Your Questions About Power Design

OPAL-RT TECHNOLOGIES

ON®

WILEY

ECCE 2021

IEEE ENERGY CONVERSION CONGRESS & EXPO

Vancouver, Canada ≋ Oct. 10-14

IMPORTANT DATES

January 15, 2021
Digest submission

May 1, 2021
Author notification

June 30, 2021
Final papers with
IEEE copyright forms

IEEE

IAS IEEE INDUSTRY APPLICATIONS SOCIETY Linking Research to Practice

pels IEEE POWER ELECTRONICS SOCIETY Powering a Sustainable Future

General Chair
Giovanna Oriti
Naval Postgraduate School, USA

ECCE 2021 Technical Program Co-Chairs
Contact email: ecce2021tpc@gmail.com

Jean-Luc Schanen
Univ. Grenoble Alpes- G-INP, France
Luca Zarri
Univ. Bologna, Italy
Mark Scott
Miami University, USA
Gianmario Pellegrino
Politecnico di Torino, Italy
Michael Harke
Collins Aerospace, USA
Elisabetta Tedeschi
NTNU, Norway / Univ. Trento, Italy

The Thirteenth Annual IEEE Energy Conversion Congress and Exposition (ECCE 2021) will be held in Vancouver, British Columbia, Canada, from October 10 to October 14, 2021. ECCE is a pivotal international event on energy conversion. ECCE 2021 will feature both industry-driven and application-oriented technical sessions as well as an exposition. The conference will bring together practicing engineers, researchers and other professionals for interactive and multidisciplinary discussions on the latest advances in areas related to energy conversion.

Technical papers are solicited on any subject pertaining to the scope of the conference including, but not limited to, the following major topics:

Energy Conversion Systems and Applications

- Renewable and alternative energy
- Smart grids, micro-grids, and utility applications
- Electrical energy storage
- Energy conversion for information technology and communication systems
- Energy harvesting
- Energy efficiency for residential, commercial, and industrial applications
- Big data and machine learning applications in energy conversion
- Wireless power transfer
- Lighting applications and displays
- Transportation electrification
- High power/voltage power conversion
- High voltage isolation and lightning strike protection
- Electric machines and drives for transportation electrification

Component, Converter and Subsystem Technologies

- Power electronic devices (silicon and wide bandgap) and applications
- Passive components and materials
- Power electronic packaging, integration, and advanced manufacturing
- Reliability, advanced fault protection systems, diagnostics, prognostics, and equipment health management
- Thermal management and advanced cooling technologies
- Electromagnetic interference and electromagnetic compatibility
- Power conversion topologies, modulation, and control
- Electrical drive systems and topologies and their control
- Modeling and control of components, converters, and systems
- Rotating/linear electro-mechanical devices

Digest Submission: Prospective authors are requested to submit a single column, single spaced digest no longer than five (5) pages summarizing the proposed paper. The digest should include key equations, figures, tables, and references as appropriate, but no author names or affiliations. ***Digests not conforming to these requirements will be rejected without review.*** The digests must clearly state the objectives of the work, its significance in advancing the state of the art, and the methods and specific results in sufficient detail. All digests will go through a double-blind peer review process to ensure a confidential and fair review. The papers presented at the conference will be included in the IEEE Xplore Digital Library. Please refer to the conference website for a detailed list of technical topics and the digest submission method.

IEEE ENERGY CONVERSION CONGRESS & EXPO

Vancouver, Canada ≋ Oct. 10-14

IMPORTANT DATES

February 12, 2021
Tutorial proposal due

April 2, 2021
Notification of acceptance

June 30, 2021
Full tutorial materials due

IEEE

IAS IEEE INDUSTRY APPLICATIONS SOCIETY Linking Research to Practice

pels IEEE POWER ELECTRONICS SOCIETY Powering a Sustainable Future

General Chair
Giovanna Oriti
Naval Postgraduate School, USA

Tutorial Co-Chairs
Yue Cao
Oregon State University, USA

Katherine A. Kim
National Taiwan University, Taiwan

The 13th Annual IEEE Energy Conversion Congress and Exposition (ECCE 2021) will be held in Vancouver, British Columbia, Canada, from October 10 to October 14, 2021. ECCE is a pivotal international event on energy conversion. A diverse portfolio of tutorials are solicited: 1) Basic knowledge in a particular subfield of power electronics or energy conversion, from components to systems; 2) Emerging technology in either fundamental breakthroughs or new applications; 3) Industry skillsets or tools with knowledge beyond textbooks or academic papers. All tutorials are held on Sunday, October 10, 2021, either morning or afternoon. Each tutorial is 3 hours long, excluding break times. Each accepted tutorial will receive one conference registration together with an honorarium of $1,000. Note that publication of a technical paper will still require a paid full registration.

One or more of the following elements are *strongly encouraged* in the tutorial proposals: A) Industry led or co-hosted lectures; B) Interactive instructor-audience approaches, including hands-on; C) ECCE 2021 regionally oriented topics; D) Collaborative cross-disciplinary topics or teams; E) Other creative topics or formats that engage the audience.

Factors considered as *less attractive* to the audience are: a) Narrowly focused topics; b) Theory heavy lectures; c) Similar tutorial topics or teams from the immediate past ECCE or other major PELS conferences; d) Solicitation of a particular product or service.

Potential topic areas include but are not limited to:

Energy Conversion Systems and Applications

- Renewable energy, including under-represented ocean-wave, tidal, geothermal
- Smart grids, micro-grids, nano-grids
- Electrical energy storage, including real physics or controlled virtual storage
- Energy conversion for information technology and communication systems
- Energy harvesting and conversion
- Smart and energy efficient buildings
- Energy efficiency for advanced manufacturing
- Big data and machine learning in energy conversion
- Cybersecurity in power electronics based systems
- Transportation electrification, including aircraft and urban aerial mobility
- Battery charging technologies
- Resiliency in energy systems

Component, Converter and Subsystem Technologies

- Power electronic devices
- Power conversion topologies, modeling, and control
- Electric machines and drives
- Passive components, magnetics, and materials
- Packaging, integration, and advanced manufacturing
- EMI and EMC
- Thermal management, advanced cooling technologies
- Wireless power transfer
- High voltage power conversion, including insulation technologies
- Design automation or optimization
- Reliability, diagnostics, prognostics, and health management
- Fault-tolerant converters and systems

Others

- Schematic and PCB layout designs
- Pedagogy for undergraduate learning or under-represented groups
- Post-COVID technology innovations

Proposal Submission and Review Process: All tutorial proposals should be submitted via the ECCE 2021 web portal under **"Call for Tutorials"**. Please follow the Tutorial Proposal Form on the website as a submission template. The proposals will be reviewed by a panel of subject matter experts.

IEEE ENERGY CONVERSION CONGRESS & EXPO 2021 Vancouver, Canada Oct. 10-14

Tutorial Proposal Form

Format: Maximum 5 pages. All pages are formatted to 8-1/2 by 11 inch or A4 paper with margins of one inch on every side. All texts use single space, Times New Roman, black ink, and a font size of 11 or 12.

Recommended Sections:

1. Tutorial Title

2. Instructor Team

name(s), affiliation(s), and contact information

3. Abstract

No more than 500 words. Accepted abstract will be published through the conference website, program, and proceedings.

4. Tutorial Outline

Outline shall only define the topics and subtopics. No detailed descriptions please. Time allocation and instructor breakdown by topics is recommended.

5. Lecture Style and Requirements

Briefly describe the tutorial format, which may include traditional lecture, software/hardware demonstration, interactive audience polls/quizzes, worksheets, discussion, etc. Note any equipment or space requirements beyond a laptop and projector. Also list the targeted audience and tutorial difficulty level, including any pre-requisite knowledge.

6.Instructor Biography

No more than 200 words for each person. Each biography shall include the qualifications most relevant to the proposal. Past tutorial/teaching experience and outcome can be highlighted. External website link can be included but may not be reviewed.

IEEE ENERGY CONVERSION CONGRESS & EXPO

Vancouver, Canada ≋ Oct. 10-14

IMPORTANT DATES

March 31, 2021
Proposal submission deadline

May 1, 2021
Notification of session acceptance

June 1, 2021
Final session plan submission deadline

The Thirteenth Annual IEEE Energy Conversion Congress and Exposition (ECCE 2021) will be held in Vancouver, British Columbia, Canada, from October 10 to October 14, 2021. ECCE 2021 will bring together practicing engineers, researchers, and other energy conversion professionals for interactive and multidisciplinary discussions on the latest advances in the areas related to energy conversion.

Special Sessions are solicited focusing on emerging technologies and industry-oriented topics, featuring diversified formats including oral presentations, open panel discussions, debates, virtual factory tour and demo, etc. Industry hosted or co-hosted sessions are of particular interest, and audience participation is strongly encouraged. Note that commercialization content should be avoided, and no written papers are required for Special Session presentations. Materials presented in the Special Sessions are not subject to peer review and will not be made available in the conference proceedings. However, presenters are encouraged to distribute their presentations to the audience.

Potential topic areas include but are not limited to:

Components and Converters

- Wide bandgap devices and their emerging applications in power electronics
- Artificial intelligence (AI) aided converter control and design
- Thermal management, and advanced cooling technologies
- Reliability, diagnostics, and prognostics of components and modular systems
- Electric machine design and motor drives
- Advanced technologies for power electronics such as materials, 3-D printing, magnets, magnetic devices, capacitors, switching devices, EMI/EMC, etc.

Power Electronics Intensive Energy Conversion Systems

- Renewable energy systems, energy storage systems, and their integration into modern electric grids
- AC, DC, and hybrid micro-grids and nano-grids
- Power electronic based grid infrastructures: technologies, trend, and grid integration
- Resiliency enhancement and active stabilization of power electronics based power systems
- Transportation electrification, including electric vehicles, aircraft, ships, drones, etc.
- Cybersecurity in power electronic inverters and inverter dominated energy systems

Others

- Advanced testing and validation, including controller/power hardware-in-the-loop testing, etc.
- Standard development for power electronics systems/products
- Power electronics education and research for under-represented groups
- COVID-related innovations with power electronics technologies

Proposal Submission Guidelines: Special Session organizers are requested to submit a maximum five-page proposal summarizing the proposed session plan. The proposal should indicate the session format and should contain the session title, session organizer, presenters or panelists (with short biography), abstract, etc. All proposals should be submitted via the ECCE 2021 website under "Call for Special Sessions".

General Chair
Giovanna Oriti
Naval Postgraduate School, USA

Special Session Chairs
Xiaonan Lu
Temple University, USA

Fei Ding
National Renewable Energy Laboratory, USA

www.ieee-ecce.org/2021 Vancouver, Canada – October 10 – October 14 , 2021

Vancouver, Canada

SAVE the DATE

10–14 October 2021

ECCE

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2021

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