IEEE ENERGY CONVERSION CONGRESS & EXPO BALTIMORE, MD ▲ SEPT. 29 - OCT. 3

PROGRAM

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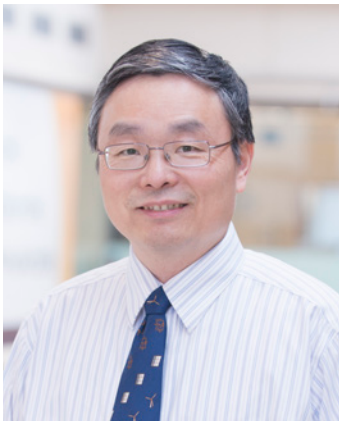

It is my great pleasure to welcome all of you to Baltimore for the 11th Annual Energy Conversion Congress and Exposition, ECCE 2019, sponsored by the IEEE Power Electronics Society (PELS) and the IEEE Industry Application Society (IAS).

As the world's leading technical conference and exposition for energy conversion solutions, ECCE provides an excellent opportunity to researchers, engineers, graduate and undergraduate students, and other professionals from all over the world with vastly different backgrounds in energy conversion for the exchange of technical knowledge, networking, and exposure to the latest technologies. ECCE is unique in our emphasis on integrated systems, presenting the best in current energy conversion research, as well as innovations from more traditional component topics.

ECCE 2019 features an emphasis on the new challenges in the energy conversion industry. Our plenary speakers include Dr. Babu Chalamala, Manager of the Energy Storage Technology and Systems Department, Sandia National Laboratories; Dr. Lauren Boteler, U.S. Army Research Laboratory (ARL), Advanced Power Electronics Group; Dr. Alain Charles, Vice President, Technology Development Center, Infineon Technologies Americas Corp.; Mr. Christopher P. Manning, Director of the Command, Power and Integration Directorate (CP&ID); and Dr. Don Tan, NGAS Distinguished Engineer and Power Products Manager, Northrop Grumman Aerospace Systems. We are extremely fortunate to have these five distinguished leaders from industry and the scientific community to share their wisdom and visions with us.

The Technical Program Committee (TPC) of ECCE 2019 has made significant effort to expand the technical program to 154 Oral Sessions and 28 Poster Sessions, featuring a total of 1,069 technical papers, which are selected from 1,779 digests. Among these oral sessions, four memorial sessions have been dedicated to three of our colleagues who passed away in the past year: Prof. **Bob Lorenz** (Electric Machines), Prof. **Manfred Depenbrock** (Direct Torque Control), and Dr. **Milan M. Jovanovic** (High Efficiency Power Supplies).

I would like to call your attention to two of the 18 Special Sessions of ECCE 2019. The Special Session Virtual Factory Tours will bring the audience into the actual production floor of four energy conversion companies. The Special Session Empower Billion Lives (EBL) will showcase the global final competition to select 5 global winners from 23 global finalists selected from five regional rounds of competition.

The publication chairs of ECCE 2019 have provided an instruction sheet in your conference bag to show you the way to set the Adobe Reader so that the papers will be opened in a separate window. This will help you read the conference proceedings more efficiently and conveniently.

ECCE 2019's professional program starts on Sunday with 18 tutorials that offer an in-depth discussion of important and complex technical topics combining practical applications with theory. In addition, our partners and exhibitors will demonstrate their state-of-the-art technologies, products and solutions, creating a highly interactive network environment in the Exhibition Hall.

ECCE is similar to a homecoming event, designed for you to catch up with old friends and meet new ones. This year, ECCE 2019 is once again co-located with the 2019 Industry Application Society (IAS) Annual Meeting (AM). The technical and professional programs of ECCE 2019 will be held in the Baltimore Convention Center and the technical and professional program of the 2019 IAS AM will be held in the Hilton Hotel. However, 2019 IAS AM attendees are invited to join the Plenary Session, as well as our social functions, such as the Welcome Reception, Expo Opening Reception, Industry Night Out, and Award Luncheon. I would warmly welcome those who are new to ECCE and we hope to see you at our ECCE Newcomers session, just after the Sunday Welcome Reception.

I would like to express my utmost gratitude to the members of the ECCE 2019 Organization Committee, the ECCE Steering Committee, and SmithBucklin, who have made this event possible, through their hard work, selfless dedication, as well as numerous extra hours. I would like to thank PELS and IAS for their sponsorship and stewardship, and the generous support of all our corporate partners. 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 welcome you to ECCE 2019 in Baltimore.

With my best regards,

Yan-Fei Liu

Dr. Yan-Fei Liu
General Chair IEEE ECCE 2019

WELCOME FROM TECHNICAL PROGRAM CHAIRS

Electrical energy conversion is a driving force to recent changes in both industry and our society. Energy from solar, wind, ocean and tidal wave, heat, or fuel sources can be transformed into, and effectively transported and distributed in the form of electrical energy. The use of electrical energy is ubiquitous and the new trend in electrification of the transportation, manufacturing and other sectors will further its reach. Energy conversion plays a critical role in the entire electrical system and presents unique opportunities for technological and business development, innovation, and collaboration among industry, research laboratories and academic institutions.

Since the start of the conference series in 2009, ECCE has been at the forefront of fostering such development and collaboration by providing an international forum for presenting the latest technologies, exchanging new ideas, and discussing future challenges. There has been a continuous growth in the numbers of technical papers submitted, the topics covered and worldwide attendance representation. We are pleased that you have selected ECCE to be one of the top events to participate in and greatly appreciate your support as authors, reviewers, session and topic chairs, exhibitors and attendees.

This year, for the 11th edition of ECCE, we received 1779 valid digests from authors all around the globe. Each digest was assigned to three to five experts in the field for review. The Technical Program Committee (TPC), which consists of Chairs, Associate Chairs, Vice Chairs, and Topic Chairs, organized the review process. The TPC met in early April to collectively make the final decision and develop the program which we are proud to present to you here. The program includes 1069 technical papers presented in 15 parallel oral sessions and 28 poster sessions. Additionally, the program also includes 18 presentation-only special sessions that are scheduled throughout the week.

All papers presented at ECCE 2019, will be uploaded to IEEE Xplore Digital Library and made available to the world research community. Please reference this official conference policy if your institution requires conference attendance justification. Following ECCE 2019, depending on the topics, all presented papers are eligible for submission to IEEE Transactions on Industry Applications or Power Electronics. For more specific policy about submission to each of these journals, please contact its editorial board or the relevant technical committee of IAS.

On behalf of the entire Technical Program Committee, we hope that you will consider 2019 to be one of the best ECCE events yet. We look forward to seeing you in Baltimore. Once again, we want to give our gratitude to all of you who have contributed to ECCE2019.

Sincerely,

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GENERAL INFORMATION

Registration Hours

Pratt Street Lobby

Saturday, September 28 . . . . . 5:00PM – 7:00PM

Sunday, September 29 . . . . . 7:30AM – 7:00PM

Monday, September 30. . . . . 7:30AM – 6:00PM

Tuesday, October 1 . . . . . 7:30AM – 5:00PM

Wednesday, October 2 . . . . . 7:30AM – 7:00PM

Thursday, October 3 . . . . . 7:30AM – 12:00PM

Expo Hall Hours

Exhibit Hall FG

Monday, September 30. . . . . 4:30PM – 7:30PM

Tuesday, October 1 . . . . . 10:30AM – 5:00PM

Creative Digressions

Monday through Thursday

Room 333

Creative Digression rooms are available to attendees requiring a break from busy conference activities. Rooms will be equipped with large tables, note pads, easels and white boards in order to facilitate one-on-one discussions, idea generation sessions, business meetings, or social interactions. Coffee and tea will also be available.

Family Room

Monday through Thursday

Room 334

Family rooms are available for use by attendees with young children. These rooms will serve as a safe space for children to rest, enjoy complimentary snacks, watch videos, or create art with crayons and paper during the conference hours. All children must be supervised by a parent or family member at all times. Additionally, a nursing room is available on the 3rd floor of the Convention Center for nursing mothers.

Wi-Fi

Attendees have full access to Wi-Fi in the meeting space, foyer, and exhibit hall.

Network: ECCE WiFi (Password ecce19)

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Download the ECCE 2019 mobile app to access all things related to the conference, including session information, exhibitors and locations, floor plans, timely notifications, and more! Visit the Apple Store and Google Play Store and search 'ECCE2019'.

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

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Exhibitors: Exhibitors may only distribute commercial materials in their booth, at Exhibitor Product Demos they are conducting and at press conferences they are holding. ECCE reserves the right to remove without notice any materials not in compliance with this policy.

Non-Exhibitors: Distribution of commercial material in the ECCE 2019 hotel space (including directly to the hotel rooms of ECCE participants), meeting space and Exhibit Hall by people or organizations not participating in the Exposition is prohibited. ECCE reserves the right to remove without notice any materials not in compliance with this policy.

SCHEDULE-AT-A-GLANCE

SUNDAY, SEPTEMBER 29

8:00AM – 11:45AM	**AM Tutorials**	
11:45AM – 12:30PM	**Lunch On Your Own**	*Available for purchase in the Pratt Street Lobby*
12:30PM – 4:15PM	**PM Tutorials**	
4:30PM – 5:30PM	**PELS Membership Town Hall Meeting (MTM)**	*Room 325*
5:00PM – 7:00PM	**Registration Open**	*Pratt Street Lobby*
6:00PM – 8:00PM	**ECCE Welcome Reception**	*Camden Lobby*
7:30PM – 9:30PM	**IAS-IPCSD Department Meeting**	*Room 331*
8:00PM – 8:30PM	**Newcomers Orientation**	*Room 344*

MONDAY, SEPTEMBER 30

7:30AM – 7:00PM	**Registration Open**	*Pratt Street Lobby*
7:30AM – 8:30AM	**Oral Presenter Breakfast**	*Baltimore Ballroom*
8:30AM – 11:15AM	**Plenary Session**	*Baltimore Ballroom*
11:15AM – 12:30PM	**Lunch On Your Own**	*Available for purchase in the Pratt Street Lobby*
12:00PM – 1:00PM	**IEMDC 2021 Organizing Committee** *(Invitation only)*	*Room 331*
12:30PM – 2:10PM	**Technical Program: Oral Sessions**	*300-level Meeting Rooms*
	Special Session: Launching of ITRW 1.0	*Room 327*
	Special Session: Bidirectional DC-DC Converters for Medium and Low Voltage DC Power Systems – A	*Room 329*
	Special Session: Sustainable Energy Systems and Opportunities for Power Electronics – A	*Room 328*
2:10PM – 2:20PM	**PM Break**	
2:20PM – 4:20PM	**Technical Program: Oral Sessions**	*300-level Meeting Rooms*
2:20PM – 4:25PM	**Special Session: Bidirectional DC-DC Converters for Medium and Low Voltage DC Power Systems – B**	*Room 329*
	Special Session: Sustainable Energy Systems and Opportunities for Power Electronics – B	*Room 328*
4:30PM – 7:30PM	**Student Demonstrations on Emerging Technology**	*Student Demonstration Lounge, Exhibit Hall FG*
	Expo Hall Opening Reception	*Exhibit Hall FG*
5:00PM – 7:30PM	**Technical Program: Poster Sessions**	*Exhibit Hall FG*
7:30PM – 8:30PM	**Women In Engineering Evening Event**	*Room 327*

TUESDAY, OCTOBER 1

7:30AM – 7:00PM	**Registration Open**	*Pratt Street Lobby*
7:30AM – 8:30AM	**Oral Presenter Breakfast**	*Baltimore Ballroom*
8:30AM – 10:10AM	**Technical Program: Oral Sessions**	*300-level Meeting Rooms*
	Special Session: Empower Billion Lives – A	*Room 328*
	Special Session: Special Session: Virtual Factory Tours	*Room 327*
10:10AM – 10:30AM	**AM Break**	
10:10AM – 12:10PM	**Special Session: Empower Billion Lives – B**	*Room 328*
10:30AM – 1:00PM	**Technical Program: Poster Sessions**	*Exhibit Hall FG*
10:30AM – 5:00PM	**Expo Hall Open**	*Exhibit Hall FG*
12:15PM – 2:30PM	**Lunch in the Exhibit Hall**	*Exhibit Hall FG*
1:30PM – 3:00PM	**Student Demonstrations on Emerging Technology**	*Student Demonstration Lounge, Exhibit Hall FG*
2:00PM – 3:40PM	**Special Session: Empower Billion Lives — C**	*Room 328*
2:30PM – 5:00PM	**Technical Program: Poster Sessions**	*Exhibit Hall FG*
3:00PM – 4:00PM	**IAS Transportation Systems Committee (TSC) Meeting**	
	IAS-IPCSD – Standards Meeting	*Room 331*
4:00PM – 5:00PM	**IAS-IPCSD – Editorial Meeting**	*Room 331*
4:00PM – 5:40PM	**Special Session: Empower Billion Lives — D**	*Room 327*
4:30PM – 6:30PM	**PELS Mentorship Roundtables**	*Room 327*
6:30PM – 9:00PM	**IAS – PELS Joint Young Professionals Reception**	*Offsite*

WEDNESDAY, OCTOBER 2

7:30AM – 6:00PM	**Registration Open**	*Pratt Street Lobby*
7:30AM – 8:30AM	**Oral Presenter Breakfast**	*Baltimore Ballroom*
8:00AM – 9:00AM	**Women in Engineering (WIE) Breakfast**	*Room 325*
8:30AM – 10:10AM	**Technical Program: Oral Sessions**	*300-level Meeting Rooms*
	Special Session: Challenges and Successes in Accelerating the Adoption of Wide Bandgap Power Electronics	*Room 327*
	Special Session: Go Real: Power Electronics from Simulations to Experiments in Hours – A	*Room 336*
	Special Session: Cyber and Hardware Security for Power Electronics in a Changing World – A	*Room 329*
	Special Session: DC Circuit Protection – A	*Room 328*
10:10AM –10:30AM	**AM Break**	
10:30AM –12:10PM	**Technical Program: Oral Sessions**	*300-level Meeting Rooms*
	Special Session: Go Real: Power Electronics from Simulations to Experiments in Hours – B	*Room 336*
	Special Session: Cyber and Hardware Security for Power Electronics in a Changing World – B	*Room 329*
	Special Session: DC Circuit Protection – B	*Room 328*
	Special Session: Improved SiC and GaN Device and Module Performance, Packaging, Reliability	*Room 327*
12:10PM – 2:00PM	**Lunch On Your Own**	*Available for purchase in the Pratt Street Lobby*
2:00PM – 3:40PM	**Technical Program: Oral Sessions**	*300-level Meeting Rooms*
	Special Session: Evolution of the EV Powertrain	*Room 336*
	Special Session: Integrated Storage and Power Electronics	*Room 328*
	Special Session: Aircraft Hybridization and Electrification Roadmap	*Room 327*
	Special Session: Grid-Forming Inverters in Modern Power Grids: Modeling, Control and Advanced Testing – A	*Room 329*
3:40PM – 4:00PM	**PM Break**	
4:00PM – 5:40PM	**Technical Program: Oral Sessions**	*300-level Meeting Rooms*
	Special Session: Ge Trend, Requirement and Development of DC Technologies for Medium and Low Voltage DC Grids	*Room 336*
	Special Session: Go Real: Electrification of Aircraft – From More Electric to All Electric Propulsion – B	*Room 328*
	Special Session: Current Status and Future Prospects of GaN Power HEMTs	*Room 327*
	Special Session: Grid-Forming Inverters in Modern Power Grids: Modeling, Control and Advanced Testing – B	*Room 329*
7:00PM – 9:30PM	**Industry Night Out Reception**	*Baltimore Ballroom*

THURSDAY, OCTOBER 3

7:30AM – 12:00PM	**Registration Open** ..... *Pratt Street Lobby*
7:30AM – 8:30AM	**Oral Presenter Breakfast** ..... *Baltimore Ballroom*
8:30AM – 10:10AM	**Technical Program: Oral Sessions** ..... *300-level Meeting Rooms*
	Special Session: The Role of Simulation Software for Power Electronics Control Design in Education – A ..... *Room 327*
10:10AM – 10:30AM	**AM Break**
10:30AM – 12:10PM	**Technical Program: Oral Sessions** ..... *300-level Meeting Rooms*
	Special Session: The Role of Simulation Software for Power Electronics Control Design in Education – B ..... *Room 327*
12:10PM – 2:00PM	**IEEE Awards Luncheon** ..... *Baltimore Ballroom*
2:10PM – 3:50PM	**Technical Program: Oral Sessions** ..... *300-level Meeting Rooms*

IAS Committee Meetings at ECCE

SUNDAY, SEPTEMBER 29		
1:00PM – 4:00PM	**IAS-IPCSD Standards Meeting**	*Room 331*
4:00PM – 5:00PM	**IAS-IPCSD Editorial Meeting**	*Room 331*
7:30PM – 9:00PM	**IAS-IPCSD – Department Meeting**	*Room 331*
8:00PM – 8:30PM	**Newcomer's Orientation**	*Room 344*
TUESDAY, OCTOBER 1		
7:00PM – 9:00PM	**IEEE IAS/PELS Young Professional Reception**	*Offsite*

IEMDC Committee Meetings

MONDAY, SEPTEMBER 30		
12:00PM – 1:00PM	**IEMDC 2021 Organizing Committee Meeting** *(Invitation Only)*	*Room 331*
TUESDAY, OCTOBER 1		
12:00PM – 1:00PM	**IEMDC Steering Committee Meeting** *(Invitation Only)*	*Room 331*

ECCE Committee Meetings

TUESDAY, OCTOBER 1		
7:30AM – 8:30AM	**ECCE 2019, 2020, and 2021 Handover** *(Invitation Only)*	*Room 331*
8:30AM – 9:30AM	**ECCE 2020 Organizing Committee Meeting** *(Invitation Only)*	*Room 331*
10:15AM – 12:00PM	**ECCE Steering Committee Meeting** *(Invitation Only)*	*Room 331*

PELS MEETINGS

SUNDAY, SEPTEMBER 29	
10:30AM – 2:00PM	PELS Pre-Strategy Meeting *(Officers Only)* ..... Room 324
4:00PM – 5:30PM	PELS Town Hall Meeting ..... Rooms 325-326
MONDAY, SEPTEMBER 30	
11:00AM – 12:00PM	International Future Energy Challenge (IFEC) Info ..... Room 324
11:00AM – 12:30PM	PELS Cyber-Physical Security Meeting ..... Room 325
12:00PM – 1:00PM	Products Industry Subcommittee ..... Room 324
12:30PM – 3:30PM	PELS Membership Meeting ..... Room 326
1:00PM – 2:30PM	IEEE Journal of Emerging and Selected Topics in Power Electronics (JESTPE) Steering Committee ..... Room 325
2:30PM – 4:30PM	IEEE Journal of Emerging and Selected Topics in Power Electronics (JESTPE) Awards and Editorial Board ..... Room 325
3:00PM – 4:00PM	Power Electronics Magazine Advisory Board ..... Room 324
3:30PM – 4:30PM	PELS Chapter Chair Forum ..... Room 326
4:00PM – 5:00PM	PELS Industry Advisory Board ..... Room 324
TUESDAY, OCTOBER 1	
8:00AM – 9:00AM	PEDG Steering Committee Meeting ..... Room 324
	PELS TC3 Motor Drives & Actuators ..... Room 325
9:00AM – 10:30AM	PELS TC5 - Sustainable Energy Technical Committee ..... Room 324
10:00AM – 11:00AM	PELS Digital Media/Education Meeting ..... Room 326
10:30AM – 11:30AM	PELS Mentorship Committee ..... Room 325
10:30AM – 12:00PM	PELS TC1 – Power and Control Core Technologies ..... Room 324
11:30AM – 12:30PM	PELS Fellows Committee *(Members Only)* ..... Room 326
12:00PM – 1:30PM	PECCE Asia Coordination Committee Meeting ..... Room 324
	PELS TC2 – Power Conversion Sys and Components ..... Room 325
1:00PM – 2:00PM	PELS Global Intersociety Relations Committee ..... Room 326
1:30PM – 3:00PM	PELS TC4-Vehicle and Transportation Systems ..... Room 324
2:00PM – 3:30PM	ECCE Global Steering Committee ..... Room 325
2:30PM – 4:00PM	PELS TC6 – High Performance and Emerging Technologies Meeting ..... Room 326

TUESDAY, OCTOBER 1 *(continued)*

3:00PM – 4:00PM	**eGrid Steering Committee**	*Room 324*
4:00PM – 5:00PM	**PELS TC7 – Communication Energy System**	*Room 324*
5:00PM – 6:30PM	**PELS Mentorship Roundtables**	*Room 327*
7:00PM – 9:00PM	**IEEE IAS/PELS Young Professional Reception**	*Offsite*

WEDNESDAY, OCTOBER 2

8:00AM – 9:00AM	**PELS WIE Breakfast**	*Room 325*
9:00AM – 10:00AM	**PELS Energy Access Committee Meeting / Empower A Billion LIves**	*Room 326*
9:30AM – 11:30AM	**PELS Products Committee Meeting**	*Room 324*
10:00AM – 11:30AM	**SPEC Steering Committee**	*Room 325*
	PELS ITRW Steering Committee	*Room 324*
11:30AM – 1:00PM	**PELS Nominations Committee** *(Members Only)*	*Room 325*
11:30AM – 1:30PM	**IEEE Transactions on Power Electronics Paper Awards and Editorial Board Meeting**	*Room 326*
12:00PM – 1:00PM	**PELS Standards Meeting**	*Room 326*
1:00PM – 3:00PM	**PELS Technical Operations Meeting**	*Room 326*
4:00PM – 5:30PM	**PELS Open Access Journal Committee Meeting**	*Room 326*

THURSDAY, OCTOBER 3

2:30PM – 5:30PM	**PELS Administrative Committee Meeting**	*Rooms 325/326*
3:00PM – 5:30PM	**PELS Conferences Committee Meeting**	*Room 326*

FRIDAY, OCTOBER 4

7:30AM – 8:30AM	**PELS Administrative Committee Breakfast**	*Rooms 325/326*
8:30AM – 11:30AM	**PELS Administrative Committee Meeting** *(continued)*	*Rooms 325/326*

SPECIAL EVENTS

ECCE Welcome Reception

Sunday, September 29 | 6:00PM – 8:00PM

Location: Camden Lobby

The conference will host a Sunday Welcome welcoming colleagues from both ECCE and IAS. The Presidents of IAS and PELS will greet attendees at the event. You will also have a chance to thank and mingle with our corporate partners, and meet and greet our colleagues who have become IEEE Fellows this year.

Newcomer's Orientation

Sunday, September 29 | 8:00PM – 8:30PM

Location: Room 344

The Newcomer's Orientation is designed for first time attendees and will cover everything you need to know about the conference, schedules, program offerings, behind-the-curtain tricks and tidbits to help you navigate the conference.

Expo Hall Opening Reception

Monday, September 30 | 4:30PM – 7:30PM

Location: Expo Hall FG

Join us for the opening of the ECCE 2019 Exhibit Hall! Enjoy a drink and hors d'oeuvres as you mingle with industry partners and friends and explore the latest advances in products and services to meet the needs of current and future challenges facing the energy conversion industry.

Industry Night Out Reception

Wednesday, October 2 | 7:00PM – 9:30PM

Location: Baltimore Ballroom

This unique night brings together members from both ECCE and IAS to enjoy games, music, and mingling. Expand your network and knowledge during our first Industry Night Out reception. Heavy appetizers and beverages will be provided.

IEEE Awards Luncheon

Thursday, October 3 | 12:10PM – 2:30PM

Location: Baltimore Ballroom

We will gather to celebrate the great achievement of some of our colleagues at our traditional IEEE Award Luncheon event.

Tour Options

Horseshoe Casino with Curtis Engine & Equipment

Tuesday, October 1 | 9:30AM – 12:30 PM

Cost: $60

Curtis Engine & Equipment is offering a guided tour of an MTU Onsite Energy combined heat and power (CHP) unit. This plant is located on the premises of Caesars Horseshoe Casino in downtown Baltimore. We will speak on the basics of CHP Cogeneration and Trigeneration capabilities. During the tour, we will reinforce this information from the control room, switchgear room, and boiler room of our running CHP power plant. The group will be broken into sub-groups and will rotate through the following four locatons:

> Curtis Engine & Equipment Introduction

> CHP Plant Control room and equipment

> Electrical Substation – Including the ASCO ATS & Switchgear w/SLC

> Mechanical – Including the Boilers & Chillers

Oriole Park at Camden Yards

Tuesday, October 1 | 12:45PM – 3:45 PM

Cost: $60

Enjoy a behind-the-scenes tour, tailor-made for a facilities professional of the iconic and newly minted LEED Gold Oriole Park at Camden Yards. You will explore the control, mechanical, and electrical rooms that keep this 27-year-old stadium in operation. After touring Oriole Park, you will head outside to see the newly renovated Spine (the walkway between the stadiums) on your way to the Generator Plant that keeps the entire Camden Yards Sports Complex running. You can't visit the Complex without seeing the $140 million dollar upgrades recently completed at M&T Bank Stadium. After taking a walk through the new control room, you might get a chance to take a photo on the field!

TOUR SIGN UP

Pre-registration and payment for tours are required. To sign up for a tour, visit the ECCE Registration Desk located in the Pratt Street Lobby.

Women in Engineering Event

Monday, September 30 | 7:30PM – 8:30PM *Location: Room 327*

At the ECCE 2019 Women in Engineering Event, we will hold a panel on the role of women in Energy Conversion Systems. We will have panelists from academia and industry in US and worldwide. Discussion will take place over dinner.

Women in Engineering Breakfast at ECCE 2019

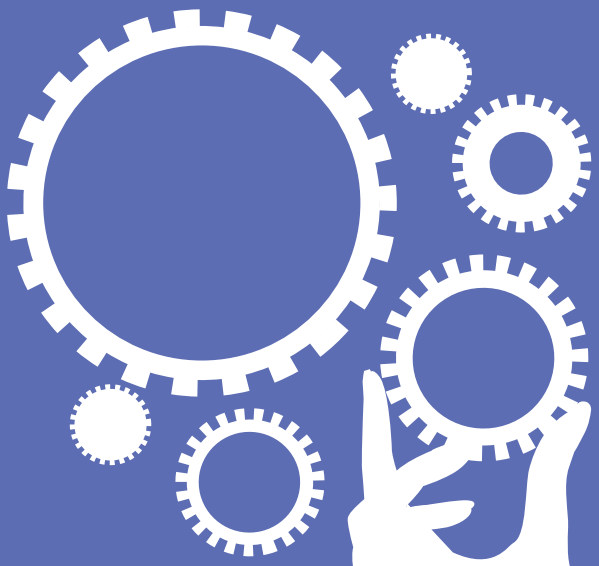
Wednesday, October 2 | 8:00AM – 9:00AM *Location: Room 325*

Join us for the WIE Breakfast, where our speakers are prominent women in power electronics and engineering. Over breakfast, we will listen to a dynamic woman speaker share her career challenges and triumphs and invite discussion onrelevant topics. The WIE Breakfast is open to all who support our efforts in providing mentorship to women in engineering and is free of charge. This event is sponsored by PELS and IAS.

Speaker: Dr. Tanya Gachovska, Solantro Semiconductor

Title: The Role of Mentorship in My Career Path from Bulgaria to Canada

Abstract: In this talk, I will share my personal story of mentorship and the mentors in my life and how they helped shape my career path from high school in Bulgaria to my current position as Senior Verification Engineer in Canada.



Women in Engineering (WiE) Events

WIE Travel Grant Program

A travel reimbursement program was established to support professional women in engineering and students who wish to attend ECCE 2019 and is funded by the ECCE 2019 Organizing Committee. Congratulations to the 2019 WIE Grant Recipients:

- Xiu Yao
- Zoleikha Abdollahi Biron
- Joanne Reichard
- Jennifer Vining
- Mengqi Wang
- Mona Ghassemi
- Roghieh Abdollahi
- Yushan Liu
- Lisien León
- Ariumbolor Purvee
- Laly James
- Celia Shahnaz
- Seema Kewat
- Constanza Ahumada
- Nahla Khaireddine
- Oumaima Ben Amira
- Sara Roggia
- Liao Huanyue

ECCE Family Room

Sunday , September 29 through Thursday, October 3

Location: Room 334

The ECCE Family Room will be available for the duration of the conference, providing a child-friendly environment to interact with your kids. The room will provide various snack and drinks, a place to watch movies/shows, books, coloring materials, games, and a nap area.

Special thanks to all the attendees who will be contributing by lending books, games, or art supplies for use during the conference.

**Kids using the Family Room should be accompanied by a parent, guardian, or caregiver at all times.*

PRESENTER INFORMATION

Oral Presenters

SPEAKER READY ROOM

Sunday through Thursday

Location: Room 330

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

Speaker Ready Room Hours:

Sunday, September 29 . . . . . 8:30AM – 5:00PM
Monday, September 30 . . . . . 8:30AM – 5:00PM
Tuesday, October 1 . . . . . 8:30AM – 12:00PM
Wednesday, October 2 . . . . . 8:30AM – 6:00PM
Thursday, October 3 . . . . . 8:30AM – 12:00PM

You may also edit your presentation during speaker ready room hours. If you have edits to your presentation, you will need to re-upload your presentation by 4:00PM the day prior for speakers presenting before 12:00PM or by 12:00PM for speakers presenting after 1:00PM. Please note, if you have edits to your presentation after the cutoff time, you will need to bring them with you on a flash drive directly to the session room. AV personnel will upload all presentations onto the laptop in your scheduled session room.

ORAL PRESENTERS' ORIENTATION

A Presenters' Orientation Breakfast will be held for oral presenters and session chairs from 7:30AM – 8:30AM **Monday through Thursday in the Baltimore Ballroom** located on the fourth floor of the Baltimore Convention Center. Oral presenters should meet with their respective session chairs to review the format and timing of their session and alert conference management of any changes. Oral Presenters should attend the orientation each day that they are scheduled to provide an oral presentation (or chair a session); you may only attend on days on which you are scheduled to speak.

USE OF PERSONAL COMPUTERS PROHIBITED

Please note that the use of personal laptops for presentations is not permitted. All presentations must be uploaded to the show computers. AV personnel will be on-hand to assist in uploading your presentation.

Poster Presenters

POSTER PRESENTATION SCHEDULE

Monday, September30 and Tuesday, October 1

Location: Exhibit Hall FG

POSTER SESSION I
Monday, September 30 . . . . . 5:00PM – 7:30PM
POSTER SESSION II
Tuesday, October 1 . . . . . 10:30AM – 1:00PM
POSTER SESSION III
Tuesday, October . . . . . 2:30PM – 5:00PM

Posters will be on display on Monday and Tuesday in Exhibit Hall FG at the Baltimore Convention Center. Poster presenters should be available for questions at their display boards during their scheduled poster presentation time. If you are unsure which session your poster should be presented, please review the complete Technical Session schedule. Poster Presenters will have access to Exhibit Hall FG at the Baltimore Convention Center to set up and tear down their posters at the times listed below.

POSTER SESSION I

Monday, September 30

Set-Up . . . . . 4:30PM – 5:00PM
Poster Session . . . . . 5:00PM – 7:30PM
Breakdown . . . . . 7:30PM – 8:00PM

Presenters for Poster Session I must have their posters set-up no later than 5:00PM. Any posters that remain on the poster boards at 8:00PM and do not belong in Poster Session II will be removed and kept in the Speaker Ready Room.

POSTER SESSION II

Tuesday, October 1

Set-Up . . . . . 9:30AM –10:30AM
Poster Session . . . . . 10:30AM – 1:00PM
Breakdown . . . . . 1:00PM – 1:30PM

Presenters for Poster Session II must have their posters set-up no later than 10:00AM. Any posters that remain on the poster boards at 1:30PM and do not belong in Poster Session III will be removed and kept in the Speaker Ready Room.

POSTER SESSION III

Tuesday, October 1

Set-Up . . . . . 2:00PM – 2:30PM
Poster Session . . . . . 2:30PM – 5:00PM
Breakdown . . . . . 5:00PM – 5:30PM

Presenters for Poster Session III must have their posters set-up no later than 2:30PM. Any posters that remain on the poster boards at 5:30PM will be removed and kept in the Speaker Ready Room.

All uncollected posters will be discarded at the end of the conference.

POSTER PRESENTERS' ORIENTATION

Poster Presenters should attend the Poster Presenter's Orientation, held at the Baltimore Convention Center, each day that they are scheduled to provide a poster presentation; you may only attend on days on which you are scheduled to present.

Monday, September 30 . . . . . 3:00PM – 3:30PM
Tuesday, October 1 . . . . . 8:00AM – 8:30AM

Emerging eT&D Grids: Energy Storage, Electrification, and the Increasing Role of Power Electronics

Dr. Babu Chalamala
Director of Energy Storage Systems, Sandia National Laboratories

Emerging electronic transmission and distribution (eT&D) grids will evolve rapidly accommodating the changes in generation mix and load profile that are associated with increasing renewable and distributed generation, electrification and bidirectional power flows. For eT&D grids to operate reliably with a high degree of autonomy, there is a greater need for energy storage systems and intelligent power conversion systems with advanced circuit topologies and high speed communication infrastructure. Current challenges for the future eT&D grids include limited scale of energy storage deployments along with low penetration of power electronics in the current grid infrastructure. As we look into a future with 70-80% renewables in the generation mix and higher amounts of dc loads including electric vehicles and appliances, the load profile and operational aspects of the grid will experience changes that are not well forecast. In this presentation, I will review state of eT&D grid development, expected developmental pathways, and projections for eT&D grid in the distant future.

Co-Design: A Paradigm Shift to Enable Next-Generation Power Modules

Dr. Lauren Boteler
U.S. Army Research Laboratory (ARL), Advanced Power Electronics Group

The Army is moving to a more electrified force for an increasing number of applications including vehicles, renewables, tactical energy networks, communications, and weapons systems. Current power electronics devices are unable to realize their full potential due to the challenges of standard packaging including thermal dissipation, reliability, and parasitic inductance. As technology advances, the electrical, thermal, and reliability needs of these systems must be simultaneously accounted for due to the need for more power in smaller units with no loss in performance. Unfortunately, most research has focused on solving only one technical challenge: a better heat sink, a better circuit design or a more reliable material. When thermal design is treated as a discrete step and not addressed until the end of development, systems become large, overly complex, and inefficient. This presentation will introduce the concept of co-design, a paradigm shift which moves away from the siloed approach to design and transitions into multi-disciplinary design to enable holistic improvement for next generation power electronics. The presentation will cover the current thermal and packaging challenges associated with power modules and will define the three key enabling capabilities to enable future power modules and next-generation cooling solutions: (1) parametric modeling tools, (2) additive manufacturing and (3) transient thermal mitigation.

Integration of Gallium Nitride in Power Applications: Achievements and Challenges

Dr. Alain Charles
Vice President, Technology Development Center, Infineon Technologies Americas Corp.

The U.S. Department of Energy has recognize the opportunity to reduce dramatically usage of electricity in homes and businesses through adoption of variable speed motor control. An estimated 535 x 1012 BTU of energy could be saved annually in the US through use of variable speed drive (VSD) in home appliances and an additional 461 x1012 BTU's when commercial appliances are considered. In total, this is the equivalent of reducing annual release of greenhouse gases due to the usage of 5.5 million short tons of coal.Today VSD are inverterized based on state of the art (SOA) silicon based power solution using either 6 FREDFET power MOSFET or 6 IGBT/FRD pairs together with a gate driver IC capable to drive all 6 switches as a voltage source. The proposed concept is to leverage existing 600V normally off (e-mode) CoolGaNTM switches for use in our VSD "power stages" which feature package integration of 6 GaN HEMT. The reverse recovery performance of CoolGaNTM, provides substantial advantage in term of turn on Loss at full and partial load enabling > 50% reduction in power loss. For successful adoption in motor control, 3 elements of a GaN-based solution are required:

a.) a low cost driver IC which provides current source drive signal as the CoolGaNTM gate is current driven, and protect functions (control slew rate to <5V/ns). The IC must also cost no more than existing low cost voltage source IC's used with silicon. In this paper, we will describe the proposed solution to realize this IC based on Junction Isolated level shifting technology. b.) A Competitive cost GaN devices. For RDS(ON) values in the 1 ohm range CoolGaNTM die are 5x to 6X times smaller than FREDFET's so that even with higher wafer cost per area the GaN die cost will be lower than silicon. On top, the lateral nature of the GaN device brings the potential further advantage to integrate monolithically the 6 GaN switches into one die. The paper, will show the challenge to do so, due to the back gating of the high side switch by the low side switch, due to the common silicon substrate, and the proposed remedy to this problem. c.) A low cost surface-mount package solution achieved through the simplification of the 12×12 mm QFN package due to the monolithically integrated GaN switches, which reduces the number of components in the package from 7 (or 13 in case of IGBT) to 2.

Power and Energy for the Future U.S. Army

Mr. Christopher P. Manning
Director of the Command, Power and Integration Directorate (CP&ID)

The U.S. Army has undertaken a historically unprecedented modernization effort to become a force capable of achieving overmatch in future warfare. As the U.S. Army launches these initiatives, it has become obvious that power generation, power distribution, and energy storage needs for forces are growing and, if not addressed, will become a limiting factor for battlefield operations. The U.S. Army established six modernization priorities to focus efforts and accelerate capability to the field. The U.S. Army Science and Technology community has a unique opportunity to ensure power and energy is considered upfront and often in the development of new platforms and capabilities — air and ground combat vehicles; weapons; command posts; robotics and drones; and Soldier-carried electronics.

Ultra High Power Density Demands 99% Efficiency and 99% Duty Ratio

Dr. Don Tan
NGAS Distinguished Engineer and Power Products Manager, Northrop Grumman Aerospace Systems

Recent technology progress demonstrated effective ways of obtaining 99% power efficiency. The near adiabatic power conversion technology, for instance, needs no dedicated thermal management. Yet ultra-high power density has eluded many designs. The most recent technology trend in power conversion, particularly for dc-dc, suggests a significant increase in power density is within reach. Ultra-high power density in commercial products demands a 99% efficiency and a virtual full duty ratio (say, 99%). The path forward requires a systematic approach in leveraging distributed low-profile packaging, minimum inductive storage, capacitive energy transfer, partial power processing, integrated WBG devices, modularity, and scalability. It is anticipated that the power electronics industry will achieve an-order-of-magnitude improvement in achievable power density within the coming years.

SS1 – A | Tuesday, October 1 | 8:30AM – 10:10AM . . . . . *Room 328*
SS1 – B | Tuesday, October 1 | 10:30AM – 12:10PM . . . . . *Room 328*
SS1 – C | Tuesday, October 1 | 2:00PM – 3:40PM . . . . . *Room 328*
SS1 – D | Tuesday, October 1 | 4:00PM – 5:40PM . . . . . *Room 327*

SS1 | Empower Billion Lives

IEEE Empower a Billion Lives (EBL) is organized as a global competition by the IEEE Power Electronics Society. EBL is looking to develop new mechanisms for crowdsourcing the development of scalable solutions to energy access, which can rapidly improve the lifestyle and livelihood of the 1.1 billion people who live off-grid, and the 3 billion people who live with severe energy poverty. The current approach to resolving this issue is to build or extend the grid to these communities, at a cost point that is simply not viable. Even if we were to miraculously succeed in our mission, and were able to lift their living standards to OECD levels using today's available technology, this would result in 3.7 Gigatons/year more in carbon emissions – an environmental catastrophe!

The EBL competition was launched in 2018 as a biennial global competition to help teams around the world develop energy access solutions that could provide economically viable and scalable solutions for communities with average incomes of less than $2 per day. It was felt that teams regionally would know their community needs, and would be able to offer viable solutions to improve their productivity and livelihood. Teams would be evaluated in terms of technology, social impact and business factors, with an emphasis on the ability to scale their solutions rapidly and sustainably. The competition was conceptualized and organized by the IEEE Power Electronics Society and its volunteers and staff, with strong support from several organizations including the Center for Distributed Energy at Georgia Tech. For further details on EBL, please visit empowerabillionlives.org.

Chairs:
Deepak Divan, *Georgia Institute of Technology*
Szilard Liptak, *Georgia Institute of Technology*

SS2 | Wednesday, October 2 | 2:00PM – 3:40PM . . . . . *Room 327*

SS2 | Aircraft Hybridization and Electrification Roadmap

The present state of technology together with the need of more efficient systems are impelling the aerospace industry toward new architectures through the introduction of hybrid-electric propulsion.

The change, already announced few years ago, is now happening. Many aerospace companies are replying to this call following different paths. The definition of their roadmap and technological strategy represents the crucial point for achieving fast changes and win against the competitors. Some of the emerging actors of the hybridization/electrification scene are the UTC (United Technology Centre) that has just created a new start-up for the realization of a hybrid-electric X-plane, Safran, collaborating with Bell Helicopter on the Nexus project, and companies like Rolls Royce (RR) and General Electric (GE) with their undiscussed presence.

The idea of the session is to gather four exponents of the aforementioned pillar companies to discuss the rationale of their programs and if their efforts will lead to a common objective. As the pace of the technology change accelerates, flying companies must be more focused while embracing new approaches to train the pilots. We recently heard about the crash of the Boeing 737 Max attributed to an insufficiently instructed pilot. The presence of a pilot in the session will help in giving a direction to the discussion by providing an external point of view with a focus on the impact of the new systems on the direct users. As the proposed special session would be a sequel of the special session series established last year by the WIE ECCE initiative, ideally in the panel there will be at least two women figures.

Chair:
Sara Roggia, *SAFRAN, France*

Presenters:
Edward Lovelace, *Aurora Flight Sciences, A Boeing Company*
Matthew Burger, *Zodiac Innovative Power Solutions*
Wu, Xin, *UTRC*
Lijun He, *GE Global Research*

SS3 | Wednesday, October 2 | 4:00PM – 5:40PM . . . . . *Room 327*

SS3 | Current Status and Future Prospects of GaN Power HEMTs

Power semiconductor devices are key components of power electronics technology, used primarily as switches or rectifiers in circuits and systems. Currently, more than 70% of all electrical energy consumed is processed by power electronics. The main function of power electronics is to control and transfer the flow of electrical energy from one form to another and in a form that is suitable to the user. Semiconductor devices are widespread and can be found in almost every electrical and electronic piece of equipment or product. Their power range depends on the application and can be from milliwatts to megawatts. Power devices have a significant impact on the economy as they determine system cost and efficiency.

More than half of century was necessary for researches from industry and university to develop different types and power levels Si power semiconductor devices that have high reliability and low price. But the need for high-voltage, high power density devices operating at high frequencies and junction temperatures higher than 150 °C is growing, especially for advanced power electronics. Silicon-based devices are not able to meet these requirements without connecting, in series and in parallel, to a large number of devices using costly active or passive snubbers and expensive cooling systems. For this reason, the limitations of Si material properties for power devices have been debated during the last two decade; and wide band gap semiconductors, made of SiC and GaN have attracted considerable attention.

Significant research into GaN as material for semiconductor devices has been carried out during the last 20 years. Its wide band gap energy enables the devices to operate at elevated temperatures (600 °C) while retaining low leakage current. The higher breakdown strength for a given blocking voltage of GaN results in smaller channel lengths as compared to Si devices. As a result, the storage of the minority carriers or the input and output capacitance and, therefore, the associated switching losses at a given switching frequency, are reduced. This leads to an increase of the switching frequency to 0.5-1 MHz with acceptable switching losses, which significantly reduces the size and cost of the passive components in power electronic systems.

Regardless of the advantages that GaN materials possess, they have not been adopted for manufacturing of the entire family of high-power devices. Difficulty with crystal growth, the presence of crystal defects, such as micropipes and dislocations, and the absence of abundant wafer suppliers have all contributed to a lack of progress in the fabrication of GaN power devices by the commercial sector. Several industrial research groups and university labs have been working on improving the material properties and development of GaN power devices., In February 2006, the

first commercially available GaN high electron mobility transistor (HEMT) products were launched by Eudyna Devices (now Sumitomo Electric Device Innovations USA, Inc.) (12). Since then new GaN devices and new companies have been introduced to the market.

Most of us remember the Little Box Challenge by Google and the IEEE Power Electronics Society. The challenge was to build a power inverter that was about 10 times smaller than the state-of-the-art at the time. From the 18 finalists, the prize of $1 million was awarded to Red Electrical Devils from CE+T Power, who presented their 2 kVA inverter that had a power density of 143 W/inch3. Gallium nitride power transistors from GaN Systems were critical parts of the winning design. The benefits of GaN devices have been presented in different seminars, conference and forums, but the price and reliability of the power devices are a stopping factor for them to be imbedded in current designs. Trends are still unknown.

The structure of Si and SiC high voltage devices that are on the market is vertical, while the GaN devices are HEMT made on Si substrate. Some of the company are specialized of producing enhancement mode devices while other in depletion mode devises.

The enhancement mode devices (for example GaN systems Inc.) are normally-OFF device and are preferable because they prevent current from flowing when no voltage is applied to the gate, and therefore, it can be easily utilized in power applications. But GaN enhancement mode device, the gate switching voltages are -3 and 6 V which made the drive circuit more complicated.

The depletion mode device are normally ON devices and therefore not preferable by the power designers. A cascode circuit, includes a high-voltage, normally-ON GaN HEMT with a low-voltage MOSFET that can operate as a normally-OFF high-voltage device (example Transphorm) . The high voltage GaN HEMT is a normally-ON device and has a negative threshold voltage, and the low-voltage MOSFET is capable of blocking 30 V with a standard power MOSFET threshold voltage. The cascode circuit has the gate-driving characteristics bility of the high-voltage GaN HEMT. Since the MOSFET is a low-voltage device, its ON-resistance, RDS_ON, is significantly smaller than in the GaN HEMT, and the associated losses will be insignificant. Substituting the Si low voltage devices with a GaN devices make the losses smaller (Navitas Semiconductor). TI and VisiC have a direct drive device. It is similar to a cascade configuration: a demolition mode HEMT with a low voltage Si MOSFET. The low voltage MOSFET is used to enable the circuit while the drive is done by the HEM. VisiC has also reported 1200 V/ 50 A device.

Chairs:
Tanya Gachovska, *Solantro Semiconductor Corp*
Ruxi Wang, *GE Aviation*

Presenters:
Julian Styles, *GaN Systems LLC*
Philip Zuk, *Transphorm*
Stephen Oliver, *Navitas Semiconductor*
Luc Van de Perre, *VisIC*

SS4 – A | Wednesday, October 2 | 8:30AM – 10:10AM. . . . *Room 329*
SS4 – B | Wednesday, October 2 | 10:30AM – 12:10PM. . . *Room 329*

SS4 | Cyber and Hardware Security for Power Electronics in a Changing World

Historically, electric power generation and delivery were largely unidirectional, with centralized power stations sending power to load centers via transmission and distribution systems. But in the modern power grid with the advent of power electronics based Distributed Generation (DG) systems, Energy Storage Systems (ESS), and electric transportation, multidirectional power flows have become possible. These components are also part of a complex communication web. Supervisory Control and Data Acquisition Systems (SCADA), DG and ESS dispatch systems, and consumer devices such as home monitoring systems can continuously monitor and control power electronic devices autonomously or with human input.

Power Electronic applications such as electric vehicles (EV) – both personal and public transportation, EV charging infrastructure, critical loads such as data center power supplies are also part of the communication web. Security researchers have already demonstrated vulnerabilities in vehicles by remotely disabling moving vehicles on the highway. Power converters in home and commercial charging stations also provide means to communicate through the internet, opening further possibilities for remote manipulation.

The modern architecture of power, communication, transportation and critical load infrastructure present unique security challenges. Malign actors or entities might now destabilize this highly connected power infrastructure through (a) deliberate injection of false setpoint commands or feedback signals (b) Distributed Denial of Service (DDOS) attacks on power electronic converters (c) compromising controller firmware in power converters (d) introduction of hard-to-detect and malicious Very Large Scale Integrated (VLSI) components into controller hardware.

These potential attack vectors have led to research and development in secure power electronic systems, hardened via software and hardware means.

Chairs:
Somasundaram Essakiappan, *University of North Carolina at Charlotte*
Alan Mantooth; *University of Arkansas*
Madhav Manjrekar, *University of North Carolina at Charlotte*
Taesic Kim, *Texas A&M University-Kingsville*

SS5 – A | Wednesday, October 2 | 8:30AM – 10:10AM. . . . *Room 328*
SS5 – B | Wednesday, October 2 | 10:30AM – 12:10PM. . . *Room 328*

SS5 | DC Circuit Protection

Safety and protection against circuit faults represent a major technical challenge in the emerging DC transmission and distribution power networks. Active research is undergoing in developing innovative solid state circuit breaker (SCCB), hybrid circuit breaker (HCB), and other circuit protection solutions. The U.S. Department of Energy ARPA-E has recently awarded over $30M research grants to support these activities. This special session will provide a forum for the researchers in the subject area to report on their work and exchange technical information, and brief the general audience on the state of the art of this important research area.

Chair:
Z. John Shen, *Illinois Institute of Technology*

Presenters:
Nlsik Kizilyalli, *ARPA-E, Andrew Rockhill, Eaton Corporation*
John Shen, *Illinois Institute of Technology*
Helen Li, *Florida State University*
Lisa Qi, *ABB*
Ryan Kennedy, *Atom Power*
Fang Peng, *Florida State University*
Georgios Tsolaridis, *ETH*
Biela Jürgen, *ETH*

SS6 – A | Monday, September 30 | 12:30PM – 2:10PM. . . . *Room 329*
SS6 – B | Monday, September 30 | 2:20PM – 4:25PM. . . . . *Room 329*

SS6 | Bidirectional DC-DC Converters for Medium and Low Voltage DC Power Systems

Due to the inherent advantages of DC power systems over the conventional AC power systems such as no harmonics, no reactive power, high efficiency, DC power systems have become an emerging and promising alternative in various fields, microgrids, distribution networks, and electric transportation applications.

Bidirectional DC-DC converters, including isolated or non-isolated ones, are key elements in DC power systems, which are employed as the interfaces between medium voltage DC (MVDC) bus and low voltage DC (LVDC) bus. As well, the bidirectional DC-DC converters are indispensable in the energy storage systems.

This special session aims to summarize and share the recent advances of bi-directional DC-DC converters in terms of different aspects: new topologies, accurate modeling method, novel modulation and control techniques, applications issues of wide bandgap power devices, protection issues and applications in new industry fields. After the deep discussions on current research status, a roadmap for future developments of bi-directional DC-DC converters is expected to be formed, which could be the references for academics and industry working on various applications of DC power systems.

Chairs:
Kai Sun, *Tsinghua University, China*
Jung-Ik Ha, *Seoul National Univerity, Korea*

Presenters:
Marco Liserre, *Kiel University, Germany*
Hui Li, *Florida State University*
Subhashish Bhattacharya, *North Carolina State University*
Jung-Ik Ha, *Seoul National University, Korea*
Keiji Wada, *Tokyo Metropolitan University, Japan*
Honnyong Cha, *Kyungpook National University, Korea*
Victor Ferreira, *Kiel University, Germany*
Kai Sun, *Tsinghua University, China*

SS7 – A | Wednesday, October 2 | 2:00PM – 3:40PM . . . . . *Room 329*
SS7 – B | Wednesday, October 2 | 4:00PM – 5:40PM . . . . . *Room 329*

SS7 | Grid-Forming Inverters in Modern Power Grids: Modeling, Control and Advanced Testing

As the penetration of inverter-based resources in power grids keeps increasing, inverter-grid interactions tend to bring in a series of challenges on the stability and quality of power supply. To tackle the challenges, grid-forming inverters that actively participate in regulating the voltage and frequency of the grid are involving into modern power grids. This special session serves to share the latest research progress and industry practice on the grid-forming inverters in modern power grids. Both normal operations and fault responses of grid-forming inverters in distribution and transmission grids are welcomed. Large-scale integration of grid-forming inverters towards a 100% power-electronics-based power system is also of interest for this special session.

Chairs:
Xiaonan Lu, *Temple University*
Xiongfei Wang, *Aalborg University*

Presenters:
Xiaonan Lu, *Temple University*
Maozhong Gong, *GE Global Research Center*
Deepak Divan, *Georgia Tech*
Xiaofan Wu, *Siemens Corporate Technology*
Xiongfei Wang, *Aalborg University, Denmark*
Marco Liserre, *Kiel University, Germany*
Sheng Zheng, *Oak Ridge National Laboratory*
Pedro Rodriguez, *Loyola Tech, Spain*

SS8 – A | Monday, September 30 | 12:30PM – 2:10PM. . . . *Room 328*
SS8 – B | Monday, September 30 | 2:20PM – 4:25PM. . . . . *Room 328*

SS8 | Sustainable Energy Systems and Opportunities for Power Electronics

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 ranging from component-level innovations to system-of-systems solutions 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'19 audience. The goal is to have a series of invited presentations and intersperse them at regular intervals with questions from the target audience to create an engaging and exciting session.

Chair:
Sudip K. Mazumder, *University of Illinois*

Presenters:
Isik C. Kizilyalli, *ARPA-E*
Anil Pahwa, *NSF*
Lynn Petersen, *ONR*
Kerry Cheung, *DOE*
Vladimir Blasko, *UTRC*
Liuchen Chang, *University of New Brunswick*
Dehong (Mark) Xu, *Zhejiang University, China*
Sudip K Mazumder, *University of Illinois*
Juan Balda, *University of Arkansas*
Wei Qiao, *University of Nebraska*

SS9 | Improved SiC and GaN Device and Module Performance, Packaging, Reliability

Room 327

As wide bandgap technologies mature, the confidence of the power electronics community in these technologies will increase as their reliability and quality continued to improve. Key to this process, as noted by PowerAmerica's members in the PowerAmerica Technology Roadmap, is gaining a better understanding of degradation/failure mechanisms under harsh conditions (i.e., high voltages and/or high temperatures) as well as sources of product quality issues. It also requires generating high-quality data using advanced testing methods, developing standards, and effectively communicating reliability best practices and quality information to end users. The reliable performance of power devices is highly influenced by factors such as structure, level of defects (e.g., basal plane dislocation [BPD]), processing/manufacturing conditions, packaging, and device degradation from harsh operating conditions (e.g., high-temperature, high-voltage, high-frequency operation).

This session will address:

Device-level challenges: The GaN device community currently faces the challenge of developing high-frequency power converters and improved normally off (i.e., enhancement-mode) devices. Challenges in SiC devices include improving channel mobility with increased channel density and reduced channel lengths, reducing EMI with reduced parasitics, and optimizing gate drivers for specific application environments.

Module and packaging challenges: Key module and packaging challenges include the need to improve high-voltage insulation, thermal management, partial discharge, and EMI to enable high-performance modules (e.g., double-sided cooled power modules operating at a higher junction temperature (Tj,max: 175°C–200°C), and high-performance discrete packages that can operate at higher temperatures and voltages.

Qualification standards challenges: Because WBG PE technologies are relatively new, there is high demand for qualification standards for PE technologies similar to the Automotive Electronics Council's Qualification (AECQ) standards developed for automotive electronics or the Joint Electron Device Engineering Council's (JEDEC) standards for electronics.

Chairs:
Victor Veliadis, *PowerAmerica*
Jim LeMunyon, *PowerAmerica*

Presenters:
Timothy Monday, *X-FAB*
Pete Losee, *United Silicon Carbide*
Daniel Martin, *Wolfspeed*
Rick Eddins, *GE Aviation*

SS10 | Challenges and Successes in Accelerating the Adoption of Wide Band Gap Power Electronics

In accelerating adoption of wide bandgap semiconductors, the power electronics community must focus on an increasing 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 in turn will continue to build confidence among decision makers in wide bandgap ecosystem companies and encourage further market growth and industry demand.

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 as important to near-term growth. These include:

EV Inverters (SiC): Motor drive inverters with high power density and efficiency at elevated temperatures are essential to EVs. WBG semiconductors are ideal for such applications because of their advantages over Si in high temperature and frequency applications. Lower system costs and vehicle design simplification will improve power electronics (PE) devices integration with vehicles. The cost competitiveness of WBG semiconductors is the main hurdle for EV/HEV inverter applications.

PV Inverters (SiC): Power electronics are essential components of renewable energy power conversion, particularly the high-efficiency DC-to-AC conversion needed for photovoltaic (PV) energy generated at utility-scale solar farms. WBG-based PV inverters and PV systems convert power more efficiently, yielding significant energy savings. Along with PV systems, the PE community is also looking into WBG to increase the efficiency, power density, reliability, and other requirements (e.g., portability and EMI specification) of power inverters for wind, geothermal, and other renewable energy systems.

Enterprise Equipment (GaN): GaN-based enterprise equipment has evolved rapidly in recent years. A wide variety of applications for wireless power transfer systems—ideal for fast charging laptops or smart phones using GaN power amplifiers and E-HEMT transistors—have emerged using GaN semiconductors. Other examples include GaN-on-Si for switches, routers, servers, and data center power converters. The benefits of these GaN applications include improved power quality (or reduced power loss) in electric transmission and distribution that are closely related to smart grids and renewable energy applications (e.g., wind and solar power systems).

Data Centers (SiC and GaN): Combined with system-level improvements to power architecture, WBG power devices will dramatically increase power delivery efficiency and simplify the design of data center power systems. The simplified design of DC-powered data centers compared to traditional AC-powered centers provides lower energy conversion losses, higher reliability, and smaller equipment footprints for power conversion and cooling equipment. Key enablers for success in this near-term priority include high power density, low switching losses, and high-temperature operation, which ultimately increase system efficiency.

Industrial AC/DC Power Supplies (SiC and GaN): Power supplies are ubiquitous in electronics because all require converting power inputs to the required outputs. Power supplies using SiC and GaN are now widespread in the PE market due to several key factors. These include high power efficiency (e.g., >96%) related to fast switching speed, high power density/smaller size, good reliability, and potential for reduced costs.

Chairs:
Victor Veliadis, *PowerAmerica*
Jim LeMunyon, *PowerAmerica*

Presenters:
Vladimir Blasko, *United Technologies Research Center*
Marko Jaksic, *General Motors Company*
Sriram Chandrasekaran, *Raytheon Company*
Brij Singh, *Deere & Company*

SS11 – A | Thursday, October 3 | 8:30AM – 10:10AM . . . . . *Room 327*
SS11 – B | Thursday, October 3 | 10:30AM – 12:10PM . . . . *Room 327*

SS11 | The Role of Simulation Software for Power Electronics Control Design in Education

In this panel discussion, members of academia, industry, and the software community will discuss the role that commercial software plays in the education of tomorrow's power electronics control engineers. The growth of electrification in transportation, increasing use of renewable energy systems and microgrids, and broader adoption of motor control from industrial equipment to consumer products is driving demand for power electronics control engineers. The use of system-level simulation software in developing controls for power electronics systems is accepted most companies as a way of reducing development and testing time and costs. A casual review of job posting sites shows that it is common to find experience in simulation software as a required skill for engineers in the power electronics field.

Power electronics programs in universities realize that they have a responsibility to their students to equip them with a sound understanding of their field and experience with the kinds of tools that recruiting firms consider important. Simulation software companies exist to satisfy commercial companies seeking better design workflows to improve productivity. At the same time, software providers recognize the importance of being part of the education of power electronics engineers in ways that help the educators, students, and the companies that hire them.

Attend this panel session as we explore answers to these questions:

- What role does this software play in electrical engineering and power electronics education programs?
- What is the balance between simulation software being an aid to applying theory and teaching fundamentals and offering features that mask the underlying principles for the sake of increasing design throughput?
- How do universities ensure a practical knowledge of software tools that complements the concepts and knowledge needed to develop power electronics systems?
- Should graduates be taught best practices and limitations of simulating control systems that involve high speed switching power electronics?
- What does industry expect graduates to understand about simulation software used to develop power electronics control systems?
- With real-time simulation becoming common in commercial companies, should it be part of the lab curriculum?
- What is the role of automatic code generation of C code in learning? When should it be used instead of writing C code by hand?
- How do educators and software providers partner to ensure that graduates have the skills to use simulation to achieve accurate and useful simulations?

Chairs:
Tony Lennon, *MathWorks*

Presenters:
Alan Mantooth, *University of Arkansas*
Veda Galigekere, *Oakridge National Laboratory*
Bryan Lieblick, *Plexim*
Katherine Kim, *National Taiwan University*
Jean Sylvio Ngoua Teu Magambo, *Safran*
Albert Dunford, *Powersim*
Thomas Jahns, *University of Wisconsin*
Madison, Tony Lennon, *MathWorks*

SS12 | Wednesday, October 2 | 4:00PM – 5:40PM . . . . . *Room 336*

SS12 | The Trend, Requirement and Development of DC Technologies for Medium and Low Voltage DC Grids

DC technologies have already been widely used in high voltage transmission networks for the large transfer capacity and flexible control. DC technologies show also advantages over conventional AC technologies in low voltage microgrids and in medium voltage networks for reducing losses, fulfilling the increasing load demands, and integrating renewable power generation to the distribution networks. In addition, transport electrification brings new opportunities and challenges for using DC technologies. With the increase of reliability and reduction of costs of power electronic converters, medium voltage and low voltage DC (MV/LVDC) will play more and more important roles in modern power systems. The technologies aims to reduce operation costs, increase capacity, enhance reliability and increase power quality.

MV/LVDC have been used for various applications, which include smart building (also smart office/classroom), distributed energy sources (wind, solar, storage), industrial and commercial loads (motor drives and data centers), transport electrification (electric vehicles, shipboard, rail aircrafts), offshore platform power supply, offshore renewable collection, and distribution networks.

However, these applications are designed at different voltages to meet their specific requirements individually. So far, standardization has not been put into practice in order to facilitate the development of components and devices from various manufacturers and contribute to the wider applications of DC technologies.

The DC voltage is constrained by the insulation capability of the existing cables, and acceptable levels of audible noise in dry weather as well as electric field and space charge current at ground level. The maximum transfer capacity is influenced by the DC voltage. Thus, The factors influencing the DC voltages and system operation needed to be surveyed and analyzed, which include voltage standards, configurations of converters, protection strategies, control strategies, dispatching and restoration for hybrid AC/DC voltage, optimal economical operation, and system reliability.

This Special Session will cover trend of MV/LV DC grid development, relevant technology requirements and DC voltage standardization. Experience from existing MV/LVDC technologies, and factors affecting DC grids operation will also be included for the benefits of future developments.

Chair:
Jun Liang, *Cardiff University, United Kingdom*

Presenters:
Jun Liang, *Cardiff University, United Kingdom*
Kai Strunz , *TU Berlin, Germany*
Bernardo Severino, *TU Berlin, Germany*
Igor Cvetkovic, *Virginia Tech*
Kazuto Yukita, *Aichi Institute of Technology, Japan*

SS13 – A | Wednesday, October 2 | 8:30AM – 10:10AM . . . *Room 336*
SS13 – B | Wednesday, October 2 | 10:30AM – 12:10PM . . *Room 336*

SS13 | Go Real: Power Electronics from Simulations to Experiments in Hours

This special session aims to help researchers, graduate students, and engineers remove the barriers to go real from power electronics simulations to experiments. It will demonstrate that it is possible to obtain experimental results within hours after completing simulations by adopting the SYNDEM Smart Grid Research and Educational Kit, which is a reconfigurable, open-source, multifunctional power electronic converter with the capability of directly downloading codes from Matlab/Simulink. The session will consist of 100-minute presentations and 100-minute demonstrations. The presentations part will cover the introduction of the Smart Grid Research and Educational Kit and four case studies on solar systems, wind power generation systems, an eight-node 100%-power-electronic-converter-based microgrid, and anti-islanding detection. The demonstrations part will showcase two live demonstrations with the kit: a DC-DC-AC grid-tied energy conversion system and a motor drive system.

Chairs:
Qing-Chang Zhong, *Illinois Institute of Technology & Syndem LLC*
Beibei Ren, *Texas Tech University*

Presenters:
Qing-Chang Zhong, *Illinois Institute of Technology & Syndem LLC*
Yeqin Wang, *Syndem LLC*
Yiting Dong, *Texas Tech University*
Beibei Ren, *Texas Tech University*
Mohammad Amin, *Norwegian University of Science and Technology*

SS14 | Wednesday, October 2 | 4:00PM – 5:40PM . . . . . *Room 328*

SS14 | Electrification of Aircraft – From More Electric to All Electric Propulsion

There is an increasing trend towards more electrification and for deployment of electric/hybrid propulsion for aircraft. In addition, a number of industries have started to develop VTOL vehicles for short distance flights and has become an important and an emerging topic. This session will cover new developments and research on electric and hybrid propulsion, more electric aircraft, drones, electric taxi and VTOL vehicles. The benefits of electrification and the status of electrifications in the commercial aircraft including power system, main engine start (MES), and environmental control system (ECS) will be discussed. The power and Energy management system and propulsion strategies for solar airplane, flying cars, drones will also be presented. The enabling technologies such as high efficiency power electronics, high-speed electric machines, and energy storage technologies as applicable to these emerging aero systems will also be presented.

Chairs:
Bulent Sarlioglu, *University of Wisconsin-Madison*
Kaushik Rajashekara, *University of Houston*

Presenters:
Charles E. Lents, *UTRC*
Sean Clarke, *NASA*
Peter Savagian, *Ampaire*
Kamiar Karimi, *Boeing*

SS15 | Wednesday, October 2 | 2:00PM – 3:40PM . . . . . *Room 336*

SS15 | Evolution of the Powertrain

There is no question that the future of mobility will be autonomous and electrified. In fact, it is expected that global automakers and suppliers will spend more than $300 billion over the next 10 years to bring electric cars to the mass market. A year ago, that figure was only $90 billion. The automotive industry deals with one of the most complex products in the world that is highly regulated. Because of this, predictions especially related to electrification, are risky because factors like legislation, infrastructure, cost, customer acceptance, etc. all play a major role in the race toward full implementation. Learn from a group of experts who will talk about several factors that are about to disrupt the global transportation system through the evolution of advanced powertrains.

Chair:
Lakshmi Varaha Iyer, *Magna International*

Presenters:
Martin Winter, *Magna Interantional Inc.*
Florian Sell-Le Blanc, *Aumann Espelkamp GmbH*
Alexander Dunker, *Aumann Espelkamp GmbH*
Ruoyu Hou, *GaN Systems*
Dan Ludois, *University of Wisconsin-Madison*

SS16 | Tuesday, October 1 | 8:30AM – 10:10AM . . . . . *Room 327*

SS16 | Virtual Factory Tours

In a special session, a factory representative will talk about his or her company while showing slides and/or videos on the screen. A Virtual Factory Tour is intended to mimic an actual factory walk through. The venue is expected to be a win-win for the company promoting capability and for the attendees seeing that capability. We are hoping to have four slots for presentations.

Chairs:
Ira J. Pitel, *Magna-Power Electronics*
Alex Huang, *University of Texas at Austin*

Presenters:
Dave Seitz, *NWL*
Adam Pitel, *Magna-Power Electronics*
Burak Ozpinec, *Oak Ridge National Laboratory*
Chris Dries, *United Silicon Carbide*

SS17 | Wednesday, October 2 | 2:00PM – 3:40PM . . . . . *Room 328*

SS17 | Power Electronics: Enabling Integrated Battery Storage Systems towards 100% Renewable Energy Based Society

To enable 100% renewable generation where renewable energy-based electrical energy can be used anywhere and at any time, energy storage systems will be a very promising solution. According to the Department of Energy, revolutionary breakthroughs in electric energy storage will have a major impact on U.S. energy security, and the electrical grid and its resiliency. Solar and wind energy's potential is limited by their intermittent nature, disreputability, scalability, and cost of energy storage. Nevertheless, both solar, wind energy and Li-ion batteries are projected to have a substantial cost reduction by year 2025 (Levelized Cost Of Electricity substantially less than 1c/kWh for solar energy and overall cost less than $50/kWh for storage). However, several technical barriers and difficulties still stand on its way to massive deployment due to its high cost and low safety issue. The session will try to cover several topics to discuss the possible solutions from perspective of technical views from new power devices level, battery management, power conversion to advanced grid interactions with battery support.

1) The system architecture of different power levels for Energy Storage Systems. With gradual mature of advanced WBG power devices and power ICs, three critical applications will be boomed: residential energy storage system, e-mobility storage, and utility-scale storage systems. Over 99% efficient AC/DC converters have been developed using discrete GaN HFETs operating at 1.5 MHz. Substantial cost reductions and power density improvements are expected to enable residential storage applications. To enable the emobility based society, advanced power electronics for extremely fast charging at 400 kW+ level will be possibly discussed for future 1000V Battery EVs (BEV) by using advanced high voltage SiC power devices. To enable a utility scale-storage system, high power SiC power electronics solution with high power density and high efficiency will be discussed in this session.

2) Battery Management. Fundamental electrochemical-thermal models for batteries will be covered in this discussion. Simplified equivalent circuit models (ECM) based on electrochemical-thermal modeling and extensive results from the various project testbeds will be covered. The interdisciplinary discussion will help power electronic researchers aware of possible performance-limiting factors due to aging through variable parameters and try to make battery more affordable and safe.

3) Advanced Grid Interactions with support of battery storage systems. This talk will focus on the grid resiliency features such as black start, grid voltage and frequency support, complete island operation, smooth transition between grid-tied mode and islanding operations, and a micro-grid operation with support of energy storage system.

4) New Wide bandgap devices(WBG) and their integration. Highly integrated and compact power electronics in a fundamentally new WBG Power IC will be discussed for interfacing battery storage system. Significant performance improvement in terms of size and cost reduction in WBG devices can be further achieved by integrating multiple WBG devices with gate driver, control, and protective circuits in the form of a monolithic power IC. However, WBG power IC technology is still in its infancy, and many technological barriers exist for interfacing battery system.

Chairs:
Issa Batarseh, *University of Central Florida*
Haibing Hu, *Nanjing University of Aeronautics and Astronautics*
Alex Q. Huang, *University of Texas at Austin*

Presenters:
Alex Q. Huang, *University of Texas at Austin*
Said Al-Hallaj, *All Cell Technologies LLC*
Zhe LI, *Tsinghua University*
Amit Kumar Bhattacharjee & Issa Batarseh, *University of Central Florida*
Sudip K Mazumder, *Professor, University of Illinois at Chicago*

SS18 | Monday, September 30 | 12:30PM – 2:10PM . . . . . *Room 327*

SS18 | Launching of ITRW 1.0

The International Technology Roadmap for Wide Bandgap Power Semiconductors (ITRW) has been developed as an IEEE Power Electronics Society Initiative to inspire leadership in the emerging and fast moving field of wide bandgap power electronics. The impact of wide bandgap power electronics has been nothing short of revolutionary across all aspects of power electronics giving dramatic changes in efficiency, performance and physical size.

In 2015 the IEEE Power Electronics Society initiated the ITRW project to develop a strategic roadmap to provide vision and leadership to academia, industry and consumers as to where the wide bandgap technology was moving. Several working groups were formed as well as an industry advisory board and a global steering committee to ensure that the resulting work would be genuinely global in nature, and build on the IEEE's role as a neutral forum for advancing humanity. Meetings have been held across the world since the inaugural meeting in December 2015 at TU Delft, including North America, Europe, and Asia to allow as many stakeholders as possible to influence the work of the roadmap and provide their valuable input.

The publication of this inaugural ITRW roadmap is a direct result of the sponsorship and leadership provided by the IEEE Power Electronics Society, with a long term commitment of several presidents supporting this initiative including Prof. Bram Ferreira, Prof. Alan Mantooth and Prof. Frede Blaaberg. As can be seen from the extensive list of volunteers who have contributed to the roadmap, much time and effort has been provided by the PELS community at large and this is reflected in the diversity of technology (both fundamental and applications oriented) presented in the ITRW roadmap. The team has also highlighted key technological successes to illustrate how wide bandgap power electronics have made a major impact across the world from grid connected systems, to mobile communications and computing and transport electrification.

The first edition of the roadmap is launched during the special session.

1. Overview of ITRW goals, scope and relation to other roadmaps
2. Working Group Materials and Devices
3. Working Group Packaging and Integration
4. Working Group GaN System Integration and Application
5. Working Group SiC System Integration and Application

Chair:
Braham Ferreira, *University of Twente*

Presenters:
Braham Ferreira, *University of Twente*
Peter Wilson, *University of Bath*
Robert Kaplar, *Sandia National Labs*
Victor Veliadis, *North Carolina State University*
Mark Johnson, *Nottingham University*
Daniel Shi, *ASTRI*
Fred Wang, *University of Tennessee*
Sibylle Dieckerhoff, *Berlin University of Technology*
Laili Wang, *Xi'an Jiaotong University*
Jin Wang, *Ohio State University*
Chaobo Dai, *GEIRI, Ste Grid*

TUTORIALS

Tutorials will be held on Sunday, September 29. Pre-registration for each tutorial is required. Please visit the Registration Desk for space availability.

Sunday, September 29 **8:00AM – 11:45AM**

AM Tutorials

T01 | From Si to GaN, What Power Electronics Engineers Need to Know About GaN

Room 336

Instructor:

Fred Yue Fu, *GaNPower International Inc.*

Power semiconductor devices are the key components in today's power electronics systems. Since 1950s, power semiconductor technology has gone through many iterations: from BJT to DMOS, from IGBT to Super Junction MOS. Wide band-gap semiconductor materials, such as SiC and GaN can offer much better performance with higher frequency, higher efficiency and lower system profile and are positioned to replace silicon in many applications.

To give a better understanding of power semiconductor devices, this tutorial start from a brief introduction of Silicon MOS and GaN HEMT device structures, including an illustration of the conduction channels to conduct current and the drift regions to sustain high voltage. This will help solve the mystery of why GaN HEMT is superior than silicon MOS in terms of Rdson*Qg and how come there is no avalanche breakdown in GaN. We will also use these structures to give the audience some idea such as why CoolMOS suffers a Coss linearity problem (thus EMI issue) and why there is a dynamic Rdson issue in GaN and how to deal with it. For GaN, a special session will be given to present the different structures of D-mode and E-mode HEMT, their merits and drawbacks.

The second part will be dedicated to how power semiconductor devices are processed / packaged and tested. Both silicon MOS and GaN HEMT will be included so that the audience can have a clearer picture of how the devices are made and how to choose different packaging formats based on applications. We will show that how GaN can be more cost effective and why GaN HEMTs are only for lower to middle power range and why high voltage (>1700V) GaN devices are rare in the market. Also, device testing and characterization will be briefly explained to help audience comprehend the parameters listed on the data-sheet. In this session, we will give the audience an idea of why GaN is more expensive than silicon and why we believe the cost of GaN fabrication will be dramatically reduced in the near future.

In the third part, GaN applications will be highlighted, with a special focus on LLC topology. First we will explain some common issues for using GaN devices, such as temperature coefficients for Rdson and Vth, power and gate drive loop common source inductance, miller capacitance under high dV/dt, etc. Then, we will explain how we implement GaN HEMTs to our digitally controlled LLC resonant converters with practical solutions. We will show to the audience why we believe LLC resonant topology is an ideal choice for high frequency GaN based converters. In this part, we will present our innovative ultra-small and high frequency (>1MHz) 65W USB-PD adapter solution with efficiency as high as 94%. For higher power applications, such as Electric Vehicle on board charger (OBC) and DC/DC converters, we will introduce our novel SCC (switch controlled capacitor) topology with mutli-phase LLC solution so that we can achieve a much better performance compared to traditional design with higher frequency, lower transformer / inductor profile, smaller output capacitors and potentially lower overall cost.

T02 | SiC Power Devices, Practical Implementation and Application

Room 337

Instructors:

Edgar Ayerbe, Jianwen Shao, Daniel Martin, *Wolfspeed*

This tutorial will focus on practical implementation aspects of SiC power devices. It will start with some fundamental knowledge of SiC MOSFET, then some design guidelines for discrete devices in terms of short circuit, avalanche, body diode, Vth shift, thermal and package long-term reliability consideration will be presented. The second section for the tutorial will cover application aspects of SiC MOSET, gate drive circuit design, PCB layout considerations, and modeling and simulation. The third section will discuss progress of SiC module design. Conventional power package like 62mm and EconoDUAL struggle to take full advantage of SiC based technology offers. A new SiC module with low inductance and better dynamic current sharing will be introduced. In addition, an example three-phase converter with a DC link, bussing, sensors, drivers, and controls will be detailed that takes advantage of the module design.

T03 | Predictive Control – A Simple and Powerful Method of Control Power Converters and Drives

Room 338

Instructors:

Ralph M. Kennel, *Technische Universitaet Muenchen*
Jose Rodriguez, *Universidad Andres Bello*
Marian P. Kazmierkowski, *Warsaw University of Technology*
Zhenbin Zhang, *Shandong University*

So far the control of electrical power using power converter has been based on the principle of mean value, using pulse width modulation with linear controllers in a cascaded structure. Recent research works have demonstrated that it is possible to use Predictive Control to control electrical energy with the use of power converters, without using modulators and linear controllers. This is a new approach will have a strong impact on control in power electronics in coming decades. The main advantages are: 1) concepts are very intuitive and easy to understand; 2) easy inclusion of non-linearity in the model.

T04 | Discrete State Event-Driven Method: A Novel Approach for Power Electronics Transient Simulation

Room 339

Instructors:

Zhengming Zhao, *Tsinghua University*
Hua Jin, *Powersim Inc.*
Bochen Shi, Yicheng Zhu, Zhujun Yu, Jiahe Ju, *Tsinghua University*

Simulation plays a critically important role in power electronics research and product development. In spite of the advance in computer hardware and software, however, there are still two significant challenges facing existing tools: Capability to accurately simulate switching transients of semiconductor devices in details in a large- scale system, and simulating a high-voltage high-power large-scale system at a reasonable speed. This tutorial reviews the current status and challenges of existing simulation tools, and presents the principle, effectiveness and applications

of a novel simulation approach: The Discrete State Event-Driven (DSED) method. With the DSED method, device-level transients and system-level dynamics can be simulated with high accuracy and significantly shorter time as compared to other software. For example, for small-scale converters (e.g. 20 switches), the speed gain is up to 10 folds as compared to one leading software specialized in power electronics, and up to 100 folds as compared to Matlab/Simulink®. When a system is larger, the speed gain is more significant. For example, for large-scale converters (e.g. 600 switches), the speed gain is up to hundreds of folds as compared to the specialized software on the premise of the same accuracy. With the capability to simulate a large converter system accurately and at a very fast speed, DSED makes it possible to analyze and design a high-power converter more reliably and perform studies that are very difficult or impossible to do otherwise. Also, in this tutorial, the methodology of obtaining detailed device models from manufacturer datasheet and simple lab tests will be described.

T05 | SiC Enabled MV Power Conversion Systems and HV SiC Power Device Design and Fabrication

Room 340

Instructors:

Subhashish Bhattacharya, Victor Veliadis, *NC State University*
Brij Singh, *John Deere, United States*

The tutorial will outline the applications of High power/voltage power converters in all industry sectors - Solid State Transformer, HVDC, FACTS and power quality, MV motor drives (including high-speed machines with high fundamental frequency), MV DC grids, MV grid connected converters for renewables such as solar, wind, etc., MV converters for mining applications, MV converters for traction applications, MV converters for industrial applications such as steel mills, cement, and others; with present OEM solutions. The improvements required in efficiency, power density, specific power and volumetric density metrics are forcing the industry to re-evaluate present state of the art Silicon power devices based solutions in terms of the potential offered by recently developed HV SiC power devices for HV and high power (MW class) power converters. The opportunities for HV SiC devices for MV and high power converters and utility applications and the challenges to apply these HV SiC devices successfully will be presented in-depth with SiC device voltage ranges from 1200V to 3300V MOSFETs, and HV 10 kV - 15 kV MOSFETs, JBS diodes, and 15 kV SiC IGBTs. The potential and challenges of the HV 10-15 kV devices to enable MV power conversion systems, including MV motor drives, FACTS and MVDC grids will be explored with demonstrated application examples of SST (Solid State Transformer), MV SiC power converters for grid tied solar applications, MV motor drives, shipboard power supply applications and MV DC grids. The roadmap of HV SiC power devices in terms of cost targets, module packaging, reliability qualification and standards compliance of HV SiC devices will be addressed. Challenges in adopting these HV SiC devices for MV power conversion in terms of magnetics, capacitors, and insulation materials will be discussed.

The tutorial will also outline the advantages of SiC over other power electronic materials, and will introduce HV SiC devic being developed for power electronic applications. ESD, high-voltage testing, and packaging aspects will be covered. The design and properties of SiC JFETs, MOSFETs, BJTs, IGBTs, Thyristors, and Junction Barrier Schottky and PiN diodes will be discussed, with an emphasis on their performance advantages over those of their Si counterparts. Common SiC Edge Termination techniques, which allow SiC devices to exploit their full high-voltage potential, will be rigorously treated and their impact on device performance will be highlighted. Aspects of device fabrication will be taught with an emphasis on the processes that do not carry over from the mature Si manufacturing world and are thus tailored to SiC. In particular, the tutorial will stress in- depth the design and fabrication of SiC MOSFETs, which are being inserted in the majority of SiC based power electronic circuits. Device reliability will be reported through exemplary hard switching and unclamped inductive load results.

T06 | Electric Propulsion: Challenges and Opportunities

Room 341

Instructors:

Jin Wang, *The Ohio State University*
Tom Jahns, *University of Wisconsin*
Bulent Sarlioglu, *University of Wisconsin*
Ayman El-Refaie, *Marquette University*
Patrick McClusky, *University of Maryland*
John Kizito, *North Carolina A&T University*
Julia Zhang, *The Ohio State University*

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.

This tutorial will start with an introduction of different types of turbo and hybrid propulsion systems and state-of-the-arts of power electronics and electric machines for aircrafts.

Then the tutorial will first focus on the partial discharge phenomena at low air pressure and how it will affect the designs of power electronics and electric machines. Newly published results on partial discharges in motor windings and power modules with Silicon Carbide (SiC) based high dv/dt waveforms will also be presented.

On the topic of integrated high power density motor drives, the tutorial will first introduce the state of the art high specific power electrical machines for various sectors of the aviation hybrid/electric space. Difference in requirements and challenges for each sector will be discussed. The pros and cons of different machine topologies including various stator structures, winding configurations and rotor configurations will be discussed highlighting key opportunities and challenges. Key factors in terms of achieving high specific power such as advanced thermal management and advanced materials will also be introduced.

Then, the development status of SiC devices and megawatt level power converters will be discussed. A case study based on state-of-the-art commercially available SiC power modules will be presented as an example. New technologies that enable ultra-high power density converter designs including 3D printing based design and graphene enhanced thermal managment for power modules will be introduced.

The last main part of the tutorial is dedicated to the thermal management of the propulsion system for future hybrid and electric aircrafts. Specific challenges in thermal designs for aerospace applications will be introduce first. Then multiple advanced thermal design approaches for integrated electric machines and power electronics will be discussed in detail.

Though the material presented in this tutorial is aerospace application oriented, the knowledge presented on high power density electric propulsion systems can be extended to many applications where high power rating, high power density and high efficiency are expected.

T07 | Multi-Scale Control of Power Electronic Systems

Room 342

Instructor:

Sudip K. Mazumder, *University of Illinois at Chicago, NextWatt LLC*

This tutorial provides a fundamentally different perspective to multi-scale control of switching power electronic systems along with plurality of practical experimental results and is expected to be of great interest to the power electronic system engineers, professionals, educators, and students.

It is based on controlling the time evolution of the switching states (i.e., switching sequences) as well as controlling the switching transition of the power semiconductor device of the solid state electronic system. The former – i.e., switching sequence based control yields rapid response under transient condition, optimal equilibrium response, and yields seamless transition between the two states of dynamics. The first part of the tutorial will primarily focus on switching sequence based control for power electronics systems. By enabling integration of modulation and control, switching sequence based control precludes the need for ad-hoc offline modulation synthesis. In other words, an optimal switching sequence for the power converter is generated dynamically without the need for prior determination of any modulation scheme (which generates a pre-determined switching sequence) in typical conventional approaches.

One of the fundamental distinctions between switching sequence based control and conventional model predictive control is that the former ensures optimal determination of the switching sequence of the power converter under stability bound. The tutorial will provide the mechanism to carry out switching sequence based control and model predictive control syntheses and demonstrate the differences between the two optimal control schemes. Several device, converter, and network level implementations (e.g., microinverter, solar inverter, pulsed-power systems, microgrid, parallel inverters, multilevel converter, aircraft power system) of the switching sequence based control will be provided encompassing author's multiple years of project experience encompassing leading advanced defense and energy industries.

Finally, the tutorial will focus on switching transition control. The primary objective of this control is to demonstrate how key power electronic system parameters including **dv/dt** and **di/dt** stress, switching loss, and electromagnetic noise emission can be controlled dynamically by modulating the dynamics of the power semiconductor devices. Both electrical and newly developed optical control mechanisms to achieve switching transition control will be demonstrated. In the context of the latter, mechanisms for monolithic integration of switching sequence control as well as switching transition control will be outlined and the revolutionary impact of such a novel integration on system performance will be demonstrated with numerous recent and ongoing practical applications.

T08 | Energy Harvesting (EH) for the Industrial Internet of Things (IIoT)

Room 343

Instructor:

Brian Zahnstecher, *PowerRox LLC*

Whether you believe marketing projections for Internet of Things (IoT), Industrial IoT (IIoT), wearable, and Wireless Sensor Network (WSN) devices should be in the tens of billions or trillions of devices, you likely agree there will be an explosive growth in the number of such devices in an evolution that began a few years ago and will grow exponentially over the next 3-5 years. Unfortunately, many of these projections neglect the very real power gap that exists today in that it is literally infeasible to power all these devices by today's standards. This tutorial focuses on quantitatively identifying this gap and addressing it with power budget reduction/optimization techniques, providing an understanding of energy harvesting technologies, and how they can be applied to IoT/IIoT designs, and practical development strategies for implementing in the near-, mid-, and long-term.

The IIoT and key applications enabled in the areas of industrial monitoring, factory automation, and the ubiquitous deployment of sensors and controls in harsh environments are the highest opportunity growth areas with the lowest barrier to entry in the energy harvesting (EH) world. Many of these applications align very well with the Industry 4.0 objectives.

From a technical standpoint, it is only intelligent power management and optimization of ultra-low power devices (not a dependence on amazing advances in battery technology) that will enable all the fantastic applications in smart agriculture, smart cities, industrial automation, home automation, etc. This tutorial is intended for Industrial Designers, IoT/Ultra-Low Power product Design Engineers, Analog & Digital Electrical Engineers, Device Architects, & Technical Marketing/Sales Personnel associated with developing, optimizing, and enabling ultra-low power products/industries for industrial applications.

T09 | Capacitors for Power Electronics – from an Application Perspective

Room 344

Instructor:

Huai Wang, *Aalborg University*

Capacitors are one of the key components in typical power electronic systems in terms of cost, volume, and reliability. Power electronics applications are consuming unprecedented quantities of electrolytic capacitors, film capacitors, and ceramic capacitors. This tutorial aims to the sizing, modeling, and reliability of capacitors from an application perspective, focusing on both classical and emerging power electronics applications. It will start with a brief introduction to different types of capacitors used in power electronics applications, and their respective technology limits and emerging developments. Then the performance factors and sizing criteria of capacitors for various power electronic applications will be discussed. A model based design approach and multi-objective optimization for capacitor banks will be presented. A two-terminal active capacitor concept will also be presented, which enables reduced design cost or increased power density in a couple of power electronic applications by directly replacing passive capacitors. Condition monitoring of capacitors will be introduced in terms of methodologies and principles. Throughout the tutorial, a few step-by-step examples will be included, such as capacitors for DC-DC converters, Modular Multi- Level Converters (MMC), and photovoltaic inverters. The tutorial covers the state-of-the- art research outcomes with balanced contents for both audiences with entry-level and advanced knowledge on the topic. It intends to bridge the gaps among university researchers, industry power electronic designers, and capacitor manufacturers. The target participants are: 1) University researchers who are interested in practical considerations in capacitors for power electronic applications, latest capacitor technologies, and active capacitor concepts; 2) Industry power electronic designers who would like to have better understanding in how to optimally sizing capacitors to fulfill electrical, thermal, and reliability aspects of product specifications with cost and performance optimization; and 3) Capacitor manufacturers who would like to know more about the specific demands from various power electronic applications, to be better at supporting customers with optimized and dedicated capacitor solutions.

T10 | Reliability of Silicon Carbide MOSFETs: Status and Improvement Prospect

Room 336

Instructor:

Francesco Iannuzzo, *Aalborg University*

Silicon Carbide Metal-Oxide-Semiconductor Field-Effect Transistors (SiC MOSFETs) are the most disputed technology in power electronics over the last decade, as it represents a concrete candidate to take over Silicon-based traditional Insulated-Gate Bipolar Transistors (IGBTs). Many hurdles still need to be overtaken, though, including primarily cost and reliability.

The tutorial presents the current status of Silicon Carbide MOSFET technology from a reliability perspective, and it is split in two parts, namely: I) Introduction and II) Current issues and case studies.

After a brief introduction about reliability basics and their implication in power electronics, Part I starts with a recapitulation of MOSFET device's operating principle, then moves straight to the state of the art of SiC MOSFET technology, including both semiconductor and packaging. Differences with Silicon-based traditional MOSFET technologies are listed up afterwards, putting the stresses on the most challenging ones, both in terms of design and application.

A set of detailed studies are presented in the second part, including some in-depth discussions on temperature uniformity issues at chip level, electro-thermal modeling, short-circuit capability and related predictive models, issues at packaging level, and accelerated test principles, including major challenges.

A couple of important case studies are also presented, namely: i) implication of short circuit stress on threshold voltage and ii) implication of threshold voltage instabilities on aging phenomena.

Condition monitoring principles for SiC MOSFETs conclude the second part, and present challenges in SiC MOSFETs' reliability are presented at the end of the tutorial.

The proposed teaching style is mostly practical/application related, and aimed at beginners, both from academia and industry.

T11 | Application of Thermal Interface Materials in Power Modules to Enhance Thermal Performance and Reliability

Room 337

Instructors:

Kevork Haddad, Paul Drexhage, Bernhard Eichler, *SEMIKRON Inc*

In power electronics applications thermal interface materials (TIM) are placed between the powerdevices and heatsink in order to provide good thermal contact. They have a crucial role in ever demanding applications where an increased lifetime is required due to high power densities and elevated temperatures.

This tutorial will deep dive into the TIM topic to cover its theoretical and practical aspects. After a brief introduction of the purpose of TIM, it will examine different types of material and applications, paste thickness and heatsink specification. It will also present selection criteria for TIM in combination with power modules. The measurement of effective thermal paste thickness, evaluation and qualification of TIM and estimating its thermal resistance will be discussed. This also includes the selection of the optimal thickness and print pattern. The tutorial will also explain failure modes and lifetime aspects associated with TIM. Concrete examples will be given to highlight available TIM materials in the market and their applications in industry standard modules. Latest trends and pre-applied thermal interface materials for power modules are also discussed in length, including the performance difference between different materials in combination with power module packaging technologies.

T12 | Design, Monitoring and Control of Reliable Power Electronics

Room 338

Instructors:

Christoph H. van der Broeck, *RWTH Aachen University*
Huai Wang, *Aalborg University*
Frede Blaabjerg, *Aalborg University*
Rik W. De Doncker, *RWTH Aachen University*

Design, monitoring, and control are three key aspects to fulfill reliability and availability targets of power electronic systems. The first part of this tutorial will focus on the reliability-oriented design prospective and the necessary too, such as component- level and system-level lifetime and reliability modeling. It is used to support decision making in the design phase of power electronic converter systems. Design for reliability concept and the term mission profile will be introduced. State-of-the-art component-level understanding of failure mechanisms, models, and system-level predictability will be discussed. There are different methods available for lifetime and reliability prediction techniques. The underlying assumptions made in each modeling step and the corresponding limitations will be uncovered. Throughout the tutorial, several power electronic converter case studies will be used to illustrate the introduced concepts and methodologies. The second part of the tutorial introduces technologies for electrothermal real-time monitoring, localized degradation diagnosis, and active thermal control yielding enhanced lifetime. First, it is discussed how junction temperature sensing and compact 3-D thermal models can be efficiently combined in accurate and high–bandwidth electrothermal monitoring systems. By estimating 3-D distributed temperatures and losses of power modules, the monitoring system detects of critical temperatures throughout the power module and enables a converter operation with dynamic peak power rating. After reviewing state-of-the-art condition monitoring techniques, advanced methods for detection and quantization of localized degradation are introduced. They identify changes of the device loss behavior as well as of the thermal impedances during normal converter operation and correlate them to degradation mechanisms. This guarantees reliable and safe converter operation through early diagnosis of critical degradation and timely initiation of predictive maintenance. Finally, techniques for active control of junction temperatures are discussed that increase the reliability and service life of power electronic modules. They directly reduce thermally induced strain and simultaneously decrease fatigue. The tutorial will demonstrate how reliability-oriented design, thermal and degradation monitoring as well as lifetime enhancing control are crucial technologies that work hand- in-hand to ensure safe and reliable operation of next generation converters over a long lifetime.

T13 | Power Electronics for High-Precision Applications

Room 339

Instructor:

Bas Vermulst, *Eindhoven University of Technology*

High-precision power amplifiers are used in, for instance, semiconductor lithography positioning systems, where any error in the current translates to a positioning error; magnetic resonance imaging, where current errors directly relate to image distortion; audio amplifiers; electron microscopy, etc. Most of these applications require high power levels (up to MW levels), while having current and voltage errors in the ppm range. In comparison; inverters for grid applications are

found in the same power range, but a THD of a few percent is often deemed quite acceptable. Moreover, high-precision applications generally require much larger bandwidths (up to 100s of kHz) with almost zero phase delay, making modeling and control very important topics as well. These challenges require a very different approach than, for instance, a classical inverter for an electric drive.

This tutorial focuses aspects related to high-precision power conversion, elaborating on the origins and effects of distortion in the voltage and current waveforms. To fully understand these effects, we will dive into the most significant parts that contribute to this distortion, such as semiconductors and passives (inductors and capacitors). Furthermore, the influence of blanking time and the modulator non-linearities will be discussed.

T14 | Electric Traction Drive Systems

Room 340

Instructors:

Gui-Jia Su, Jason Pries, *Oak Ridge National Laboratory*

Electric traction drive systems (ETDS) have experienced substantial changes over the past two decades. Battery electric vehicles (BEVs) with a range of ~300 miles are available today with comparable or better performance than internal combustion engine (ICE) vehicles. However, BEVs are still expensive for competing with ICE vehicles. The U.S. Department of Energy and the United States Council for Automotive Research LLC (USCAR) have established a partnership focusing on pre-competitive research and development (R&D) to enable increased vehicle electrification. The partnership has established progressively higher technical targets for battery, ETDS, and other power conversion systems needed in EVs. This tutorial starts with an overview on the electric traction drive system targets as well as their breakdown for the inverter and motor in terms of cost, power density, specific power, efficiency, and reliability. We will then present our recent work on inverters, focusing on inverter topology and performance improvements by using wide-band-gap devices, and reduced-rare earth electric motors.

T15 | High-Speed Electric Machines and WBG Power Electronics Technology Trends and Design Techniques for Electric Vehicles *Room xxx*

Room 341

Instructors:

Iqbal Husain, Wensong Yu, Md Sariful Islam, *NC State University*

The transition to electric road transport technologies is gaining momentum with record-high new electric vehicle registrations taking place in recent years. The market drivers for electric and hybrid electric vehicles (EVs and HEVs) are energy diversification, environmental concerns, and economic growth. The strict carbon emission standards set by the regulatory agencies fueled the growth of electric vehicles all over the world. According to a recent prediction, the total number of EVs will hit 125 million by the end of 2030. Moreover, the sales of EV in the USA has increased by 81% in 2018 compared to 2017. The main components of the electric propulsion system of EVs are the electric machines and power electronics inverter. Due to the high density and high efficiency, Interior PM Synchronous Machines (IPMSM) is well adopted by the industry, although solutions with Induction Machines (IM) exists. The solution for the traction inverter is still silicon (Si) IGBT based; however, the Wide Bandgap (WBG) drives are emerging due to its high voltage, high frequency, high temperature, and low loss capabilities.

New EVs are being offered with improved performances and capabilities such as increased acceleration and extended range. These capability and performance enhancements are met with an increased demand in the propulsion system. Widespread research in the area of electric machines for traction applications is pushing the boundaries for maximum speed and power density with design innovations utilizing both conventional and emerging new materials. Electric machines with higher operating speeds are feasible using higher mechanical gear ratios. Consequently, higher torque- density and power density can be achieved. Recent evolution of Wide Bandgap (WBG) semiconductor-based drives with their capabilities of higher frequency and higher temperature operation is also a catalyst to increase the operating speed of traction machines. WBG drives improve efficiency, power density, and controllability on a system level. In the future, designs will need to evolve to meet new requirements such as moving to higher system voltages. DC-link voltage level up to 800-V standard is being considered to support charge rates up to 350kW. However, the interaction of high-speed electric machines with the WBG power electronics creates new sets of issues compared to the existing system. High torque-density and power-density machines for traction applications need special design methodology to achieve the electromagnetic, structural, and thermal performance requirements. Moreover, the price uncertainty of permanent magnets paves the path for non-rare earth electric machines where they have to offer specific advantages compared to the IPM machines in the traction applications. In the case of WBG drives, even though these improve the performance at the system level, the design of traction inverter has to address the voltage overshoot, EMI, and volume constraints.

This tutorial on high-speed electric machines and WBG power electronics is designed to cover the current trends, techniques, design methodologies, challenges, and design innovations of permanent magnet electric machines along with the design, challenges, and advantages of WBG power electronics for traction applications. This tutorial is organized into five parts: Part I gives a review of state-of-the-art, trends and design techniques of electric machines for current electric vehicles, and system architecture of electric vehicles; Part II presents machine sizing and specifications, and design methodology of high-speed electric machines; Part III covers emerging new materials, and design innovations for electric machines; Part IV presents alternative electric machine examples for traction applications; Part V shows the design, modeling, challenges, benefits, and examples of WBG traction inverter for electric machines, finally concluding with some thoughts on trends into the future for widespread industrial adoption.

T16 | Differential Power Processing for Solar Photovoltaic Systems: Development and Applications

Room 342

Instructor:

Katherine A. Kim, *National Taiwan University*

In photovoltaic (PV) systems connected to the ac power grid, PV panels are traditionally connected in series strings with one central converter to control and process the PV's power. However, imbalances or mismatch in the PV cell characteristics can result in low system efficiency, which can occur due to partial shading, different panel angles, cell aging, etc. The concept of differential power processing (DPP) dc-dc converters are utilized to improve PV power output under mismatched conditions. DPP converters allow for independent MPPT of each PV panel while only processing a portion of the total PV power.

This tutorial introduces the concept of DPP for PV systems and covers the basic architectures, including PV-to-bus, PV-to-PV, and PV-to-isolated-port. Power flow analysis, converter topologies, and basic control methods will be overviewed, along with the advantages and trade-offs of the various techniques. The current challenges of commercialization and steps being taken to overcome these problems will also be discussed and explored through applications examples.

T17 | HVDC Transmission Systems and DC Grids: Developments and Challenges

Room 343

Instructors: Daniel-Ioan Stroe, PhD; Macieej Swierczynski, PhD

As large renewable power plants tend to be located far from consumption centers, integration of the power collected from these power plants represent a major challenge. For example, the electrical outputs of these renewable power plants could be DC or AC voltage with magnitude and frequency which are incompatible with that of the AC grids. Therefore, power electronic interfacing is needed to decouple the AC grids from the power plants, control active and power exchange with AC grid, and assist renewable power plants to ride-through different AC and DC network faults. The commercially available state-of-the-arts high voltage direct current (HVDC) link technologies are based on voltage source converters. However, most of the presently operational HVDC transmission systems are based on the thyristor line commutated current source converter technology that offers low semiconductor power loss and high power density, thanks to the robustness and high current capability of the thyristor in a single wafer capsules. On the other hand, thyristors inject significant low frequency harmonics into AC side, which must be eliminated by large passive filtering, and cannot decouple the control of reactive power from the active or DC power to be injected into the AC network. The use of large passive components leading to large footprint systems. Self-commutated voltage source converter HVDC transmission systems were developed to address the shortcomings associated with the line commutated current source converter based HVDC transmission systems.

PART1

This part aims to clarify the advantages and disadvantages of different HVDC technologies, i.e., LCC and VSC from the broader context of large power evacuation, HVAC grid support and renewable power generation and integration. The tutorial will cover integration of large renewable energy plants, including operation, control and interactions with AC grids. Also, interactions of current source converter (CSC) and voltage source converter (VSC) based HVDC with AC systems through controls and harmonics will be analyzed. AC and DC faults analysis for different HVDC technologies will be discussed. Finally, DC grids will be reviewed and discussed including the theoretical concepts, technology, control, faults, DC/DC embedded, and protection with particular emphasis on practical implementation aspects and on reported operational issues. For ease of illustration, the tutorial will be supported with simulations performed in MATLAB/SIMULINK.

PART 2

This part will review the fundamental theoretical frameworks that govern operation and control of present generation of multilevel voltage source converters for DC transmission systems. The tutorial will cover selected topics and emphasize particular aspects in effort order to provide a global view of power electronics systems, and to bridge the gap between the traditional power electronics researchers and their counterparts from the power systems.

T18 | Artificial Intelligence Applications to Power Electronics

Room 344

Instructors:

Joao Pinto, *Federal Univesity of Mato Grosso do Sul*
Burak Ozpineci, *Oak Ridge National Laboratory*
Raymundo Cordero, *Federal Univesity of Mato Grosso do Sul*

It has been successfully proven that Artificial Intelligence has more powerful performance for handling some problems than conventional techniques, but lack of computation apparatus, mainly in hardware, had hindered the extensive use of AI. Nonetheless, recent advances in processors/computers is making the use of AI an easier goal to achieve. Current investments in the area of AI across the globe attest to the unquestionable value attributed to AI nowadays. Yet, most of its applications are still restricted to software-based products, such as data modelling and classification type problems. So far, AI applications to power electronics and related areas are still limited, in part because some power electronics researchers do not trust the power performance of AI, and in part because they may not envision opportunities for its application. The goal of this tutorial is to address these issues.

First, it provides an overview of artificial intelligence, of its paradigms (machine learning, search methods, logic-based tools, knowledge-based tools, and probabilistic methods), and the types of problems AI addresses: classification, regression, optimization, and prediction. Second, it presents techniques such as artificial neural network and deep learning, evolution theory-inspired algorithms, fuzzy sets, and rough sets. Third, it explains how these techniques could cope with some power electronics problems, in order to give the audience a glance at potential research opportunities regarding the applying of AI in power electronics. Fourth, it presents a variety of applications of these techniques for different power electronics problems, ranging from optimum design, control, reliability, energy management, to smart grid, and examines successfully implemented examples. Finally, it highlights AI research trends and possible future applications to power electronics. By the end of this tutorial, the attendees will have a good overview of AI, and its potential application to power electronics problems they may be facing in their research.

TECHNICAL PROGRAM SCHEDULE

ORAL SESSIONS

The following Oral Sessions cover all areas of technical interest to the practicing power electronics professional.

Monday, September 30 **12:30PM – 2:10PM**

S1 | Wind Systems

Room 344
Chairs: Qiang Wei, Hengzhao Yang

12:30PM | Remote Monitoring and Diagnostics of Pitch Bearing Defects in a MW-Scale Wind Turbine Using Pitch Symmetrical-component Analysis [19010]
Lijun He, Liwei Hao and Wei Qiao, *GE Research, United States; University of Nebraska-Lincoln, United States*

12:55PM | LVRT Control of Back-to-Back Power Converter PMSG Wind Turbine Systems: an FPGA Based Hardware-in-the-Loop Solution [19069]
Zhenkun Zhang, Zhenbin Zhang, Xiaodong Liu, Quanrui Hao and Zhiwei Zhang, *Shandong University, China; The Ohio State University, United States*

1:20PM | Maximum Power Point Tracking for Wind Turbine Using Integrated Generator-Rectifier Systems [20013]
Phuc Huynh, Samira Tungare and Arijit Banerjee, *University of Illinois at Urbana-Champaign, United States*

1:45PM | Simple Empiric Root-Mean-Square Electric-Drivetrain Model for Wind Turbines with Full-Size Converter [20015]
Daniel von den Hoff, Denise Cappel, Abdul Baseer, Rik W. De Doncker and Ralf Schelenz, *PGS, E.On ERC, RWTH Aachen University, Germany; CWD, RWTH Aachen University, Germany*

S2 | Grid-Forming Converters

Room 342
Chairs: Xiongfei Wang, Yenan Chen

12:30PM | Small-Signal Modeling, Stability Analysis, and Controller Design of Grid-Friendly Power Converters with Virtual Inertia and Grid-Forming Capability [19775]
Han Deng, Jingyang Fang, Jiale Yu, Vincent Debusschere and Yi Tang, *Nanyang Technological University, Singapore; Grenoble Institute of Technology, France*

12:55PM | Transient Stability Analysis of Droop-Controlled Grid-Connected Converters With Inertia Emulating Low-Pass Filters [19666]
Donghua Pan, Xiongfei Wang, Fangcheng Liu and Rongliang Shi, *Aalborg University, Denmark; Huawei Technologies Co., Ltd., China*

1:20PM | Active Power Reserve Control for Grid-Forming PV Sources in Microgrids using Model-based Maximum Power Point Estimation [19592]
Zhe Chen, Robert H. Lasseter and Thomas M. Jahns, *University of Wisconsin - Madison, United States*

1:45PM | An Optimized Virtual Synchronous Generator Control Strategy for Power Decoupling in Grid Connected Inverters [19581]
Yuzhi Zhang and Raheja Utkarsh, *ABB Inc., United States*

S3 | Converters for HVDC

Room 343
Chairs: Hans-Peter Nee, Balanthi Abdul Beig

12:30PM | Hybrid Phase Converter with Enhanced Efficiency and dc Fault Tolerant Capability for HVDC Application [20503]
Siba Kumar Patro and Anshuman Shukla, *Indian Institute of Technology Bombay, India*

12:55PM | Level-Shift Modulation and Control of a Dual H-bridge Current Flow Controller in Meshed HVDC Systems [19670]
Wei Liu, Jun Liang, Carlos Ugalde-Loo, Chuanyue Li, Gen Li and Peng Yang, *Cardiff University, United Kingdom*

1:20PM | HVDC Breaker Test Bench Based on a Power Converter Using Cascaded H-bridge Cells [19287]
Nikola Krneta and Makoto Hagiwara, *Tokyo Institute of Technology, Japan*

1:45PM | Operation of a Novel Hybrid Modular Multilevel Energy Storage Converter under Fault Condition [19637]
Wu Zeng and Rui Li, *Shanghai Jiao Tong University, China*

S4 | Datacenter and Computer Power Supplies

Room 346
Chairs: Taesic Kim, Gab-Su Seo

12:30PM | 3kW Four-Level Flying Capacitor Totem-Pole Bridgeless PFC Rectifier with 200V GaN Devices [20092]
Qingyun Huang, Qingxuan Ma, Pengkun Liu, Alex Huang and Michael de Rooij, *University of Texas at Austin, United States; Efficient Power Conversion, United States*

12:55PM | A Comparison of Multilevel "Zero Inductor Voltage" Converters for Datacenter Applications [20710]
Samuel Webb, Tianshu Liu and Yan-Fei Liu, *Queen's University, Canada*

1:20PM | Low-Frequency Input Impedance Modeling of Single-Phase PFC Converters for Data Center Power System Stability Studies [20725]
Jian Sun, Mingchun Xu, Mauricio Cespedes and Mike Kauffman, *Rensselaer Polytechnic Institute, United States; Facebook, United States*

1:45PM | Modeling and Analysis of Data Center Power System Stability by Impedance Methods [20726]
Jian Sun, Mingchun Xu, Mauricio Cespedes, David Wong and Mike Kauffman, *Rensselaer Polytechnic Institute, United States; Facebook, United States*

S5 | Inductive Power Transfer

Room 340
Chairs: Burak Ozpineci, Yue Cao

12:30PM | Time-weighted Average Efficiency Optimization for Reconfigurable IPT system with CC and CV outputs [19037]
Ruimin Dai, Ruikun Mai, Zhehui Zhu and Zhengyou He, *Southwest Jiaotong University, China*

12:55PM | Power Factor Correction in EV Charger with Bridgeless Zeta-SEPIC Converter [19541]
Radha Kushwaha and Bhim Singh, *Indian Institute of Technology Delhi, India*

1:20PM | Study on Parasitic Capacitance Effect in High Power Inductive Power Transfer System [19327]
Ying Mei, Jiande Wu, Hua Zhang, Fei Lu and Xiangning He, *Zhejiang University, China; Drexel University, United States*

1:45PM | Design of Isolated Gate Driver Power Supply in Medium Voltage Converters using High Frequency and Compact Wireless Power Transfer [19522]
Van Thuan Nguyen, Veera Bharath Chandra Reddy Gandluru and Ghanshyamsinh Gohil, *The University of Texas at Dallas, United States*

S6 | DC-DC Non-Isolated Converter 1

Room 347
Chairs: Santanu Mishra, Christina DiMarino

12:30PM | MSP-LEGO: Modular Series-Parallel (MSP) Architecture and LEGO Building Blocks for Non-isolated High Voltage Conversion Ratio Hybrid Dc-Dc Converters [19963]
Yueshi Guan, Ping Wang, Ming Liu, Dianguo Xu and Minjie Chen, *Princeton University, United States; Harbin Institute of Technology, China*

12:55PM | Ladder Transformerless Stacked Active Bridge Converters [19696]
Jianglin Zhu, Roman Scheuss and Dragan Maksimovic, *University of Colorado Boulder, United States; University of Applied Sciences Buchs NTB, Switzerland*

1:20PM | Equilateral Triangle Modular Multilevel Step-Up DC/DC Converter for Offshore Wind Energy Systems [19156]
Esmaiel Gandomkar, Hamid Naseem and Jul-Ki Seok, *Yeungnam University, Korea (South)*

1:45PM | A Novel High-Gain DC-DC Topology Based on Coupled Inductors and Decreased Voltage Stresses on Output Elements [20243]
Nima Abdolmaleki, Roy McCann, Mohsen Mahmoudi and Ali Ajami, *University of Arkansas, United States; Azarbaijan Shahid Madani University, Tabriz., Iran*

S7 | AC-DC Single-Phase

Room 349
Chairs: Brian Cheng, Pritam Das

12:30PM | A kW Power Factor Corrector Using Low-voltage Current Device For Input Current Shaping [19301]
Chung-Pui Tung, John Wing-To Fan, Jeff Po-Wa Chow, Akhil Relekar, Wan-Tim Chan, Ka-Wai Ho, Ke-Wei Wang and Henry Shu-hung Chung, *City University of Hong Kong, Hong Kong; BC Technology (Hong Kong) Limited, Hong Kong; Mosway Semiconductor Limited, Hong Kong*

12:55PM | A High-performance 65 W Universal ac-dc Converter Using a Variable-Inverter-Rectifier-Transformer with Improved Step-down Capability [19435]
Intae Moon, Ranjram Mike, Sombuddha Chakraborty and David Perreault, *Massachusetts Institute of Technology, United States; Texas Instruments, United States*

1:20PM | 5-Level Flying Capacitor Bridgeless PFC Converter Using Cost-Effective Low-Voltage GaN Transistors [19761]
Kun Xiong, Jun Wang, Sai Tang, Daming Wang, Chao Zhang, Z. John Shen and Xin Yin, *Hunan University, China; Illinois Institute of Technology, United States*

1:45PM | Analyzing and Reducing Current Harmonics of AC and DC sides of Cascaded H-Bridge Converters for Electric Vehicle Charging Stations [20393]
Amirhossein Moeini and Shuo Wang, *University of Florida, United States*

S8 | Multilevel Converter Control

Room 348
Chairs: Fei Lui, Qing-Chang Zhong

12:30PM | Circulating Current Suppression Control of Modular Multilevel Converters Under Optimized Phase Disposition (PD) Modulation [19015]
Yichao Sun, Dan Lyu, Carlos Teixeira, Brendan McGrath, Grahame Holmes and Qi Wang, *Nanjing Normal University, China; RMIT University, Australia*

12:55PM | Strategies for Decoupling Internal and External Dynamics Resulting From Inter-Arm Passive Component Tolerances in HVDC-MMC [19518]
Shuren Wang, Grain Adam, Ahmed Massoud, Derrick Holliday and Barry Williams, *University of Strathclyde, United Kingdom; Qatar University, Qatar*

1:20PM | A Generalized Voltage Balancing Algorithm for Modular Multilevel Cascaded Converters [19814]
Ezequiel Rodriguez Ramos, Glen Farivar, Josep Pou, Hossein Dehghani Tafti, Christopher David Townsend and Sergio Vazquez, *NTU: Nanyang Technological University, Singapore; Energy Research Institute at Nanyang Technologic, Singapore; UWA: University of Western Australia, Australia; US: Universidad de Sevilla, Singapore*

1:45PM | Computationally-efficient Hierarchical Optimal Controller for Grid-tied Cascaded Multilevel Inverters [20369]
Mitchell Easley, Mohsen Hosseinzadehtaher, Amin Yousefzadeh Fard, Mohammad B Shadmand and Haitham Abu-Rub, *Kansas State University, United States; Texas A and M University at Qatar, Qatar*

S9 | Modulation 1

Room 350
Chairs: John Shen, Marcello Pucci

12:30PM | Model Predictive Control with Secondary Objective Functions for Power Module Loss Reduction [20079]
Luocheng Wang, Tao Han, Jiangbiao He and Tiefu Zhao, *University of North Carolina at Charlotte, United States*

12:55PM | Fast Detection of Open Circuit Device Faults and Fault-Tolerant Operation of Single-Phase H-Bridge Flying Capacitor Multilevel Converters [20039]
Parham Hekmati, Z. John Shen and Ian P. Brown, *Illinois Institute of Technology, United States*

1:20PM | Self-healing Model Predictive Controlled Cascaded Multilevel Inverter [20519]
Mitchell Easley, Matt Baker, Ahmad Khan, Mohammad B Shadmand and Haitham Abu-Rub, *Kansas State University, United States; Texas A and M University at Qatar, Qatar*

1:45PM | iTHD Improvement for Interleaved Totem-pole CRM PFC [19185]
Xu Teng, Song Jinfeng, Wu Yuefei, Jiang Yajuan and Lin Zhuang, *LGE China RD center, China*

S10 | Prof. Bob Lorenz Memorial Session 1

Room 338
Chairs: Thomas M. Jahns, Bulent Sarliglu

12:30PM | In Memoriam Prof. Bob Lorentz
Thomas M. Jahns and Bulent Sarlioglu

12:55PM | Analysis of Novel Hybrid-Magnet-Circuit Variable Flux Memory Machines with Different Magnet Arrangements [19945]
Hui Yang, Hao Zheng, Heyun Lin, Z. Q. Zhu, Jiaxing Lei, Wei Liu and Shukang Lyu, *Southeast University, China; The University of Sheffield, Great Britain*

1:20PM | A Methodology of Permanent Magnet Material Selection for Active Magnetization Change [20607]
Ryoko Imamura and Robert Lorenz, *University of Wisconsin-Madison, WEMPEC, United States*

1:45PM | Self-Sensing and Power Conversion Comparison for Flux Weakening Surface Mounted Permanent Magnet Servo Motors Designed using Symmetric and Asymmetric Rotors [20102]
Huthaifa Flieh, Timothy Slininger, Shao-Chuan Chien, Li-Hsing Ku and Robert Lorenz, *WEMPEC - University of Wisconsin Madison, United States; Motor Drive Solution BU, Delta Electronics, Inc, Taiwan*

S11 | Doubly-Fed Electric Machines

Room 337
Chairs: Tausif Husain, Renato Lyra

12:30PM | Radial Forces in Brushless Doubly-Fed Machines [19024]
Peng Han and Ming Cheng, *University of Kentucky, United States; Southeast University, China*

12:55PM | Synthesis of Airgap Magnetic Field Modulation Phenomena in Electric Machines [19025]
Peng Han and Ming Cheng, *University of Kentucky, United States; Southeast University, China*

1:20PM | Analysis of Operation Modes and Grid-Connected Control for the Dual-Stator Brushless Doubly Fed Induction Generator [19624]
Yu Zeng, Ming Cheng and Xinchi Wei, *Southeast University, China; State Grid Corporation of China, China*

1:45PM | An Approach to Maximize Torque Density in a Brushless Doubly-fed Reluctance Machine [20336]
Shivang Agrawal, Alexander Province and Arijit Banerjee, *University of Illinois at Urbana-Champaign, United States*

S12 | High-Speed Electric Drives

Room 339
Chairs: Shih-Chin Yang, Roberto Petrella

12:30PM | A Real-Time Real-power DSCC-based Emulator Capable of Reproducing Both Bending and Torsional Vibrations of a Motor and Load [19310]
Kenichiro Saito and Hirofumi Akagi, *Tokyo institute of technology, Japan*

12:55PM | Pseudo Six-Step Modulation with Optimal Flux Tracking for Control of High-Speed Permanent Magnet Synchronous Machines (PMSMs) [19321]
Shangjian Dai, Jiabin Wang and Zhigang Sun, *The University of Sheffield, United Kingdom; Rolls-Royce plc, United Kingdom*

1:20PM | Comparison of High Speed Permanent Magnet Machine Sensorless Drive Using Trapezoidal BLDC and Sinusoidal FOC under Insufficient PWM Frequency [20413]
Ching-Lon Huang, Guan-Ren Chen and Shih-Chin Yang, *National Taiwan University, Taiwan*

1:45PM | Optimized Flux-Weakening Control with Virtue Voltage Buffer for Saturated High-Speed Induction Motor Drives [19363]
Zhen Dong, Zhengtao Ding and Dianguo Xu, *The University of Manchester, United Kingdom; Harbin Institute of Technology, China*

S13 | Diagnostics and Fault Tolerance in Electric Drives

Room 336
Chairs: Pinjia Zhang, Antonio J. Marques Cardoso

12:30PM | Reuse of a Damaged Permanent Magnet Synchronous Motor for Torque Ripple and Acoustic Noise Elimination using a Novel Repetitive Observer [19813]
Mi Tang, Shafiq Odhano, Andrea Formentini and Pericle Zanchetta, *the University of Nottingham, United Kingdom; The University of Nottingham, United Kingdom*

12:55PM | Wavelet Transformation-Based Diagnosis of Turn-to-Turn Faults in Vector Control Drive system [20398]
Hassan Eldeeb, Haisen Zhao and Osama Mohammed, *Florida International University, United States; North China Electric Power University, China*

1:20PM | Modular 2n-phase Inverter (M2I) Topology with Novel Phase Current Injection Scheme for Fault- tolerant Multiphase Electric Machine Drives [20571]
Woongkul Lee, Seun Guy Min and Bulent Sarlioglu, *UW-Madison, United States*

1:45PM | Hardware-in-the-loop Simulations of Inverter Faults in an Electric Drive System [19251]
K. S. Amitkumar, Pragasen Pillay and Jean Belanger, *Concordia University, Canada; OPAL-RT TECHNOLOGIES, Canada*

S14 | SiC Device and Application

Room 341
Chairs: Ruxi Wang, Jin Wang

12:30PM | Output Sine-Wave Filter Design and Characterization for a 10 kW SiC Inverter [19837]
Jan-Kaspar Mueller, Tobias Manthey, Di Han, Bulent Sarlioglu, Jens Friebe and Axel Mertens, *Leibniz University Hannover, Germany; University of Wisconsin-Madison, United States*

12:55PM | Analysing the Crosstalk Effect of SiC MOSFETs in Half-Bridge Arrangements [20023]
Ian Laird and Xibo Yuan, *University of Bristol, United Kingdom*

1:20PM | Design of 6.78 MHz SiC MOSFET Class-E Inverter with a Class-phi High-Speed Driver [20359]
Haruma Yogi, Xiuqin Wei, Hiroo Sekiya and Takashi Hikihara, *Chiba Institute of Technology, Japan; Chiba University, Japan; Kyoto University, Japan*

1:45PM | An Analog Active Gate Drive Circuit Architecture for Wide Band Gap Devices [20106]
Ramanujam Ramabhadran, Maja Harfman Todorovic, Cong Li, Erdem Asa and Kum-Kang Huh, *GE Global Research, United States*

S15 | Power Device Characterization and Measurement

Room 345
Chairs: Mark J Scott, Jun Wang

12:30PM | Characterization of the Delay and Transfer Function of Measurement Equipment for SiC - Power Semiconductors [19082]
David Reiff, Jianghua Feng, Jing Shang and Volker Staudt, *Ruhr University Bochum, Germany; CRRC Zhuzhou Institute, China*

12:55PM | Impedance Matching Scheme of Electrical Variable Capacitors Using SiC MOSFET for 13.56Mhz RF Plasma Systems [19820]
Juhwa Min, Beomseok Chae, Yongsug Suh, Jinho Kim and Hyunbae Kim, *Chonbuk National University, Korea (South); Samsung Electronics, Korea (South)*

1:20PM | Analysis of PiN Diode Reverse Recovery Based on the Field-circuit Couple Modeling [20751]
Mingyang Wang, Zipeng Liang, Mufeng Xiong, Shaoxing Qu, Sideng Hu and Xiangning He, *Zhejiang University, China*

1:45PM | Teaching How to Characterize and Implement High Speed Power Devices for Tomorrow's Engineers [19864]
Jean-Luc Schanen, Yvan Avenas, Benoit Sarrazin, Caio Freitas, Wendpanga Bikinga, Alexis Derbey, Sebastien Flury, Florian Dumas, Pierre Lefranc, Rachelle Hanna and Herve Chazal, *Univ Grenoble Alpes, France*

S16 | Wind Systems

Room 344
Chairs: Jonathan Bird, Akanksha Singh

2:20PM | Impedance-Based Small-Signal Modeling and Stability Analysis of Type-3 Wind Turbines in Weak Grid [19764]
Donghai Zhu, Xudong Zou, Wen Dong, Xiang Guo, Yihang Yang, Xinchun Lin and Yong Kang, *Huazhong University of Science and Technology, China; State Grid Jiangsu Electric Power Co., LTD. Main, China*

2:45PM | SWT and BES Optimisation for Grid-connected Households in South Australia [19881]
Rahmat Khezri, Amin Mahmoudi and Mohammed Haque, *Flinders University, Australia; University of South Australia, Australia*

3:10PM | Transformerless Series Active Compensator Operating with Floating Capacitors for DFIG based Wind Energy Conversion System [20099]
Italo Andre Cavalcanti de Oliveira, Cursino Brandao Jacobina, Nady Rocha, Emerson Lacerda Soares and Nayara Brandao de Freitas, *UFCG, Brazil; UFPB, Brazil*

3:35PM | Parametrically Robust Mutual Inductance Estimation based Adaptive Control Architecture for Doubly Fed Induction Generator (DFIG) [20408]
Anuprabha Ravindran Nair, Rojan Bhattarai and Sukumar Kamalasadan, *University of North Carolina at Charlotte, United States; Argonne National Laboratory, United States*

4:00PM | Design and Analysis of an Axial Flux Doubly Fed Induction Generator for Wind Turbine Applications [20758]
Shuvajit Das and Yilmaz Sozer, *University of Akron, United States*

S17 | Stability in Smart Grid Applications

Room 343
Chairs: Norma Anglani, Adel Nasiri

2:20PM | Stability Boundary Acquisition of Weak Grid-Tied Single-Stage Inverter [19460]
Yiming Tu, Jinjun Liu, Zeng Liu, Danhong Xue and Xiangpeng Cheng, *Xi'an Jiaotong University, China*

2:45PM | Optimal Digital Controller Design for Passive Stabilization of a Grid-Connected Three-Phase Inverter with LCL filter [19045]
Toshiji Kato, Kaoru Inoue and Yuki Yamamoto, *Doshisha University, Japan*

3:10PM | An Active Voltage Stabilizer for a Generic DC Microgrid [20324]
Vishnu Mahadeva Iyer, Srinivas Gulur, Subhashish Bhattacharya, Jun Kikuchi, Srikanthan Sridharan, Ke Zou and Chingchi Chen, *NC State University, United States; Ford Motor Company, United States*

3:35PM | Passivity-Oriented Discrete-Time Voltage Controller Design for Grid-Forming Inverters [20160]
Hui Yu, Ma Awal, Hao Tu, Yuhua Du, Srdjan Lukic and Iqbal Husain, *North Carolina State University, United States*

4:00PM | Stability Analysis of the PV Generator Based on Describing Function Method [19093]
Yue Li, Yanghong Xia and Yonggang Peng, *Zhejiang University, China*

S18 | Smart Buildings and Appliances

Room 342
Chairs: Xiaonan Lu, Michael McIntyre

2:20PM | Model-Predictive Control of Electrical Energy Storage Systems for Microgrids-Integrated Smart Buildings [20117]
Enrico Mion, Tommaso Caldognetto, Francesco Simmini, Mattia Bruschetta and Ruggero Carli, *University of Padova, Italy; Interdepartmental Centre Giorgio Levi Cases, Italy*

2:45PM | An Improved Temperature Prediction Technique for HVAC Units Using Intelligent Algorithms [20198]
Keming Yan, Chris Diduch and Mary Kaye, *University of New Brunswick, Canada*

3:10PM | A Generic Load Forecasting Method for Aggregated Thermostatically Controlled Loads Based on Convolutional Neural Networks [19718]
Xun Gong, Eduardo Castillo Guerra, Julian Luciano Cardenas Barrera, Bo Cao, Liuchen Chang and Saleh Saleh, *University of New Brunswick, Canada*

3:35PM | On the Optimal Energy Controls for Large Scale Residential Communities including Smart Homes [20412]
Huangjie Gong, Vandana Rallabandi, Michael L McIntyre and Dan Ionel, *University of Kentucky, United States; University of Louisville, United States*

4:00PM | Peer-to-Peer Energy Arbitrage in Prosumer-based Smart Residential Distribution System [19787]
Md Habib Ullah and Jae-Do Park, *University of Colorado Denver, United States*

S19 | Datacenter, UPS and Battery Management

Room 346
Chairs: Katherine Kim, Josiah McClurg

2:20PM | High-Power-Density GaN-Based Single-Phase Online Uninterruptible Power Supply [19808]
Danish Shahzad, Nauman Zaffar and Khurram Afridi, *Cornell University, United States; Lahore University of Management Sciences, Pakistan*

2:45PM | Design Optimization of Unregulated LLC Converter with Integrated Magnetics for Two-Stage 48V VRM [20265]
Mohamed H. Ahmed, Fred C. Lee, Qiang Li and Michael De Rooij, *CPES Virginia TEch, United States; Efficienct Power Conversion, United States*

3:10PM | Experimental validation of an Ultra-Fast Medium Voltage UPS Utility Disconnect Switch [19055]
Pietro Cairoli, Rodrigues Rostan, Raheja Utkarsh, Walton Simon and Elliott Nick, *ABB Inc USCRC, United States; ABB Ltd., New Zealand*

3:35PM | A 13.56 MHz Multiport-Wireless-Coupled (MWC) Battery Balancer with High Frequency Online Electrochemical Impedance Spectroscopy [20209]
Ming Liu, Ping Wang, Yueshi Guan and Minjie Chen, *Princeton University, United States; Harbin Institute of Technology, China*

4:00PM | A Denoising SVR-MLP Method for Remaining Useful Life Prediction of Lithium-ion Battery [20367]
Weirong Liu, Lisen Yan, Xiaoyong Zhang, Dianzhu Gao, Bin Chen, Yingze Yang, Fu Jiang, Zhiwu Huang and Jun Peng, *Central south university, China*

S20 | Other Charging Techniques

Room 340
Chairs: Mithat Kisacikoglu, Yingjie Li

2:20PM | Embedded compensation for DDQ/Bipolar-Q IPT Charging Pads [20063]
Daniel Efren Gaona Erazo, Saikat Ghosh and Teng Long, *University of Cambridge, United Kingdom*

2:45PM | Bidirectional Grid-Side Power Management in DWPT Systems for EV Charging Applications [20184]
Ahmed Azad and Zeljko Pantic, *Utah State University, United States; Utah State University, United States*

3:10PM | Zero-Torque Three-Phase Integrated On-board Charger based on Multi-Elements Machine Torque Cancellation [19198]
Jialou Gao, Yuanzhi Zhang, Wei Sun, Dong Jiang and Ronghai Qu, *Huazhong University of Science and Technology, China*

3:35PM | Fast and Ultra Fast Charging for Battery Electric Vehicles – A Review [19810]
Camilo Suarez and Wilmar Martinez, *KU LEUVEN, Belgium; KE LUEVEN, Belgium*

4:00PM | Analysis and Design of Double-sided LCLC Compensation Parameters with Coupling-insensitive ZVS Operation for Capacitive Power Transfer [20391]
Gao Feng, Wang Zhenpo, Li Lantian, Wang Shuo and Deng Junjun, *Beijing Institute of Technology, China*

S21 | DC-AC Multi-Phase

Room 349
Chairs: Pedro Rodriguez, Alireza Safaee

2:20PM | High Power Density Design of a 1-MW Medium-Voltage High-Frequency Converter for Aircraft Hybrid-Electric Propulsion Applications [19436]
Di Zhang, Jiangbiao He, Di Pan, Michael Schutten and Mark Dame, *GE Research, United States*

2:45PM | Three Phase Quasi Z Source Inverters with Multiple AC Outputs [20040]
Shri Prakash Sonkar, Vivek Nandan Lal and Rajeev Kumar Singh, *IIT(BHU) VARANASI, India*

3:10PM | A Soft-switched isolated Single Stage Bidirectional Three Phase AC-DC Converter [19782]
Dibakar Das and Kaushik Basu, *Indian Institute of Science, India*

3:35PM | A Modified PBC Controller Using Dynamic Damping Injection for LCL-Filtered Grid-Tied Inverter with Zero Steady-State Error [19048]
Jinping Zhao, Weimin Wu, Huang Min, Huai Wang, Frede Blaabjerg and Chung Henry, *Shanghai Maritime University, China; Aalborg University, Denmark; City of Hongkong, Hong Kong*

4:00PM | Stabilization of Inverter-Based Distributed Generation System via Virtual Impedance Regulator [20363]
Huanyue Liao and Xin Zhang, *Nanyang Technological University, Singapore*

S22 | DC-AC Modulation Techniques

Room 347
Chairs: John Lam, Regan Zane

2:20PM | Constant Common-Mode Voltage Transformerless Inverter for Grid-Tied Photovoltaic Application [19370]
Md Noman Habib Khan Khan, Yam Siwakoti, Tan Kheng Suan Freddy and Li Li, *UTS, Sydney, Australia, Australia*

2:45PM | Improved Three-Phase Critical-Mode-Based Soft-Switching Modulation Technique with Low Leakage Current for PV Inverter Applications [20660]
Zhengrong Huang, Qiang Li and Fred Lee, *CPES, Virginia Tech, United States*

3:10PM | Five-phase Series-end Winding Motor Controller: Converter Topology and Modulation Method [19176]
Li An, Jiang Dong, Liu Zicheng and Kong Wubin, *Huazhong University of Science and Technology, China*

3:35PM | An Asymmetrical Space Vector PWM Scheme for a Three Phase Single-stage DC-AC Converter [19526]
Parthasarathy Nayak and Kaushik Rajashekara, *University of Houston, United States*

4:00PM | Mixed Series-Parallel Connected Current Source Converters with Interleaved SPWM [20298]
Li Ding and Yun Wei Li, *University of Alberta, Canada*

S23 | Small and Large Signal Modeling

Room 350
Chairs: Jian Sun, Braham Ferreira

2:20PM | DC Impedance Model of MMC Considering Capacitor Voltage and Circulating Current Dynamics [19754]
Le Kong, Shuyao Wang, Nattapat Praisuwanna, Shuoting Zhang, Liang Qiao, Fred Wang and Leon M. Tolbert, *University of Tennessee, Knoxville, United States*

2:45PM | An Enhanced Multi-frequency Small-Signal Model for a High-Bandwidth PCM Buck Converter [19459]
Xiangpeng Cheng, Jinjun Liu, Zeng Liu, Li Cheng and Yiming Tu, *Xi'an Jiaotong University, China*

3:10PM | Accurate Small-signal Model for LLC Resonant Covnerters [20240]
Yi-Hsun Hsieh and Fred C. Lee, *Center for Power Electronics Systems, Virginia T, United States*

3:35PM | Machine Learning based Modeling of Power Electronic Converters [20343]
Harish Krishnamoorthy and Tulasi Narayanan Aayer, *University of Houston, United States*

4:00PM | An Exact Time-Domain Based Novel Simulation-Design Tool For Study And Optimal Design Of LLC And CLL Resonant Converters [20556]
Amit Kumar, Abhishek Awasthi, Omid Salari, Arpan Laha and Praveen Jain, *Queen's University, Canada*

S24 | DC-DC Converter Control

Room 348
Chairs: Santanu Kapat, Chi Kong Tse

2:20PM | Current Sharing Method of Charge Controlled Interleaved Buck Converter [19325]
Minrui Leng, Guohua Zhou, Qingxin Tian, Lunbo Deng and Songrong Wu, *Southwest Jiaotong University, China*

2:45PM | Second Harmonic Current Reduction for Cascaded Inverter with Pre-regulator+LLC Converter as Front-End DC-DC Converter [19383]
Fei Liu, Xinbo Ruan, Xinze Huang and Yang Qiu, *NUAA, China*

3:10PM | Self-Correction and Dead-Beat Current Control Strategy for Digital Programmed Boost Converter [19487]
Bingqing Shi, Zhengming Zhao, Shusheng Wei and Chunpeng Zhang, *Tsinghua University, China*

3:35PM | An Extended Describing Function Model for A Hybrid Frequency/Phase-shift Controlled SiC-Based High-Gain DC-DC Resonant Converter Module [20511]
Mehdi Abbasi, Reza Emamalipour, Muhammad Ali Masood Cheema and John Lam, *York University, Lassonde School of Engineering, Canada; Northern Transformer, Canada*

4:00PM | Cycle-by-Cycle Digital Control of a Multi-Megahertz Variable-Frequency Boost Converter for Automatic Power Control of LiDAR [20581]
Xiaofan Cui, Christopher Keller and Al-Thaddeus Avestruz, *University of Michigan Ann Arbor, United States*

S25 | Electric Machines: Direct Drive and Magnetic Gearing

Room 337
Chairs: Jonathan Bird, Greg Heins

2:20PM | Comparative Study on a Novel Consequent-Pole Modular Linear Vernier Machine with Permanent Magnet Arrays on Both Mover and Stator Iron Cores [19107]
Chaojie Shi, Ronghai Qu, Dawei Li, Yuting Gao and Rui Li, *Huazhong University of Science and Technology, China; HuaHuazhong University of Science and Technology, China*

2:45PM | Acoustic Noise Analysis of a Magnetically Geared Permanent Magnet Generator [19576]
Steffen Korsgaard, Anders Byrdal Kjaer, Simon Staal Nielsen, Lorand Demsa and Peter Omand Rasmussen, *Aalborg University, Denmark; Vestas Wind Systems A/S, Denmark*

3:10PM | Design Optimisation and Comparison of Fractional-Slot Overlap and Non-Overlap Winding Direct-Drive PM Wind Generators for DC-Connected Applications [20133]
Casper Jeremias Johannes Labuschagne and Maarten Jan Kamper, *University of Stellenbosch, South Africa*

3:35PM | Electromagnetic Design and Assembly Analysis of a Halbach Rotor Magnetic Gear for a Marine Hydrokinetic Application [20505]
Hossein Baninajar, Jonathan Bird, Sina Modaresahmadi and Wesley Williams, *Portland State University, United States; University of North Carolina at Charlotte, United States*

4:00PM | Rotor Slots Design based on Skin Effect to Reduce Losses in Line-Start Vernier Motor [20524]
Vincent Fedida, Dawei Li and Ronghai Qu, *Huazhong University of Science and Technology, China*

S26 | Electric Machines: Additive Manufacturing

Room 338
Chairs: Nick Simpson, Rafal Wrobel

2:20PM | Characterization of Magnetic Anisotropy for Binder Jet Printed Fe93.25Si6.75 [19244]
Thang Pham, Hawke Suen, Patrick Kwon and Shanelle Foster, *Michigan State University, United States*

2:45PM | Design and Experimental Characterisation of an Additively Manufactured Heat Exchanger for an Electric Propulsion Unit of a High-Altitude Solar Aircraft [19350]
Rafal Wrobel, Ben Scholes, Ahmed Hussein, Ahmad Mustaffar, Sana Ullah, David Reay and Barrie Mecrow, *Newcastle University, United Kingdom; Necastle University, United Kingdom; HiETA technologies, United Kingdom*

3:10PM | Design of High Performance Shaped Profile Windings for Additive Manufacture [20280]
Nick Simpson, Chris Tighe and Phil Mellor, *University of Bristol, United Kingdom; Electrical Cooling Solutions Ltd, United Kingdom; Uni, United Kingdom*

3:35PM | Ceramic 3D Printed Direct Winding Heat Exchangers for Improving Electric Machine Thermal Management [20548]
William Sixel, Mingda Liu, Gregory Nellis and Bulent Sarlioglu, *University of Wisconsin-Madison, United States*

4:00PM | Investigation of an Additively-Manufactured Modular Permanent Magnet Machine for High Specific Power Design [20612]
Fan Wu and Ayman EL-Refaie, *Marquette University, United States*

S27 | Sensorless Control of Electric Drives

Room 339
Chairs: Hinkkanen Marko, Radu Bojoi

2:20PM | Analysis of Position Control Stability Affected by Non-ideal Characteristics of IPMSM in Signal-Injection Sensorless Control [20678]
Joohyun Lee, Yong-Cheol Kwon and Seung-Ki Sul, *Seoul National University, Korea, Republic of; PLECKO Co., Ltd., Korea, Republic of*

2:45PM | A Linear Active Disturbance Rejection Controller-Based Sensorless Control Scheme for PMSM Drives [20684]
Lizhi Qu, Liyan Qu and Wei Qiao, *University of Nebraska-Lincoln, United States*

3:10PM | Discrete-time SMO based Sensorless Control of CSC-fed IPMSM Drives with Low Switching Frequency [20463]
Li Ding, Yun Wei Li, Navid R. Zargari and Richard Paes, *University of Alberta, Canada; Rockwell Automation, Canada*

3:35PM | High Frequency Injection Based Rotor Position Self-Sensing for Synchronous Electrostatic Machines [19689]
Aditya N. Ghule, Peter Killeen and Daniel C. Ludois, *University of Wisconsin - Madison, United States*

4:00PM | Sensorless Self-Commissioning of Synchronous Reluctance Machine with Rotor Self-Locking Mechanism [20116]
Anantaram Varatharajan, Paolo Pescetto and Gianmario Pellegrino, *Politecnico di Torino, Italy*

S28 | GaN Device and Application

Room 341
Chairs: Han Peng, Feng Qi

2:20PM | An Ultrafast Discrete Protection Circuit Utilizing Multi-Functional Dual-Gate Pads of GaN HEMTs [19415]
Ruoyu Hou and Juncheng Lu, *GaN Systems Inc., Canada*

2:45PM | Impact of Substrate Termination on Dynamic On-State Characteristics of a Normally-off Monolithically Integrated Bidirectional GaN HEMT [19798]
Carsten Kuring, Nick Wieczorek, Oliver Hilt, Mihaela Wolf, Boecker Jan, Wuerfl Joachim and Dieckerhoff Sibylle, *Technische Universitaet Berlin, Germany; Ferdinand-Braun-Institut, Germany*

3:10PM | Three-Dimensional Integrated GaN-based DC-DC Converter with an Inductor Substrate [19830]
Qi Zhiyuan, Wang Laili, Pei Yunqing, Wang Kangping, Zhao Cheng, Yang Fengtao and Zheng Zijie, *Xi'an Jiaotong University, China*

3:35PM | Finite Element Modeling of IGBT Modules to Explore the Correlation between Electric Parameters and Damage in Bond Wires [20744]
Maogong Jiang, Guicui Fu, Martin Fogsgaard, Lorenzo Ceccarelli, He Du, Amir Bahman, Yongheng Yang and Francesco Iannuzzo, *Beihang University, China; Aalborg University, Denmark*

4:00PM | Design of GaN based Ultra-high Efficiency, High Power Density Resonant Dickson Converter for High Voltage Step-down Ratio [19279]
Deepak Gunasekaran and Fang Peng, *Michigan State University/Analog Devices Inc., United States; Florida State University, United States*

S29 | LED Drivers and Intelligent Illumination

Room 336
Chairs: Omer Gundogmus, Efren Flores-Garcia

2:20PM | Fault-Tolerant LED Lighting Systems Featuring Minimal Loss of Luminous Flux [19867]
Fernando Bento and Antonio J. Marques Cardoso, *CISE, University of Beira Interior, Portugal*

2:45PM | Closed-Loop Control of LCL-T Resonant DC-DC Converter Operating as Automotive LED Driver [20044]
Mausamjeet Khatua, Satyaki Mukherjee, Alihossein Sepahvand, Vahid Yousefzadeh, Montu Doshi, Khurram Afridi and Dragan Maksimovic, *Cornell University, United States; University of Colorado Boulder, United States; Texas Instruments, United States*

3:10PM | Resonant Switched-Capacitor Auxiliary Circuit for Active Power Decoupling in Electrolytic Capacitor-less AC/DC LED Drivers [20389]
Zhenyu Shan, Xiaomei Chen, Shengwen Fan, Guofeng Yuan and Chi K. Tse, *North China University of Technology, China; Hong Kong Polytechnic University, Hong Kong*

3:35PM | Adapting the Outphasing Technique for VLC Based on Summing the Light [19950]
Daniel G. Aller, Diego G. Lamar, Juan Rodriguez, Pablo F. Miaja and Javier Sebastian, *University of Oviedo, Spain*

4:00PM | An Energy Efficient Li-Fi Transmitter with Single Inductor Multiple Output LED Driver [20703]
Kumar Modepalli, Soumya Chakraborty and Leila Parsa, *Rensselaer Polytechnic Institute, United States; University of California, Santa Cruz, United States*

S30 | Emerging Design and Applications of Energy Conversion 1

Room 345
Chairs: Eduard Muljadi, Aparna Saha

2:20PM | Low-Loss Switched Capacitor Voltage Balancing Circuit and Its Design Considerations [19114]
Liming Liu, Zach Pan, Yu Du, Yuxiang Shi and Yang Xiaobo, *ABB Inc., United States; ABB, China*

2:45PM | Design and Implementation of Switch-mode Solar Photovoltaic Emulator using Power-Hardware-in-the-loop Simulations for Grid Integration Studies [20557]
Isuru Jayawardana, Carl Ngai Man Ho and Mandip Pokharel, *University of Manitoba, Canada*

3:10PM | Discrete State Event-Driven Framework for Simulation of Switching Transients in Power Electronic Systems [19155]
Yicheng Zhu, Zhengming Zhao, Bochen Shi, Jiahe Ju, Zhujun Yu, Liqiang Yuan and Kainan Chen, *Tsinghua University, China*

3:35PM | Considerations of the Magnetic Field Uniformity for 2-D Rotational Core Loss Measurement [19921]
Shuaichao Yue, Yongjian Li, Qingxin Yang and Changgeng Zhang, *Hebei University of Technology, China; Tianjin University of Technology, China*

4:00PM | Application of Linear Permanent Magnet Flux-Switching Motors to Needle-free Jet Injection [19466]
Nick N. L. Do, Andrew J. Taberner and Bryan P. Ruddy, *The University of Auckland, New Zealand*

Tuesday, October 1 8:30AM – 10:10AM

S41 | PV Systems 1

Room 344
Chairs: Mohammad B Shadmand, Hengzhao Yang

8:30AM | Comprehensive Approach of Estimating Power-Peaks of Partially Shaded PV Strings with Overlapping Bypass Diodes [19118]
Zaid Alqaisi and Yousef Mahmoud, *Student, United States; Professor, United States*

8:55AM | A GaN-Based Active Power Decoupling Approach for Enhancing the Efficiency and Reliability of Residential PV Microinverters [20314]
Malek Ramezani, Fariborz Musavi, Saeed Golestan, Siavash Beheshtaein, Josep M. Guerrero and Robert Cuzner, *Washington State University, United States; Aalborg University, Denmark; University of Wisconsin Milwaukee, United States*

9:20AM | One Year Submillisecond Fast Solar Database: Collection, Investigation, and Application [20535]
Yue Cao, John Magerko, Rodrigo Serna, Shibin Qin, Robert Pilawa-Podgurski and Philip Krein, *Oregon State University, United States; EPRI, United States; Citadel LLC, United States; Apple Inc, United States; UC Berkeley, United States; Univ of Illinois - Urbana-Champaign, United States*

9:45AM | A Novel Approximate Model Based Fault Diagnosis Technique for a Photovoltaic DC/AC Grid Tied Inverter [20770]
Laurice Ann Smith, Naidu Satya and Mohamed O Badawy, *San Jose State University, United States*

S42 | DC Microgrid Control

Room 343
Chairs: Yaow-Ming Chen, Anshuman Shukla

8:30AM | Finite-time Stabilization of Constant Power Loads in DC Microgrids [19632]
Qianwen Xu, Frede Blaabjerg and Chuanlin Zhang, *Nanyang Technological University, Singapore, Denmark; Aalborg University, Denmark; Shanghai University of Electric Power, China*

8:55AM | Optimal Droop Coefficient Computation by Multi-Objective Optimization for Distributed Generators in DC Microgrids [19120]
Anushka Dissanayake and Nishantha Ekneligoda, *Oklahoma State University, United States*

9:20AM | Time Optimal Control of Constant Power Loads in DC Microgrids [19092]
Anushka Dissanayake and Nishantha Ekneligoda, *Oklahoma State University, United States*

9:45AM | Hysteresis Droop Controller with One Sample Delay for DC-DC Converters in DC Microgrids [20664]
Guangyuan Liu, Paolo Mattavelli and Stefano Saggini, *University of Padova, Italy; University of Udine, Italy*

S43 | Virtual Synchronous Generators

Room 342
Chairs: Qing-Chang Zhong, Pedro Rodriquez

8:30AM | Improved VSG Control for Type-IV Wind Turbine Generator Considering Operation Limitations [19776]
Chu Sun, Syed Qaseem Ali, Geza Joos and Francois Bouffard, *McGill University, Canada; OPAL-RT TECHNOLOGIES Inc., Canada*

8:55AM | Stability Analysis Considering Dual Physical Constraints of Parallel-connected Virtual Synchronous Generators forming Microgrids [20169]
Peilin Xie, Chang Yuan, Yajuan Guan, Sen Tan, Mingshen Li, Juan C. Vasquez and Josep M. Guerrero, *Aalborg University, Denmark; North China Electric Power Uni, China*

9:20AM | Transient Stability Analysis of Virtual Synchronous Generator Connected to an Infinite Bus [19194]
Pengkun Li, Yue Wang, Yonghui Liu, Hui Zhou, Guoqing Gao and Wanjun Lei, *Xi'an Jiaotong University, China*

9:45AM | Multi-parameter Adaptive Power Allocation Strategy for Microgrid with Parallel PV/Battery-VSGs [19984]
Meiqin Mao, Jian Hu, Yong Ding and Liuchen Chang, *Hefei University of Technology, China*

S44 | Inductive Power Transfer 2

Room 340
Chairs: Mohammad Islam, Jin Ye

8:30AM | A Reactive Compensation Method Using Switch Controlled Capacitor for Wireless Power Transfer [19268]
Jin Zhao, Jianzhong Zhang, Yaqian Zhang, Zakiud Din and Juri Jatskevich, *Southeast University, China; University of British Columbia, Canada*

8:55AM | Variable Duty Control of Three-Phase Voltage Source Inverter for Wireless Power Transfer Systems [20654]
Gui-Jia Su, Omer Onar, Jason Pries and Veda Galigekere, *Oak Ridge National Lab, United States*

9:20AM | A Self-oscillating Controller Based on Pulse Density Modulator in Wireless Power Transfer [19295]
Dong Wu, Ruikun Mai, Shiqiao Zhao, Zhengyou He and Fan Peng, *Southwest Jiaotong University, China*

9:45AM | A Soft-switched Active Clamped Half-bridge Current Source Inverter for Wireless Inductive Power Transfer [19699]
Phuoc Sang Huynh and Sheldon Williamson, *University of Ontario Institute of Technology, Canada*

S45 | AC-DC Multi-Phase

Room 349
Chairs: Srdjan Lukic, Mohamed Youssef

8:30AM | Improved Modulation for DAB based Three-Phase Single-Stage AC-DC Converter [19134]
Fengjiang Wu and Xiaoguang Li, *Harbin Institute of Technology, China*

8:55AM | A Single-Stage High Frequency-link Modular Three-Phase Soft-Switching AC-DC Converter for EV Battery Charger [19303]
Tomokazu Mishima and Shoya Mitsui, *Kobe University, Japan*

9:20AM | Integration of Minimum-Voltage Active-Clamping to Three-Phase Four-Wire Rectifiers with a Balancing Leg [19590]
An Zhao, Yangtao Huang, Keyan Shi, Jinyi Deng, Changsheng Hu and Dehong Xu, *Zhejiang University, China*

9:45AM | AC-DC Power Conversion Systems for Open-End Winding PMSM Based on Vienna Rectifiers [20056]
Amanda Pereira Monteiro, Cursino Brandao Jacobina, Filipe Antonio Da Costa Bahia and Reuben Palmer Rezende de Sousa, *Federal University of Campina Grande, Brazil*

S46 | DC-DC Non-Isolated Converter 2

Room 347
Chairs: Parag Kshirsagar, Dong Cao

8:30AM | Voltage-Controlled Tunable Capacitor based Resonant Power Converter [20450]
Ben Guo, Suman Dwari and Priay Shashank, *United Technologies Research Center, United States; Pennsylvania State University, United States*

8:55AM | An Inductor-less DC to DC Converter Suitable for Use In 1500V Solar Power Applications [19236]
Mahesh Swamy, *Yaskawa America, Inc., United States*

9:20AM | Resonant Network Design Methodology Based on Two-port Network Analysis Considering Load Impedance Variation [19770]
Euihoon Chung and Jung-Ik Ha, *Seoul Nationlal Univ., Korea (South)*

9:45AM | A Novel Switched-Capacitor Converter with Phase Shift Modulation [19539]
Hongyang Xie and Rui Li, *Shanghai Jiao Tong University, China*

S47 | Design for Reliability

Room 350
Chairs: Ke Ma, Alan Mantooth

8:30AM | DC Pulsed Transient Waveform Characterization Under Wavelet Transformation [19762]
Damian Oslebo, Keith Corzine, Todd Weatherford, Roberto Cristi and Atif Maqsood, *Naval Postgraduate School, United States; University of California, Santa Cruz, United States*

8:55AM | Application of Digital Twin for Condition Monitoring in DC-DC Power Converters [20273]
Yingzhou Peng and Wang Huai, *Aalborg University, Denmark*

9:20AM | A Quasi-Online Monitoring Method of Output Capacitor and Boost Inductor for DCM Boost Converter [19209]
Lingge Li, Kai Yao, Chanbo Guan, Chengjian Wu, Bin Fang, Zhen Zhang, Chunwei Ma, Jienan Chen and Junfang Zhang, *Nanjing University of Science and Technology, China*

9:45AM | PCB Layout Based Short-Circuit Protection Scheme for GaN HEMTs [20027]
Ozturk Sahin Alemdar, Furkan Karakaya and Ozan Keysan, *Aselsan Inc., Turkey; Middle East Technical University, Turkey*

Tuesday, October 1 **10:30AM – 12:10PM**

S48 | Large Signal Stability and Control

Room 346
Chairs: Minjie Chen, Yunwei Li

8:30AM | An Asymmetrical Fault Current Iterative Algorithm of Droop-Controlled Inverter [19216]
Huimin Zhao, Jun Ge, Zhikang Shuai, Ying Cheng, Jinyong Lei and John Shen, *Hunan University, China; China Southern Power Grid, China*

8:55AM | Suppression of Quantization-Induced Limit Cycles in Digitally Controlled DC-DC Converters by Dyadic Digital Pulse Width Modulation [19638]
Maksudjon Usmonov, Paolo Crovetti, Francesco Gregoretti and Francesco Musolino, *Politecnico di Torino, Italy*

9:20AM | Conceptual Systematic Stability Analysis of Power Electronics based Power Systems [19795]
Qianwen Xu, Xiongfei Wang, Taul Mads Graungaard and Frede Blaabjerg, *Aalborg University, Denmark*

9:45AM | A Stabilizer for Inverters Operating in Grid-Feeding, Grid-Supporting and Grid-Forming Modes [20360]
Aswad Adib, Fariba Fateh and Behrooz Mirafzal, *Kansas State University, United States*

S49 | Modeling and Simulation Tools

Room 329
Chairs: Han Peng, Dragan Maksimovic

8:30AM | A Numerical Method for Calculating the Output Spectrum of an H-Bridge Inverter with Dead-time Based on Switching Mode Analysis [19575]
Qihao Yu, Erik Lemmen and Bas Vermulst, *Eindhoven University of Technology, Netherlands*

8:55AM | Three-Phase Test Bench for Multiple Submodules in Modular Multilevel Converter System [19617]
Shan Jiang, Ke Ma and Ye Zhu, *Shanghai Jiao Tong University, China*

9:20AM | Hierarchical Layout Synthesis and Design Automation for 2.5D Heterogeneous Multi-Chip Power Modules [19372]
Imam Al Razi, Quang Le, H. Alan Mantooth and Yarui Peng, *University of Arkansas, United States*

9:45AM | Estimation of Lumped Equivalent Circuit Elements of a SiC Power Module [19083]
David Reiff, Axel Rothstein, Jianghua Feng, Jing Shang and Volker Staudt, *Ruhr University Bochum, Germany; CRRC Zhuzhou Institute, China*

S50 | Inverter Control

Room 348
Chairs: Carl Ho, Marcello Pucci

8:30AM | Optimized Based Algorithm First Order Sliding Mode Control for Grid-Connected Packed E-Cell (PEC) Inverter [19418]
Mohammad Babaie, Mohammad Sharifzadeh, Majid Mehrasa and Kamal Al-Haddad, *Ecole de technologie superieure, Canada; Babol Noshirvani University of Technology, Iran*

8:55AM | A Novel Decentralized Control Strategy for Input-Series Output-Parallel Inverter System [19545]
Ke Zhang, Wu Chen, Liangcai Shu, Chenyang Xue, Han Ye and Waqar Azeem Syed, *Southeast University, China; Southeast University, China*

9:20AM | Power Decoupling Control for Boost-Type Single-Phase Inverter with Active Power Buffer [19548]
Shenquan Liu, Yufei He, Gang Wang and Minghao Wang, *South China University of Technology, China; The Hong Kong Polytechnic University, Hong Kong*

9:45AM | Harmonic Analysis of Common-mode Reduction Modulation for Three-level Inverter [20256]
Ruirui Chen, Jiahao Niu, Handong Gui, Zheyu Zhang, Fred Wang, Leon Tolbert, Daniel Costinett, Benjamin Blalock and Benjamin Choi, *University of Tennessee, United States; Clemson University, United States; NASA Glenn Research Center, United States*

S51 | Electric Machines: Loss analysis 1

Room 337
Chairs: Gerd Bramerdorfer, Franco Leonardi

8:30AM | A new Zig-Zag Variable Load Test Approach for Enhanced Stray-Load Loss Measurements [19568]
Silvio Vaschetto, Andrea Cavagnino, Emmanuel Agamloh and Alberto Tenconi, *Politecnico di Torino, Italy; Baylor University, Waco, Texas, United States*

8:55AM | Effect of Inverter Output dv/dt with Respect to Gate Resistance and Loss Comparison with dv/dt Filters for SiC MOSFET based High Speed Machine Drive Applications [19684]
Heonyoung Kim, Sayan Acharya, Anup Anurag, Byeong-Heon Kim and Subhashish Bhattacharya, *North Carolina State University, United States*

9:20AM | Investigation and Prediction of PWM-induced Iron Loss in Lamination Steels Using High-Frequency Inverters with Wide-Bandgap Switches [20020]
Le Chang, Woongkul Lee, Thomas Jahns and Khwaja Rahman, *University of Wisconsin- Madison, United States; General Motors Global Propulsion Systems, United States*

9:45AM | Iron Loss Calculation under PWM inverter Switching for SiFe Steel Materials [20376]
Hiroaki Matsumori, Toshihisa Shimizu, Takashi Kosaka and Nobuyuki Matsui, *Nagoya Institute of Technology, Japan; Tokyo Metropolitan University, Japan*

S52 | Induction Machines

Room 338
Chairs: Cong Ma, Silvio Vaschetto

8:30AM | Induction Motor Mapping Using Rotor Field-Oriented Analysis Technique [19240]
Matteo Carbonieri, Nicola Bianchi and Luigi Alberti, *University of Padova, Italy*

8:55AM | Prediction of Drive-Fed Induction Machine Efficiency Using Sine Wave Efficiency Results [19249]
Mahmud Ghasemi Bijan and Pragasen Pillay, *Concordia University, Canada*

9:20AM | Hybrid Method for Measuring Rotor Bar-Lamination Contact Resistances [19506]
Andrea Cavagnino, Silvio Vaschetto and Zbigniew Gmyrek, *Politecnico di Torino, Italy; Lodz University of Technology, Poland*

9:45AM | A Method to Estimate Torque and Stray Load Loss of Induction Motor without Torque Detector [20432]
Shu Yamamoto, Hideaki Hirahara and Balapuwaduge Amith Shantha Gunasekara, *Polytechnic University, Japan*

S53 | Energy Efficiency Issues in Electric Drives

Room 336
Chairs: Lijun He, Arijit Banerjee

8:30AM | Novel Winding Changeover Method for A High Efficiency AC Motor Drive [19374]
Seong-Hwan Im, Gwangmin Park and Bon-Gwan Gu, *Kyungpook National University, Korea (South); Korea Automotive Technology Institute, Korea (South)*

8:55AM | Operation and Analysis of Current-Source Inverters Using Dual-Gate Four-Quadrant Wide-Bandgap Power Switches [20354]
Renato Amorim Torres, Hang Dai, Thomas Jahns and Bulent Sarlioglu, *University of Wisonsin-Madison, United States*

9:20AM | An H8 Current-Source Inverter using Wide Bandgap Bidirectional Switches [20424]
Hang Dai, Renato Amorim Torres, Thomas Jahns and Bulent Sarlioglu, *WEMPEC, University of Wisconsin-Madison, United States*

9:45AM | Implementation of the Master-Slave Windings Scheme for the Low Pulse Ratio Operation in Motor Drivers [20613]
Mufeng Xiong, Zipeng Liang, Sideng Hu, Wenxi Yao and Xiangning He, *Zhejiang University, China*

S54 | Prof. Bob Lorenz Memorial Session 2

Room 339
Chairs: Thomas M. Jahns, Bulent Sarlioglu

8:30AM | In Memoriam Prof. Bob Lorentz
Thomas M. Jahns and Bulent Sarlioglu

8:55AM | Design of Current Regulator for Induction Machines at Low Sampling-to-Fundamental Frequency Ratios with Improved Current Observer [20308]
Yang Xu, Chikara Morito and Robert Lorenz, *University of Wisconsin-Madison, United States; Toshiba Mitsubishi-Electric Industrial Sys Corp, Japan*

9:20AM | Spatial Deadbeat Torque Control for Six-Step Operation [20262]
Marc Petit, Bulent Sarlioglu, Robert Lorenz, Brent Gagas and Caleb Secrest, *UW-Madison, WEMPEC, United States; General Motors, United States*

9:45AM | Enhancement of SPMSMs Sensorless Torque Estimation Using High Frequency Signal Injection [19570]
David Reigosa, Ye Gu Kang, Maria Martinez, Daniel Fernandez, Juan Manuel Guerrero and Fernando Briz, *University of Oviedo, Spain; University of Wisconsin, Korea (South)*

S55 | Gate Drive for Wide Band Gap Device 1

Room 341
Chairs: Tanya Gachovska, He Li

8:30AM | An Intelligent Model-Based Multi-Level Active Gate Driver for Power Semiconductor Devices [19163]
Shuang Zhao, Xingchen Zhao, Haider Mehisan, Chris Farnell and Alan Mantooth, *University of Arkansas, United States*

8:55AM | Economical Methods for SiC JFET's short-circuit Protection using Commercial Gate Drivers [19715]
Rostan Rodrigues and Xiaoqing Song, *ABB Inc, United States*

9:20AM | Design and Implementation of Digital Active Gate Control with Variable 63-level Drivability Controlled by Serial 4-bit Signals [20709]
Hidemine Obara, Tomoyuki Mannen, Keiji Wada, Koutaro Miyazaki, Toru Sai, Makoto Takamiya and Takayasu Sakurai, *Yokohama National University, Japan; Tokyo Metropolitan University, Japan; The University of Tokyo, Japan*

9:45AM | Current Sharing and Overvoltage Issues of Paralleled SiC MOSFET Modules [20639]
Krishna Mainali, Ruxi Wang, Juan Sabate and Steven Klopman, *GE Global Research, United States; GE Global Research, United States*

S56 | Emerging Design and Applications of Energy Conversion 2

Room 345
Chairs: Kaveh Ashenayi, Ahmet Yeksan

8:30AM | Electronically Assisted Circuit Breaker (EACB) for DC Power Systems [19540]
Yanjun Feng, Yuanfeng Zhou, Z. John Shen, Xin Zhou and Slobodan Krstic, *Illinois Institute of Technology, United States; Eaton Corporation, United States*

8:55AM | High-Frequency Resonant Inverter for Power Transfer Between Distributed Modules of a Biomedical Implant [20244]
Usama Anwar, Dejan Markovic and Khurram Khan Afridi, *UCLA, United States; Cornell, United States*

9:20AM | Development of a Power Electronics Teaching Lab Incorporating WBG Semiconductors with Plug and Play Modular Hardware and Advanced Curriculum [20387]
Chondon Roy, Namwon Kim, Robert Cox and Babak Parkhideh, *University of North Carolina at Charlotte, United States*

9:45AM | A New Adaptive Virtual Impedance based Fault Current Limiter for Converters [20630]
Siavash Beheshtaein, Saeed Golestan, Robert Cuzner and Josep Guerrero, *University of Wisconsin Milwaukee, United States; Aalbrog University, Denmark*

Wednesday, October 2 8:30AM – 10:10AM

S75 | PV Systems 2

Room 344
Chairs: Rangarajan Tallam, Mehdi Narimani

8:30AM | Single-Stage Common-Ground Boost Inverter (S2CGBI) for Solar Photovoltaic Systems [19179]
Sze Sing Lee, Chee Shen Lim, Yam P. Siwakoti and Kyo-Beum Lee, *Newcastle University in Singapore, Singapore; University of Southampton Malaysia Campus, Malaysia; University of Technology Sydney, Australia; Ajou University, Korea, Republic of*

8:55AM | Dual-Input Single-Stage Inverter for Photovoltaic-Battery Applications [19352]
Khalil Alluhaybi, Issa Batarseh and Haibing Hu, *University of Central Florida, United States; Nanjing University of Aeronatics and Astronautic, China*

9:20AM | Operating Mode and Coordinated Power Control for PV Battery Hybrid System Using Cascaded Multilevel Inverter [19834]
Junmou Feng, Zhao Liu, Jianshou Kong, Yue Zhang, Shanshan Zhao, Liang Dong, Qian Ma and Jian Ma, *Nanjing University of Science and Technology, China*

9:45AM | A High-Gain, Soft-switched PV Micro-Converter Using a Single Switch with A Low Switch-Voltage-to-Output-Bus-Voltage Ratio [20127]
Kajanan Kanathipan and John Lam, *York University, Canada*

S76 | Converters for DC Microgrids

Room 343
Chairs: Marco Liserre, Giovanna Oriti

8:30AM | Hybrid Modulated Bidirectional Resonant DC/DC Converter for High-Voltage Bus-Based Energy Storage Systems [19882]
Junyun Deng and Haoyu Wang, *ShanghaiTech University, China*

8:55AM | Adaptive Current Sharing of Distributed Battery Systems in DC Microgrids Using Adaptive Virtual Resistance-Based Droop Control [19508]
Yajie Jiang, Yun Yang, Siew Chong Tan and Shu Yuen Ron Hui, *The University of Hong Kong, Hong Kong*

9:20AM | Virtual Transformer Control for DC-DC Interlinking Converters in DC Microgrids [19264]
Haixu Shi, Kai Sun, Yunwei (Ryan) Li and Hongfei Wu, *Tsinghua University, China; University of Alberta, Canada; Nanjing University of Aeronautics and Astronauti, China*

9:45AM | Efficiency Evaluation for DAB Converter with Reactive Power Minimization Strategy and Full ZVS Operation [19426]
Yan Hu, Yu Zhang, Qing Chen, Tianhui Zhang, Qingxin Guan, Yang Liu, Yongyong Jia and Jiexin Yu, *Huazhong University of Science and Technology, China; State Grid Jiangsu Electric Power Co.,LTD., China; State Grid Jiangsu Electric Power Co.,LTD. Reser, China*

S77 | Power Quality in Power Systems

Room 346
Chairs: Norma Anglani, Ali Bazzi

8:30AM | Comparative Analysis on Performance of Power Quality Improvement of Grid-Connected Inverters [19589]
Wooyoung Choi and Bulent Sarlioglu, *University of Wisconsin-Madison, United States*

8:55AM | A Hybrid Front-end for Multi-Generator Power System Harmonic Elimination [20649]
Jongwan Kim and Jih-Sheng Lai, *Virginia Tech, United States*

9:20AM | A Double Reduced Order Generalized Integrator based Algorithm for Control of Four-leg Converter to Enhance Power Quality [19105]
Shilei Jiao, Kaushik Rajashekara, Krishna Raj Ramachandran Potti, Lazhar Ben-Brahim and Adel Gastli, *University of Houston, United States; Qatar University, Qatar*

9:45AM | Power Quality Enhancement by SiC Active Power Filters in Oil and Gas Platforms [20724]
Lais Vitoi, Danilo Brandao and Elisabetta Tedeschi, *Federal University of Minas Gerais, Brazil; Norwegian University of Science and Technology, Norway*

S78 | Grid-Converter Interactions

Room 342
Chairs: Grant Pitel, Qin Lei

8:30AM | Synchronous Frequency Support of Photovoltaic Power Plants with Inertia Emulation [20042]
Cristian Verdugo, Andres Tarraso, Jose Ignacio Candela, Joan Rocabert and Pedro Rodriguez, *Polytechnic University of Catalonia, Spain; Loyola University Andalusia, Spain*

8:55AM | Transient Stability Impact of Reactive Power Control on Grid-Connected Converters [19665]
Donghua Pan, Xiongfei Wang, Fangcheng Liu and Rongliang Shi, *Aalborg University, Denmark; Huawei Technologies Co., Ltd., China*

9:20AM | Grid-Tied Inverter with Simplified Virtual Synchronous Compensator for Grid Services and Grid Support [19667]
Fabio Mandrile, Enrico Carpaneto and Radu Bojoi, *Politecnico di Torino, Italy*

9:45AM | Improved Transient Frequency Stabilization of Grid Feeding Distributed Generation Systems Using Active Damping Control [20763]
Salman Harasis and Yilmaz Sozer, *University of Akron, United States*

S79 | DC-AC Single-Phase

Room 349
Chairs: Daniel Costinett, Zhiliang Zhang

8:30AM | A Single-Phase PV Inverter with Swinging Bus Controller to Eliminate Electrolytic Capacitor and Achieve Reactive Power Generation Capability [20541]
Xinmin Zhang, Mahshid Amirabadi and Brad Lehman, *Northeastern University, United States*

8:55AM | An Isolated Single-Stage Single-Phase Micro-Inverter Topology with Integrated Magnetic Components [20277]
Hafis Umar-Lawal, Carl Ngai Man Ho and Ken King Man Siu, *University of Manitoba, Canada*

9:20AM | Improvements on Harmonic Current Distortion for MHz-Operated Discontinuous Current Mode Single Phase Grid-Tied Inverter with GaN-HEMT Device [19994]
Jiantao Zhang, Takanori Isobe and Hiroshi Tadano, *University of Tsukuba, Japan*

9:45AM | A Family of Enhanced Voltage Gain Switched-Boost Impedance-Source Inverter Topologies for Renewable Energy Resources [20449]
Anish Ahmad, Rajeev Kumar Singh and Vivek Nandan Lal, *IIT Patna, India; IIT(BHU) VARANASI, India*

S80 | DC-DC Non-Isolated Converter 3

Room 347
Chairs: Jen-Hung (Peter) Huang, Li Zhang

8:30AM | Analysis of Hybrid SiC IGBT Based Resonant Switched Capacitor Converter with Circuit Parasitics Consideration [19149]
Piao Wen, Xiaofeng Yang, Chengzhang Yan, Trillion Q Zheng and Seiki Igarashi, *Beijing Jiaotong University, China; Fuji Electric Co., Ltd., Japan*

8:55AM | A 3L Capacitor Clamping Converter with Low Current Ripple and High Voltage Gain [20561]
Hong Li, Wencai Wang, Yangbin Zeng, Yangyang Zhao and Yanfeng Jiang, *Beijing Jiaotong University, China*

9:20AM | Fault Tolerance Analysis of Non-isolated High Gain Boost Converter [20283]
Ankul Gupta, Raja Ayyanar and Sombuddha Chakraborty, *Arizona State University, United States; Texas Instruments, United States*

9:45AM | A Resonant Cockcroft-Walton Switched-Capacitor Converter Achieving Full ZCS and >10kW/inch^3 Power Density [19261]
Nathan Ellis and Rajeevan Amirtharajah, *University of California Davis, United States*

S81 | PWM and Harmonic Reduction 1

Room 350
Chairs: Youim (Kelly) Tray, Toshihisa Shimizu

8:30AM | Power Quality Optimization of Post-Fault Reconfigured Multi-Level Inverter [20246]
Weiqiang Chen and Ali Bazzi, *University of Connecticut, United States*

8:55AM | Optimized Digital Implementation of Carrier-based Randomized Discontinuous PWM Technique for Active Front End (AFE) Drives [19605]
Zhe Zhang, Lixiang Wei, Peizhong Yi, Puneeth Srikanta Murthy and Yujia Cui, *University of Connecticut, United States; Rockwell Automation, Inc, United States*

9:20AM | An Asymmetric Selective Harmonic Current and Voltage Modulation-PWM Technique for Electric Vehicle Charging Stations with Cascaded H-Bridge Converters to Meet Power Quality Standards [20384]
Amirhossein Moeini and Shuo Wang, *University of Florida, United States*

9:45AM | Discontinuous Modulation of Interleaved Parallel NPC Inverters with Reduced Circulating Current [19657]
Anatolii Tcai, Sante Pugliese and Marco Liserre, *Kiel University, Germany*

S82 | Steady State Modeling

Room 340
Chairs: Huai Wang, Dong Jiang

8:30AM | Resolving Loss Discrepancy between Calculation and Measurement in a 4.5 kW GaN-based Inverter [19704]
Zhe Yang, Paige Williford, Edward Jones, Jianliang Chen, Fred Wang, Sandeep Bala and Jing Xu, *University of Tennessee, Knoxville, United States; ABB Corporate Research, United States*

8:55AM | The Principle and Calculation of AC-side Grounding Resistance of Three-phase Converter through DC Insulation Monitoring [19106]
Jifei Du, Trillion Q Zheng, Hong Li, Yangbin Zeng and Hongyan Zhao, *Beijing Jiaotong University, China*

9:20AM | Analysis of a GaN-Based CRM Totem-Pole PFC Converter Considering Current Sensing Delay [20443]
Jingjing Sun, Nathan Strain, Daniel Costinett and Leon Tolbert, *University of Tennessee, United States*

9:45AM | Comparison between Different Analysis Methodologies for LLC Resonant Converter [19190]
Yuqi Wei, Quanming Luo, Zhiqing Wang, Alan Mantooth and Xingchen Zhao, *The University of Arkansas, United States; Chongqing University, China*

S83 | Grid Synchronization

Room 348
Chairs: Xinke Wu, Blane Wilson

8:30AM | Re-synchronization of Universal Droop Control Distributed Generation Inverter to the Grid [19663]
Mohammad Amin and Qing-Chang Zhong, *Norwegian University of Science and Technology, Norway; Illinois Institute of Technology, United States*

8:55AM | Adaptive Synchronization Technique for Single-phase Inverters in AC Microgrid [19768]
Animesh Sahoo, Khizir Mahmud and Jayashri Ravishankar, *University of New South Wales, Sydney, Australia*

9:20AM | Series Harmonic Voltage Cancellator for Mitigating Effect of Grid Impedance on the Stability of Microgrids [19315]
Chun-tak Lai, Henry Shu-hung Chung and Weimin Wu, *City University of Hong Kong, Hong Kong; Shanghai Maritime University, China*

9:45AM | Observer Based Admittance Shaping for Resonance Damping in Voltage Source Converters with LCL Filter [20672]
Ma Awal, Hui Yu, Leandro Della Flora, Wensong Yu, Srdjan Lukic and Iqbal Husain, *North Carolina State University, United States; Danfoss Drives, United States*

S84 | Electric Machines for Transportation 1

Room 337
Chairs: Takashi Kato, Ayman El-Refaie

8:30AM | Synchronous Reluctance Motors with Asymmetric Rotor Shapes and Epoxy Resin for Electric Vehicles [19646]
Andrea Credo, Marco Villani, Mircea Popescu and Nicolas Riviere, *University of L'Aquila, Italy; Motor Design Ltd., United Kingdom*

8:55AM | Addressing the Challenges of Lightweight Aircraft Electric Propulsion through Electrical Machines with Air-gap Windings [20326]
Philip Henry Mellor, Callum Heath, Suzanne Collins, Nick Simpson and Ian Bond, *University of Bristol, United Kingdom; National Composites Centre, United Kingdom*

9:20AM | Systematic Comparison of Two Axial Flux PM Machine Topologies: Yokeless and Segmented Armature versus Single Sided [20421]
Narges Taran, Greg Heins, Vandana Rallabandi, Dean Patterson and Dan M. Ionel, *University of Kentucky, United States; Regal Beloit Corporation, Australia*

9:45AM | Analytical Design of an Easily Manufacturable, Air-Cooled, Toroidally Wound Permanent Magnet Ring Motor with Integrated Propeller for Electric Rotorcraft [20698]
Max Liben and Daniel C. Ludois, *University of Wisconsin -Madison, United States*

S85 | Electric Machines: Diagnostics, Noise and Vibration 1

Room 338
Chairs: Rakib Islam, Shanelle Foster

8:30AM | Detection and Classification of Damper Bar and Field Winding Faults in Salient Pole Synchronous Motors [19026]
Yonghyun Park, Sang Bin Lee, Mladen Sasic, Greg Stone and Jangho Yun, *Korea University, Korea, Republic of; Quaitrol - Iris Power, Canada; Hyundai Electric, Korea, Republic of*

8:55AM | Comparison of Fault Characteristics for Dual Three-Phase Synchronous Reluctance Motor [19917]
JunKyu Park, Cristian Babetto, Berardi Grazia, Jin Hur and Nicola Bianchi, *University of Padova, Italy; Incheon National University, Korea (South)*

9:20AM | Analysis of Unbalanced Magnetic Pull in PMSM Due to Static Eccentricity [20156]
Anmol Aggarwal, Elias Strangas and John Agapiou, *Michigan State University, United States; General Motors, United States*

9:45AM | Radial Force Reduction in SRMs using Partial Teeth Insertion on Stator and Rotor Poles [20773]
Lavanya Vadamodala, Omer Gundogmus, Abdul Wahab Bandarkar and Yilmaz Sozer, *University of Akron, United States*

S86 | Prof. Manfred Depenbrock Memorial Session

Room 339
Chairs: Mario Pacas, Volker Staudt

8:30AM | In Memoriam Manfred Depenbrock [20778]
Mario Pacas, Volker Staudt and Andreas Steimel, *University of Siegen, Germany; Ruhr-University Bochum, Germany*

8:55AM | Zero Voltage Vector Selection in a Saturation Controller-Based Direct Torque Control for Permanent-Magnet Synchronous Motors [19164]
Lizhi Qu, Wei Qiao, Liyan Qu and Zhe Zhang, *University of Nebraska-Lincoln, United States; Eaton Corporation, United States*

9:20AM | A Very Simple and Practical Deadbeat Direct Torque and Flux Control for IPMSM [19153]
Xiaogang Lin, Wenxin Huang, Yong Zhao, Wen Jiang, Ning Su and Shanfeng Zhu, *Nanjing University of Aeronautics and Astronauti, China*

9:45AM | A High Frequency Signal Injection based Optimum Reference Flux Searching for Direct Torque Control of A Three-Level Traction Drive [20146]
Mohammad Hazzaz Mahmud, Yuheng Wu, Waleed Alhosaini, Fei Diao and Yue Zhao, *University of Arkansas, United States*

S87 | High Power Switching Devices and Application

Room 341
Chairs: Ramanujam Ramabhadran, Xiu Yao

8:30AM | A 20 kV, 125 kHz Photonically Driven Power MOSFET-like Device [19674]
Kristin Sampayan and Stephen Sampayan, *Opcondys, Inc., United States*

8:55AM | Integrator Design of the Rogowski Current Sensor for Detecting Fast Switch Current of SiC Devices [19225]
Lei Ming, Zhen Xin, Yin Changqing, Chen Manxin and Loh Poh Chiang, *The Chinese University of Hong Kong, Hong Kong*

9:20AM | Multi-Objective Optimization Control for SiC/Si Hybrid Switch [20085]
Zhizhi He, Zongjian Li, Jiajun Yu, Xi Jiang and Jun Wang, *Hunan University, China, China*

9:45AM | SiC MOSFETs Modeling Considering Characteristics Variation for Module Parallel Applications [19304]
David Hongfei Lu, Hiromu Takubo, Motohito Hori and Akio Toba, *Fuji Electric Co., Ltd., Japan; Fuji Electric Co., Ltd., Japan*

S88 | Wireless Power Transfer 1

Room 345
Chairs: Fuxin Liu, Daniel Ludois

8:30AM | Design of Loosely Coupled Transformer of Wireless Power Transfer for Higher Misalignment Tolerance of System Efficiency [19143]
Haisen Zhao, Yufei Wang, Hassan H. Eldeeb, Yang Zhan, Guorui Xu and Osama A. Mohammed, *North China Electric Power University, China; Florida International University, United States*

8:55AM | Magnetic Stray Field Attenuation in High-Power WPT Systems based on a Modular Concept [19500]
Abubakar Uba Ibrahim, Wenxing Zhong, Hongzhi Cui, Hao Li and Dehong Xu, *Zhejiang University, Hangzhou, China*

9:20AM | Interoperability Evaluation of Wireless Electric Vehicle Charging Systems Based on Impedance [19623]
Kai Song, Guang Yang, Ruizhi Wei, Xiaohua Huang, Qian Zhang and Chunbo Zhu, *Harbin Institute of Technology, China; China Electric Power Research Institute, China; State Grid Beijing Power Research Institute, China*

9:45AM | Automatic Active Compensation Method of Cross-Coupling in Multiple-receiver Resonant Inductive Coupling Wireless Power Transfer Systems [19733]
Masataka Ishihara, Keita Fujiki, Kazuhiro Umetani and Eiji Hiraki, *Okayama University, Japan*

Wednesday, October 2 10:30AM – 12:10PM

S89 | Multi Level PV Systems

Room 344
Chairs: Elisabetta Tedeschi, Mohammad B Shadmand

10:30AM | Three-Phase Transformer-less Hybrid-Bypass Inverter [20159]
Zhou Liwei and Preindl Matthias, *Columbia University, United States*

10:55AM | Multilevel-Boost-Converter-Neutral-Point-Clamped-Inverter Photovoltaic System with MPPT Based on Fibonacci Search [20435]
Ronnan Cardoso, Edison da Silva and Darlan Fernandes, *Federal University of Paraiba, Brazil; Federal University of Paraiba and Federal, Brazil*

11:20AM | Design Optimization of a 1500 V GaN-Based Solar Inverter Using Flying Capacitor Multi-Level Converter Stages [20447]
Andrew Stillwell and Robert Pilawa, *University of Illinois at Urbana-Champaign, United States; University of California, Berkeley, United States*

11:45AM | Switched-Capacitor-Inductor-based Differential Power Converter for Solar PV Modules [19914]
Kamran Ali Khan Niazi, Yongheng Yang, Jinkui He, Akif Zia Khan and Dezso Sera, *Aalborg University, Denmark; The Hong Kong Polytechnic University, Hong Kong, Hong Kong*

S90 | Solid State Transformers 1

Room 343
Chairs: Subhadeep Bhattacharya, Ghanshyamsinh Gohil

10:30AM | Implementation of Flexible Large Power Transformers Using Modular Solid State Transformer Topologies Enabled by SiC Devices [20671]
Venkat NagSomeswar Rao Jakka, Harshit Nath, Subhashish Bhattacharya and Acharya Sayan, *NC State University, United States*

10:55AM | Discrete State Event-Driven Approach for High-Power Converter Simulations [19162]
Bochen Shi, Zhengming Zhao, Yicheng Zhu, Zhujun Yu, Jiahe Ju, Liqiang Yuan and Kainan Chen, *Tsinghua University, China*

11:20AM | Modified Feedforward Control to Suppress DC Voltage Disturbances for Three-Stage MMC-PET [19533]
Yaqian Zhang, Jianzhong Zhang, Jin Zhao and Fujin Deng, *Southeast University, China*

11:45AM | Intelligent Transformer Unit Topology Using Additional Small Power Converter Based on Conventional Distribution Transformer [20423]
Hyun-Jun Lee and Young-Doo Yoon, *Hanyang University, Korea (South)*

S91 | Synchronization of Grid Converters

Room 342
Chairs: Dong Dong, Brian Johnson

10:30AM | Self-Synchronising Stationary Frame Current Regulation for Grid-Connected LCL Converters Under Unbalanced Grid Voltage Conditions [19748]
Afif Nazib, Grahame Holmes and Brendan McGrath, *RMIT University, Australia*

10:55AM | Wind Power System Control Based on the Self_synchronized Universal Droop Controller [20332]
Yang Ruan and Qing-Chang Zhong, *Illinois Institute of Technology, United States*

11:20AM | Synchronous Power Controller for Distributed Generation Units [20017]
Andres Tarraso, Cristian Verdugo, Ngoc Bao Lai, Jose Ignacio Candela and Pedro Rodriguez, *SEER - UPC, Spain; Loyola University, Spain*

11:45AM | A single-phase synchronization Technique for Grid-connected RESS under Distorted Grid Conditions [20406]
Komal Saleem, Zunaib Ali and Kamyar Mehran, *Queen Mary University of London, United Kingdom*

S92 | Prof. Milan M. Jovanovic Memorial Session

Room 349
Chairs: Dushan Borojevic, Fred Lee

10:30AM | Review of Milan M. Jovanovic's Work and Impact on the Power Electronics Industry [19365]
Laszlo Huber, Yungtaek Jang and Panov Yuri, *Delta Electronics (Americas) Ltd., United States*

10:55AM | A Two-stage Universal Input Charger with Wide Output Voltage Range [19360]
Mike K. Ranjram, Cheng Zhang and David J. Perreault, *Massachusetts Institute of Technology, United States*

11:20AM | A Reverse-Feeding Hold-up Time Strategy for Two-Stage Grid-Interface PFC with a Rectifier-Coupled Boost Inductor [20060]
Jaeil Baek, Gun-Woo Moon and Minjie Chen, *Princeton University, United States; KAIST, Korea (South)*

11:45AM | Wide Voltage Range High-Efficiency Sigma Converter 48V VRM With Integrated Magnetics [20478]
Mohamed H. Ahmed, Fred C. Lee and Qiang Li, *CPES - Virginia Tech, United States*

S93 | Multilevel Converters Voltage Balancing

Room 346
Chairs: Thomas Podlesak, Brendan McGrath

10:30AM | Capacitor Voltage Balancing Control Strategy for Single Phase Five-Level ANPC Photovoltaic Inverter [19706]
Haihua Xue, Deqiang Zhang, Xi Liu, Alian Chen and Chenghui Zhang, *Shandong University, China*

10:55AM | Hybrid DC Link Voltage Balancing For a Two-Leg Five-Level Neutral Point Clamped Inverter [19525]
Eshet Wodajo, Malik Elbuluk, Seungdeog Choi and Haitham Abu-Rub, *University of Akron, United States; Mississippi State University, United States; Texas A & M University - Qatar, Qatar*

11:20AM | Balancing Average Capacitor Voltages in Neutral-Point-Clamped Converters Using Band-Limited Three-Level Modulation [19501]
Neha Beniwal, Christopher David Townsend, Glen Farivar, Josep Pou and Salvador Ceballos, *Nanyang Technological University, Singapore, Singapore; University of Western Australia, Australia, Australia; Tecnalia Research and Innovation, Spain, Spain*

11:45AM | New Active Capacitor Voltage Balancing Method for Seven-Level Full-Bridge Flying-Capacitor-Multicell (FCM) Inverters [20526]
Arash Khoshkbar-Sadigh, Vahid Dargahi and Keith Corzine, *Penn State University, United States; University of California Santa Cruz, United States*

S94 | DC-DC Non-Isolated Converter 4

Room 347
Chairs: Pradeep Shenoy, Michael Gonzales

10:30AM | Light-Load Switching-Loss Elimination Utilizing Pulse Density Modulation for Switched-Capacitor-Based Resonant Converters [20434]
Hadi Setiadi and Hideaki Fujita, *Tokyo Institute of Technology, Japan*

10:55AM | Synthesizing a Family of Converters for a Specified Conversion Ratio Using Flux Balance Principle [20157]
Ramanuja Panigrahi, Santanu K. Mishra and Avinash Joshi, *Indian Institute of Thechnology, Kanpur, India*

11:20AM | A Modular DC-DC Converter Topology based on a Three-level DC-DC Converter for Distributed Fuel Cell Architecture [20559]
Mohammad Afkar, Roghayeh Gavagsaz-Ghoachani, Apinya Siangsanoh, Matheepot Phattanasak, Jean-Philippe Martin and Serge Pierfederici, *Shahid Beheshti University, Iran; King Mongkut's University of Technology NB, Thailand; Universite de Lorraine, France*

11:45AM | Non-isolated High Gain Boost Converter Operating in Critical Conduction Mode [20279]
Ankul Gupta, Raja Ayyanar and Sombuddha Chakraborty, *Arizona State University, United States; Texas Instruments, United States*

S95 | PWM and Harmonic Reduction 2

Room 350
Chairs: Youim (Kelly) Tray, Toshihisa Shimizu

10:30AM | Interharmonics Reduction in Photovoltaic Systems with Random Sampling MPPT Technique [19569]
Ariya Sangwongwanich and Frede Blaabjerg, *Aalborg University, Denmark*

10:55AM | A Phase-Shifted-Among-Legs PWM Scheme for the Hybrid Cascaded Converter based STATCOM [19559]
Yu-chen Su, Jing-syuan Wang and Po-tai Cheng, *National Tsing Hua University, Taiwan*

11:20AM | Multifunctional Grid-Tied PV System Using Modified KLMS Control [19899]
Abhishek Kumar, Seema Kewat, Bhim Singh, Rashmi Jain and Anjeet Verma, *JC Bose University of Science & Technology,YMCA, India; Indian Institute of Technology, Delhi, India*

11:45AM | Design Considerations of DSP-based SiC-MOSFET SAPF with 100kHz Sampling and Switching Frequency [19580]
Yuxiao Zhang, Ke Dai, Hongwei Xu, Haitao Lin, Debin Zhang and Qin Lei, *Huazhong University of Science and Technology, China; Arizona State University, United States*

S96 | Control of MMC

Room 340
Chairs: Xiaonan Lu, Hanchao Liu

10:30AM | Control and Design of Mission Profile Emulator for Sub-modules in Modular Multilevel Converter [19747]
Yunxiao Yang, Ke Ma, Yubo Song and Weiyao Wang, *Shanghai Jiao Tong University, China*

10:55AM | Accurate Control of Neutral Current for Neutral Point Voltage Balancing in Three-Level Inverters Considering Digital Control and PWM Delay [20437]
Hyun-Jun Lee, Sungmin Kim and Young-Doo Yoon, *Hanyang University, Korea (South)*

11:20AM | Comparison of Phase-Shifted Carrier PWM Schemes for Modular Multilevel Converter [19067]
Qian Cheng and Chenchen Wang, *Beijing Jiaotong University, China*

11:45AM | Thermal Loading and Analysis of Modular Multilevel Converters Using Injection Control of Circulating Current and Common-mode Voltage [19167]
Deepak Ronanki and Sheldon Williamson, *University of Ontario Institute of Technology, Canada*

S97 | AC-DC Converter Control

Room 348
Chairs: Sheng Zheng, John Lam

10:30AM | DCM Buck-Buck/Boost PFC Converter with Segmented Fixed Duty-Cycle Control [19130]
Chengjian Wu, Kai Yao, Zhen Zhang, Chunwei Ma, Jienan Chen, Lingge Li and Chanbo Guan, *Nanjing University of Science and Technology, China*

10:55AM | A SVPWM Method With Reduced Switching Frequency Suitable for High Power Three-level NPC Rectifiers [19138]
Zhan Gao, QiongXuan Ge, YaoHua Li, Lu Zhao and Bo Zhang, *Institute of Electrical Engineering, China*

11:20AM | Single DC-link AC-DC-AC Converter with Shared Legs [20572]
Alan Felinto, Cursino Jacobina, Edgard Fabricio and Lacerda Rodrigo, *Federal University of Campina Grande, Brazil; Federal Institute of Paraiba, Brazil*

11:45AM | Grid Impedance Identification and Structured-h2 Optimization Based Controller Design of Active Front-end in Embedded AC Networks [19664]
Kang Li, Andrea Formentini, David Dewar, Pericle Zanchetta and Patrick Wheeler, *The University of Nottingham, United Kingdom*

S98 | Electric Machines: Loss Analysis 2

Room 337
Chairs: Franco Leonardi, Julia Zhang

10:30AM | Efficiency Maps Computation and Comparison Including Thermal Limits [19835]
Giacomo Bacco, Cristian Babetto, Michele Bonfante, Matteo Carbonieri and Nicola Bianchi, *University of Padova, Italy*

10:55AM | Electrical Machine Loss Distribution and Thermal Parameter Identification through Experimentally Informed Virtual Prototyping [20230]
Dominic North, Suzanne Collins, Nick Simpson and Philip H Mellor, *University of Bristol, United Kingdom*

11:20AM | Efficient Multidisciplinary Modeling and Simulation of a Washing Machine Motor Duty Cycle [20270]
Martin Ortega, Anqi Sun, Manoj Kandukuri, Tan Pham and Wendling Philippe, *MABE, Mexico; Altair Product Design, United States; Altair Engineering, United States; Solar Turbines, United States; Altair, United States*

11:45AM | A Hybrid Analytical and FE-based Method for Calculating AC Eddy Current Winding Losses Taking 3D Effects into Account [20658]
Narges Taran and Dan M. Ionel, *University of Kentucky, United States*

S99 | IPMSM and Synchronous Reluctance Machines

Room 338
Chairs: Tsarafidy Raminosoa, Julia Zhang

10:30AM | Reduction of Cross Magnetization in Interior Permanent Magnet Synchronous Motors with V-Shape Magnet Configurations by Optimizing Rotor Slits [19283]
Katsumi Yamazaki and Ryota Kondo, *Chiba Institute of Technology, Japan*

10:55AM | Optimal Design and Experimental Validation of a Synchronous Reluctance Machine for Fault-Tolerant Applications [19822]
Cristian Babetto, Nicola Bianchi, Torreggiani Ambra, Davoli Matteo, Bianchini Claudio and Bellini Alberto, *University of Padova, Italy; University of Modena and Reggio Emilia, Italy; Raw Power, Italy; University of Bologna, Italy*

11:20AM | Standstill Determination of PM Flux Linkage Based on Minimum Saliency Tracking for PM-SyR Machines [20142]
Paolo Pescetto and Gianmario Pellegrino, *Politecnico di Torino, Department of Energy, Italy*

11:45AM | Torque Ripple Minimization of PM-assisted Synchronous Reluctance Machines via Asymmetric Rotor Poles [20622]
Simone Ferrari, Eric Armando and Gianmario Pellegrino, *Politecnico di Torino, Italy*

S100 | Control of Electric Drives

Room 339
Chairs: Wei Xu, Michael Harke

10:30AM | Decoupled Torque Control of Multiple Three-Phase Induction Motor Drives [19863]
Sandro Rubino, Radu Bojoi, Davide Cittanti and Luca Zarri, *Politecnico di Torino, Italy; Politecnico diTorino, Italy; University of Bologna, Italy*

10:55AM | Modulated Model Predictive Control for Induction Motor Drives with Sequential Cost Function Evaluation [20741]
Valerio Vodola, Shafiq Ahmed Odhano, Cristian Garcia, Margarita Norambuena, Silvio Vaschetto, Pericle Zanchetta, Jose Rodriguez and Radu Bojoi, *Politecnico di Torino, Italy; The University of Nottingham, United Kingdom; Universidad de Talca, Curico, Chile; Universidad Tecnica Federico Santa Maria Valpara, Chile; Universidad Andres Bello, Santiago, Chile*

11:20AM | Predictive Current Control of Mutually Coupled Switched Reluctance Motors Using Net Flux Method [20746]
Siddharth Mehta, Iqbal Husain and Prerit Pramod, *North Carolina State University, United States; Nexteer Automotive, United States*

11:45AM | Levitation Control for a Double-Sided Bearingless Linear Motor Based on Feedback Linearization [19422]
Seppo E. Saarakkala, Maksim Sokolov, Reza Hosseinzadeh and Marko Hinkkanen, *Aalto University, Finland*

S101 | Thermal Management

Room 341
Chairs: Francesco Iannuzzo, Lauren Boteler

10:30AM | Two-Dimensional Thermal Modeling and Parametric Optimization of Printed Circuit Board Vias [20731]
Yanfeng Shen, Hui Zhao, Teng Long, Huai Wang and Frede Blaabjerg, *University of Cambridge, United Kingdom; Aalborg University, Denmark*

10:55AM | Thermal Buffering Effect of Phase Change Material on Press-pack IGBT during Power Pulse [19051]
Hai Ren, Gaofeng Hao, Weihua Shao, Li Ran, Lin Zhou, Philip Mawby and Huaping Jiang, *Chongqing University, China; Chongqing University; The University of Warwick, United Kingdom; The University of Warwick, United Kingdom*

11:20AM | Thermal Characterization of SiC Modules for Variable Frequency Drives [20619]
Marzieh Karami and Rangarajan Tallam, *Rockwell Automation, United States*

11:45AM | A High-Accuracy, Low-Order Thermal Model of SiC MOSFET Power Modules Extracted from Finite Element Analysis via Model Order Reduction [20737]
Cameron Entzminger, Wei Qiao, Liyan Qu and Jerry Hudgins, *University of Nebraska-Lincoln, United States*

S102 | Wireless Power Transfer 2

Room 345
Chairs: David Dorrell, Omer Onar

10:30AM | Communication-Free Control Scheme for Qi-Compliant Wireless Power Transfer Systems [19248]
Yun Yang, Siew-Chong Tan and Ron Hui, *The University of Hong Kong, Hong Kong*

10:55AM | A Square-Shaped Omnidirectional Wireless Charging Bowl with a Double Layer Electromagnetic Shield for Portable Device Applications [20345]
Junjie Feng, Qiang Li and Fred Lee, *Center for power Electronics Virginia Tech, United States*

11:20AM | Inductive Wireless Power Transfer at 100 MHz with Wide Load Range and Constant Output Current [20629]
Xin Zan, Zizhen Guo and Al-Thaddeus Avestruz, *University of Michigan, Ann Arbor, United States; Tsinghua University, China*

11:45AM | A Wireless Power Transfer System with Multiple Constant Current and Constant Voltage Outputs [19228]
Zhe Zhou, Zhanfeng Deng, Chenwen Cheng, Weiguo Li, Fangyi Li and Chris Mi, *Global Energy Interconnection Research Institute, China; San Diego State University, United States*

Wednesday **October 2, 2:00PM – 3:40PM**

S103 | Wave and Ocean Energy Systems

Room 344
Chairs: Elisabetta Tedeschi, Yongheng Yang

2:00PM | An Experimental Investigation into the Wave Power Extraction of a Small-Scale Fixed Multi-Chamber OWC Device [19609]
Mohammad Shalby, Paul Walker, David Dorrell and Ahmed Elhanafi, *University of Technology Sydney, Australia; University of KwaZulu-Natal, South Africa; National Centre for Maritime Engineering and Hyd, Australia*

2:25PM | Damping Selection Strategy for Maximum Energy on Wave Energy Power Converters [20320]
Chen Chien-An and Zuo Lei, *Virginia Tech, United States*

2:50PM | Adaptive Control of a Hybrid Energy Storage System for Wave Energy Conversion Application [20375]
Apoorv Agarwal, Vishnu Mahadeva Iyer, Anup Anurag and Subhashish Bhattacharya, *North Carolina State University, United States*

3:15PM | Investigating the Performance of a Variable Stiffness Magnetic Spring for Resonant Ocean Power Generation [20486]
Md Emrad Hossain and Jonathan Bird, *Portland State University, United States*

S104 | Solid State Transformers 2

Room 343
Chairs: John Shen, Enrico Santi

2:00PM | A Decoupled Control Scheme of Four-Port Solid State Transformer [19695]
Necmi Altin, Saban Ozdemir, Ahmad El Shafei, Adel Nasiri and Mohammad Rashidi, *University of Wisconsin-Milwaukee, United States; Eaton Corporation, United States*

2:25PM | Hybrid Multiple-Active Bridge for Unequal Power Flow in Smart Transformers [19884]
Victor Ferreira, Nimrod Vazquez, Braz Cardoso and Marco Liserre, *University of Kiel, Germany; Instituto Tecnologico de Celaya, Mexico; Federal University of Minas Gerais, Brazil*

2:50PM | Estimation of Eddy Current Winding Losses in Soft-Switching Solid-State Transformer [20674]
Xiwei Zheng, Xiangyu Han, Mickael Mauger, Prasad Kandula, Karthik Kandasamy and Deepak Divan, *Georgia Institute of Technology, United States*

3:15PM | AC-DC Converter with Hybrid Three-Level and Two-Level Legs Using Space Vector Modulation for Medium-Voltage SST Applications [20550]
Dakai Wang, Wensong Yu, Siyuan Chen and David Philpott, *North Carolina State University, United States*

S105 | Inverter Control

Room 342
Chairs: Brendan McGrath, Leon M Tolbert

2:00PM | Evaluation of Voltage Regulators for Dual-Loop Control of Voltage-Controlled VSCs [19560]
Yicheng Liao and Xiongfei Wang, *Aalborg University, Denmark*

2:25PM | A Modified Lyapunov-function based Control Scheme for Three-phase UPS with a Load Estimator in Synchronous Rotating Frame [20329]
Jinsong He, Qingsong Ran, Fanfan Lin and Xin Zhang, *Nanyang Technological University, Singapore; Powerchina Resources LTD., China*

2:50PM | Grid Tied Wind Energy Generating System Incorporating an Observer Based Nonlinear Control Exhibiting Robustness [20589]
Subarni Pradhan, Shadab Murshid, Bhim Singh and Bijaya Ketan Panigrahi, *Indian Institute of Technology, Delhi, India*

3:15PM | Inverter Output Current Overshoot Suppression during Fault Ride-through Operation for Three-phase Grid-tied Inverter with Minimized Inductor [20001]
Satoshi Nagai, Hiroki Watanabe and Jun-ichi Itoh, *Nagaoka University of Technology, Japan*

S106 | Batteries and Battery Management 1

Room 340
Chairs: Mohammad Alam, Arash Nassiri Bavili

2:00PM | Simplified Control Strategy for an Inhomogeneous Series-connected Battery String [20110]
Rishab Anand and B. G. Fernandes, *IIT Bombay, India*

2:25PM | High-dimensional Data Abnormity Detection Based on Improved Variance-of-Angle (VOA) Algorithm for Electric Vehicles Battery [19760]
Peng Liu, Jin Wang, Zhenpo Wang, Zhaosheng Zhang, Shuo Wang and David Dorrell, *Beijing Institute of Technology, China; University of Kwa-Zulu-Natal, South Africa*

2:50PM | A Single-Capacitor Equalizer Using Optimal Pairing Algorithm for Series-Connected Battery Cells [20388]
Phuong-Ha La, Hong-Hee Lee and Sung-Jin Choi, *University of Ulsan, Korea (South)*

3:15PM | Optimized Design of an Onboard Resonant Self-Heater for Automotive Lithium-Ion Batteries at Cold Climates [20469]
Chong Zhu, Yunlong Shang, Fei Lu and Hua Zhang, *Shanghai Jiao Tong University, China; Shandong University, China; Drexel Univerisity, United States*

S107 | Multilevel Converters Modulation

Room 346
Chairs: Roberto Petrella, Lee Empringham

2:00PM | Unfolder Operation and Modulation Strategy of Paralleled Current-source Converters [19587]
Yuzhuo Li, Nie Hou, Li Ding and Yunwei Li, *University of Alberta, Canada*

2:25PM | Three-phase Multilevel Asymmetric Current Source Converter [19690]
Nayara Lisboa, Montie Vitorino, Louelson Costa and Mauricio Correa, *Federal University of Campina Grande, Brazil*

2:50PM | An Optimized Phase Shifted PWM for Flying Capacitor Multilevel Converter [20759]
Waqar A. Khan, Sina Vahid, Md Rakib-Ur Rahman, Ramin Katebi, Ayman EL-Refaie and Nathan Weise, *Marquette University, United States*

3:15PM | Model Predictive Control for Three Level Neutral Point Clamped Inverter With Reduced Numbers of Switching State Combinations [20035]
Ritwik Ghosh, Narsa Reddy Tummuru and Bharat Singh Rajpurohit, *IIT Mandi, India*

S108 | DC-DC Non-Isolated Converter 5

Room 349
Chairs: Sombuddha Chakraborty, Junichi Itoh

2:00PM | A Bidirectional LLC Converter Enabled by Common-Mode and Differential-Mode Operation [19412]
Jessica D. Boles, Seungbum Lim, Juan A. Santiago-Gonzalez, David M. Otten and David J. Perreault, *Massachusetts Institute of Technology, United States*

2:25PM | A 99.7% Efficient 300 W Hard Disk Drive Storage Server with Multiport Ac-Coupled Differential Power Processing (MAC-DPP) Architecture [20164]
Ping Wang, Yenan Chen, Parker Kushima, Youssef Elasser, Ming Liu and Minjie Chen, *Princeton University, United States; Princeton Unverisity, United States*

2:50PM | Multi-objective Design of LC Filter for High-efficiency, High-power-density and High-performance Buck Converter [20288]
Xinze Li, Fanfan Lin, Xin Zhang, Meng Huang and Huai Wang, *Nanyang Technological University, Singapore; Wuhan University, China; Aalborg University, Denmark*

3:15PM | Generalized Multilevel Converter in DC/DC Application [20185]
Hao Hu, Saikat Ghosh, Yam Siwakoti and Teng Long, *University of Cambridge, United Kingdom; University of Technology Sydney, Australia*

S109 | DC-DC Isolated Converter 1

Room 347
Chairs: Jianwu Zeng, Rolando Burgos

2:00PM | Real-Time Modeling and HIL Simulation of Stacked Low-Inertia Converters with Soft-Switching and Fast Dynamic Control [20670]
Xiangyu Han, Liran Zheng, Karthik Kandasamy, Prasad Kandula, Maryam Saeedifard and Deepak Divan, *Georgia Institute of Technology, United States*

2:25PM | A Novel Modulation Method of LLC Resonant Converter with Linear Model and High Efficiency [19262]
Zhijian Fang, Zhicong Huang, Hang Jing, Guozhen Hu, Junhua Wang and Liang Tao, *China University of Geosciences (Wuhan), China; University of Macau, Macau; Wuhan University, China; Hubei Polytechnic University, China*

2:50PM | LEGO-MIMO Architecture: A Universal Multi-Input Multi-Output (MIMO) Power Converter with Linear Extendable Group Operated (LEGO) Power Bricks [20114]
Yenan Chen, Ping Wang, Youssef Elasser and Minjie Chen, *Princeton University, United States*

3:15PM | High Efficiency High Power Density Bidirectional DC-DC Converter for Photovoltaic Energy Storage System Utilization [19528]
Fangyuan Shi and Rui Li, *Shanghai Jiao Tong University, China*

S110 | Converter Stability Analysis

Room 350
Chairs: Harish Krishnamoorthy, Chi Kong Tse

2:00PM | Stability Analysis of Grid-Connected VSCs Based on S-parameters and Reflection Coefficient [19558]
Shih-Feng Chou, Xiongfei Wang and Frede Blaabjerg, *Aalborg University, Denmark*

2:25PM | Stability Analysis of MMC under Grid Voltage Phase Change [19461]
Yushuang Liu, Meng Huang, Xiaoming Zha, Chi K. Tse and Zhihong Yan, *Wuhan University, China; Hong Kong Polytechnic University, China*

2:50PM | Stability Analysis of Grid-Connected Inverters during the Transient of Grid Voltage Fluctuations in Weak Grid Cases [19986]
Jinming Xu, Shenyiyang Bian, Miao Liu, Zhang Zhao and Shaojun Xie, *Nanjing University of Aeronautics & Astronautics, China*

3:15PM | Systematic Approach for Transient Stability Evaluation of Grid-Tied Converters during Power System Faults [19515]
Mads Graungaard Taul, Xiongfei Wang, Pooya Davari and Frede Blaabjerg, *Dept. of Energy Technology, Aalborg University, Denmark*

S111 | DAB Converter Control

Room 348
Chairs: Hui Li, Leila Parsa

2:00PM | An Analog-based, Duty Cycle Modulation Method to Remove the DC Bias in the Transformer for a Dual Active Bridge Converter [19385]
Bocheng Zhang, Shuai Shao, Naipeng Yu, Xinke Wu and Junming Zhang, *Zhejiang University, China*

2:25PM | An Uncertainty and Disturbance Estimator Based Voltage Control for Dual-Active-Bridge Converters [19673]
Yuheng Wu, Mohammad Hazzaz Mahmud, Waleed Alhosaini, Yue Zhao, Alan Mantooth and Yuzhi Zhang, *University of Arkansas, United States; ABB US Corporate Research Center, United States*

2:50PM | Instantaneous Start-Up and Shutdown Method for Three-Phase Dual-Active Bridge DC-DC Converters [20019]
Daniel von den Hoff and Rik W. De Doncker, *PGS, E.On ERC, RWTH Aachen University, Germany*

3:15PM | Dual Switching Frequency Operation of Dual Active Bridge Converter [20603]
Changjiang Sun, Xin Zhang and Xu Cai, *Nanyang Technological University, Singapore; Shanghai Jiao Tong University, China*

S112 | Switched Reluctance and Flux Switching Machines 1

Room 337
Chairs: Rajesh Deodhar, Akira Chiba

2:00PM | Analysis of Novel Consequent Pole Flux Reversal Permanent Magnet Machine [19242]
Huan Qu, ZiQiang Zhu and HuaYang Li, *The University of Sheffield, United Kingdom*

2:25PM | Improved Current Profile for Noise Reduction of Switched Reluctance Motor at Middle Speed [19281]
Candra Adi Wiguna, Jihad Furqani and Akira Chiba, *Tokyo Institute of Technology, Japan*

2:50PM | Design Considerations and Performance Analysis of a Super High-Speed Switched Reluctance Motor for Electric Supercharger [19292]
Grace Firsta Lukman, Kwang-Il Jeong, Jin-Woo Ahn and Do-Kwan Hong, *Kyungsung University, Korea (South); Korea Electrotechnology Research Institute, Korea (South)*

3:15PM | A Phase Current Peak Prediction Technique to Increase the Output Power of Switched Reluctance Generators for Wind Turbines [19758]
Prashant Carl Buck, Babak Fahimi and Poras Balsara, *The University of Texas at Dallas, United States*

S113 | High Speed and Bearingless Machines 1

Room 338
Chairs: Iqbal Husain, Eric Severson

2:00PM | Very-High-Speed Miniaturized Permanent Magnet Motors: Modeling and Experimental Validation [19183]
Guillaume Burnand and Yves Perriard, *Ecole Polytechnique Federale de Lausanne, Switzerland*

2:25PM | Very-High-Speed Miniaturized Permanent Magnet Motors: Design and Optimization [19184]
Guillaume Burnand and Yves Perriard, *Ecole Polytechnique Federale de Lausanne, Switzerland*

2:50PM | Optimal Design of the Bearingless Induction Motor for Industrial Applications [20593]
Jiahao Chen and Eric Severson, *University of Wisconsin-Madison, United States*

3:15PM | Design of a Miniaturized Single-Drive Bearingless Motor [19497]
Guilherme Cavalcante Rubio, Hiroya Sugimoto and Akira Chiba, *Tokyo Institute of Technology, Japan*

S114 | Induction Motor Drives 1

Room 339
Chairs: Alireza Fatemi, Xuechao Wang

2:00PM | Fault-tolerant DTC Technique for Five-phase Three-level NPC Inverter fed Induction Motor Drive with an Open-phase Fault [19883]
Bheemaiah Chikondra, Utkal Ranjan Muduli and Ranjan Kumar Behera, *Indian Institute of Technology Patna, India*

2:25PM | Rotor Resistance Estimation for Sensorless Induction Motor Drives with A Torque Ripple Reduction Method [19044]
Cheng Luo, Bo Wang, Yong Yu, Tianqing Wang, Zhixin Huo and Dianguo Xu, *Harbin Institute of Technology, China*

2:50PM | A General Coordinate Transformation Based on Fourier Matrices for Modelling Space Harmonics in Induction Machines [20129]
Julien Cordier, Stefan Klass and Ralph Kennel, *Technische Universitaet Muenchen, Germany*

3:15PM | Active and Reactive Power Control of the Rotor Loads in a Five-Phase Wound Rotor Induction Motor Drive [19839]
Gabriele Rizzoli, Angelo Tani, Mengoni Michele, Luca Vancini and Luca Zarri, *University of Bologna, Italy*

S115 | High Power SiC Packaging

Room 341
Chairs: Christina DiMarino, Ariunbolor Purvee

2:00PM | Novel SiC Power Module for Traction Power Inverters with Low Parasitic Inductances [19727]
Marko Jaksic, Ajay Patwardhan, John Czubay, Constantin Stancu, Terence Ward, Dawud Abu-Zama, Sung Chung, Ioan Suciu, Mehrdad Teimorzadeh and Brian Peaslee, *General Motors, United States*

2:25PM | Enhanced Over-current Capability and Extended SOA of Power Modules Utilizing Phase Change Material [19197]
Weihua Shao, Ruizhu Wu, Li Ran, Huaping Jiang, Tom Combs, Kieran Yardley, Philip Mawby, Prabodh Bajpai and Debaprasad Kastha, *Chongqing University, China; University of Warwick, Great Britain; Indian Institution of Technology Kharagpur, India*

2:50PM | Current Sharing Behavior and Characterization of a 1200 V, 6.5 mOhm SiC Half-Bridge Power Module with Flexible PCB Gate Loop Connection [19697]
Grace Watt, Slavko Mocevic, Amy Romero, Rolando Burgos, Marko Jaksic and Mehrdad Teimor, *Center for Power Electronics Systems (CPES), United States; Wolfspeed, A Cree Company, United States; General Motors - Global Propulsion Systems, United States*

3:15PM | A Highly-Integrated SiC Power Module for Fast Switching DC-DC Converters [19231]
Alexander Stippich, Tobias Kamp, Alexander Sewergin, Lukas Fraeger, Arne Hendrik Wienhausen, David Buendgen and Rik W. De Doncker, *RWTH Aachen University, Germany*

S116 | Wireless Power Transfer 3

Room 345
Chairs: Xin Dai, Jason Pries

2:00PM | Precise General Modeling of Windings for Wireless Power Transfer [19561]
Xinhe Liu, Wenxing Zhong, Hongzhi Cui, Ping Lin and Dehong Xu, *Zhejiang University, China*

2:25PM | A Novel Soft-Switching Dual-Side Phase Shift Circuit for Wireless Power Transfer [19709]
Chu Wang, Min Chen, Hongzhi Cui, Xinhe Liu, Wenxing Zhong and Fangyuan Shi, *Zhejiang University, China; Shanghai Jiao Tong University, China*

2:50PM | A Novel Hinge-Joint Structure for Wireless Power Transfer System [19962]
Mohamad Abou Houran, Xiaoteng Li, Xu Yang and Wenjie Chen, *Xi'an Jiaotong University, China; State Grid Shaanxi Electric Power Company, China*

3:15PM | Low-Cost, Printed Circuit Board Construction, Capacitively Coupled Excitation System for Wound Field Synchronous Machines [19989]
Skyler Hagen, Jiejian Dai, Ian P. Brown and Daniel C. Ludois, *University of Wisconsin -Madison, United States; Illinois Institute of Technology, United States*

Wednesday, October 2 **4:00PM – 5:40PM**

S117 | Energy Storage Systems

Room 344
Chairs: Wasi Uddin, Alex De Abreu-Garcia

4:00PM | Improved Modular Multilevel Converter with Symmetrical Integrated Super Capacitor Energy Storage System for Electrical Energy Router Application [19111]
Zejie Li, Xiaofeng Yang, Haibo Tao, Trillion Q. Zheng, Xiaojie You and Pavel Kobrle, *Beijing Jiaotong University, China; Czech Technical University, Czech Republic*

4:25PM | Current Controlled Operation of Cascaded H-Bridge Converter for Fast SoC Balancing in Grid Energy Storage [19676]
Amir Hussain, Krishna Raj Ramachandaran Potti, Kaushik Rajashekara, Harish Krishnamoorthy and Stanley Atcitty, *University of Houston, United States; Sandia National Laboratories, United States*

4:50PM | SoH-Aware Charging of Supercapacitor with Lifetime Maximization [20378]
Fu Jiang, Cheng Jin, Yongjie Liu, Heng Li, Xiaoyong Zhang, Yingze Yang, Jun Peng and Zhiwu Huang, *Central South University, China; Central South University, China*

5:15PM | Architecture for Utility-Scale Multi-Chemistry Battery Energy Storage [20458]
Mitchell Smith, Michael Starke, Leon Tolbert and Madhu Chinthavali, *University of Tennessee: Knoxville, United States; Oak Ridge National Laboratory, United States*

S118 | AC Microgrids

Room 343
Chairs: Johan HR Enslin, Rob Cuzner

4:00PM | Decentralized Reactive Power Sharing Among Parallel Inverters Through Inherent Dead-time Effect [19746]
Yang Qi and Yi Tang, *Nanyang Technological University, Singapore*

4:25PM | On the Effect of Line Dynamics in Multi-inverter Systems with Generalized Droop Control [20697]
Gurupraanesh Raman, Sidhaarth Venkatachari and Jimmy Chih-Hsien Peng, *National University of Singapore, Singapore; National Institute of Technology Tiruchirappalli, India*

4:50PM | A Common Second Frequency Control of Island Cascaded-type Microgrid [20364]
Guangze Shi, Hua Han, Yao Liu, Mei Su, Zhangjie Liu and Yao Sun, *Central South University, China; China Southern Power Grid, China*

5:15PM | Leader Selection in Robust Pinning-based Distributed Control for Islanded Microgrids [20487]
Jianzhe Liu, Xiaonan Lu, Chen Chen and Bo Chen, *Argonne National Laboratory, United States; Temple University, United States*

S119 | Dynamics of Inverter-Based Resources

Room 342
Chairs: Yunwei Li, Frank Bohn

4:00PM | Model Predictive Current Control of Active Distribution Transformer With Consideration of Its Stability Analysis Based on AC-AC Matrix Converter [19205]
Yougui Guo, Bowen Yang, Chuyun Li, Wenlang Deng and Blaabjerg Frede, *Xiangtan university, China; Aalborg university, Denmark*

4:25PM | Passivity Analysis and Enhancement of Voltage Control for Voltage-Source Converters [19562]
Yicheng Liao and Xiongfei Wang, *Aalborg University, Denmark*

4:50PM | Interactions Between Phase-locked Loop Synchronized Grid Converters With Different Bandwidths and Power Ratings [19639]
Zhixiang Zou, Behnam Daftary, Roberto Rosso and Marco Liserre, *University of Kiel, Germany*

5:15PM | A Reduced-order Model of PMSG for the Low Frequency Oscillation Analysis of Power Systems [19887]
Xianzhe Li, Shuhan Liao and Xiaoming Zha, *Wuhan University, China*

S120 | Battery and Charging Infrastructure

Room 340
Chairs: Rashmi Prasad, Babak Nahid-Mobarakeh

4:00PM | Control and Implementation of Renewable Energy Based Smart Charging Station Beneficial for EVs, Home and Grid [19612]
Anjeet Verma and Bhim Singh, *IIT DELHI, India; IIT Delhi, India*

4:25PM | High Voltage Resolution Auxiliary Power Converter for Online Battery Impedance Measurement [19895]
Shimul K Dam and Vinod John, *Indian Institute of Science, India*

4:50PM | Multi-port, Bi-directional Contactless Connector for the Interface of Modular Portable Battery System [19336]
Masanori Ishigaki, Keisuke Ishikawa, Kosuke Tahara and Makoto Kusakabe, *Toyota Central R&D Labs, Japan; Toyota Central R&D Labs, Japan*

5:15PM | A Novel Systematic Approach to Construct and Assess Power Electronic Conversion Architectures Using Graph Theory and Its Application in Battery Systems [19896]
Wenping Zhang, Liuchen Chang and Riming Shao, *University of New Brunswick, Canada*

S121 | AC-AC Converters

Room 349
Chairs: Mahshid Amirabadi, Maurizio Cirrincione

4:00PM | Three-Phase to Single-Phase Multi-Resonant Direct AC-AC Converter for Metal Hardening High-Frequency Induction Heater [19127]
Tomokazu Mishima, Ryosuke Kawashima and Chiaki Ide, *Kobe University, Japan; Fuji Electronics Industry co, Japan*

4:25PM | Single-Phase Five-Leg AC-DC-AC Multilevel Converter to Enhance Power Quality [20057]
Rodrigo Pereira de Lacerda, Cursino Brandao Jacobina and Edgard L. L. Fabricio, *Federal University of Campina Grande, Brazil; Federal Institute of Paraiba, Brazil*

4:50PM | A Hybrid 4-quadrant Switch for AC Power Conversion [20769]
Giri Venkataramanan and Namrata Kogalur, *University of Wisconsin-Madison, United States*

5:15PM | Modular Capacitive-Link-Based Three-Phase AC-AC Power Converter [20196]
Afshari Ehsan and Amirabadi Mahshid, *Northeastern University, United States*

S122 | Multilevel Converters Applications 1

Room 346
Chairs: Yongsug Suh, Madhav Manjrekar

4:00PM | An Open-Circuit Fault Diagnosis Method for T-type Three-Level Rectifiers [19169]
Jie Chen, Chenghui Zhang, Xiangyang Xing, Alian Chen and Chunshui Du, *Shandong University, China*

4:25PM | A novel Hybrid N Level T Type Inverter Topology [19400]
Salvatore Foti, Antonio Testa, Luigi Danilo Tornello, Giacomo Scelba, Tommaso Scimone, Giuseppe Scarcella and Salvatore De Caro, *University of Messina, Italy; University of Catania, Italy*

4:50PM | Theoretical Analysis and Comparison of Capacitor Requirement in Modular Converters for Grid Integration of High Power Solar PV [20066]
Shambhu Sau, Arun Chandrasekharan Nair and B.G. Fernandes, *Indian Institute of Technology Bombay, India*

5:15PM | Thermal and Performance Comparison of Active Neutral-Point-Clamped (ANPC) and Dual Flying-Capacitor ANPC (DFC-ANPC) Inverters [20624]
Arash Khoshkbar-Sadigh, Roozbeh Naderi, Vahid Dargahi and Keith Corzine, *Penn State University, United States; TAE Technologies, United States; University of California-Santa Cruz, United States*

S123 | DC-DC Isolated Converter 2

Room 347
Chairs: Diego G. Lamar, Jaclyn Lynch

4:00PM | A Comparison of DC and AC Output Inductors in Tunable Piezoelectric Transformer Based DC/DC Converters [20531]
Le Wang, Qiong Wang, Rolando Burgos, Khai Ngo and Alfredo Carazo, *Virginia Tech - CPES, United States; Micromechatronics Inc, United States*

4:25PM | Adaptive Resonant Energy Realization in FB-ZCS DC-DC Converter Using Dual-Capacitor Circuit [20601]
Rohit Suryadevara and Leila Parsa, *Rensselaer Polytechnic Institute, United States; University of California Santa Cruz, United States*

4:50PM | A New Fully Magnetically Coupled SiC-Based DC/DC Step-up LLC Resonant Converter with Inherent Balanced Voltage Sharing for Renewable Energy Systems with a Medium Voltage DC Grid [20483]
Mehdi Abbasi, Reza Emamalipour, Muhammad Ali Masood Cheema and John Lam, *York University, Lassonde School of Engineering, Canada; Northern Transformer, Canada*

5:15PM | A Parallel-Resonant Isolated Bidirectional DC-DC Converter with Low Current Ripple for Battery Storage Systems [20457]
Yangbin Zeng, Hong Li, Zhi Zhang, Trillion Q. Zheng, Zhan Shang, Zhidong Qiu, Lutian Yuan and Yuhang Ding, *Beijing Jiaotong University, China*

S124 | Small-Signal Modeling for Stability

Room 350
Chairs: Khurram Afridi, Paolo Mattavelli

4:00PM | Generalized Average Model of Triple Active Bridge Converter [20720]
Shota Okutani, Pin-Yu Huang and Yuichi Kado, *Kyoto Institute of Technology, Japan*

4:25PM | Small Signal Dynamic Model and Stability Analysis of a Self-Synchronizing Grid-Tied Current Regulated Inverter [20321]
Brendan McGrath, Peishuo Mu, Afif Nazib, Donald Grahame Holmes and Carlos Teixeira, *RMIT University, Australia*

4:50PM | Impedance Modeling and Stability Analysis of Grid-tied Universal Droop Control Inverter [20004]
Mohammad Amin and Qing-Chang Zhong, *Norwegian University of Science and Technology, Norway; Illinois Institute of Technology, United States*

5:15PM | Analysis of an Impedance Modeling Approach for Droop-Controlled Inverters in System DQ Frame [20647]
Francesco Cavazzana, Aram Khodamoradi, Hossein Abedini and Paolo Mattavelli, *DTG-University of Padova, Italy*

S125 | Model Predictive Control

Room 348
Chairs: Rostan Rodrigues, Ralph Kennel

4:00PM | Model Predictive Control of PWM Rectifier under Unbalanced and Distorted Network Without AC Voltage Sensor [19494]
Yongchang Zhang, Jian Jiao, Jie Liu, Haitao Yang, Qingzhu Wan and Wei Xu, *North China University of Technology, China; Huazhong University of Science and Technology, China*

4:25PM | A Vector Analysis Based Model Predictive Control Method for Four-State Converters [19551]
Sai Tang, Xin Yin, Daming Wang, Chao Zhang, Kun Xiong, Ruqiang Zhen, Z.John Shen and Jun Wang, *Hunan University, China; Illinois Institute of Technology, United States*

4:50PM | High Frequency Bidirectional Isolated Matrix Converter for AC-Motor Drives with Model Predictive Control [19668]
Shuai Wang, Hang Gao, Jahangir Afsharian and Dewei Xu, *Ryerson University, Canada; Murata Power Solutions, Canada*

5:15PM | Model Predictive Control without Weighting Factors for T-type Multilevel Inverters with Magnetic-Link and Series Stacked AC-DC Modules [20356]
Shakil Ahamed Khan, Youguang Guo, Noman Habib Khan, Yam Siwakoti and Jianguo Zhu, *University of Technology Sydney, Australia*

S126 | Permanent Magnet Machines 1

Room 337
Chairs: Nicola Bianchi, Sara Roggia

4:00PM | A Closed-Loop Magnetization State Controller For Variable-flux IPMSMs [19020]
Akrem Mohamed Aljehaimi and Pragasen Pillay, *Misurata University, Libya; Concordia University, Canada*

4:25PM | Analysis of Dual 3-Phase Fractional-Slot Concentrated Winding PM Synchronous Machines with Different Angle Displacements [19145]
Peilin Xu, Z.Q. Zhu, B. Shao, S.S. Wang, S. Cai, J.H. Feng, S.Y. Guo, Y.F. Li and S. Z. Feng, *University of Sheffield, United Kingdom; CRRC Zhuzhou Institute Co. Ltd, China*

4:50PM | Dynamic Modeling of Surface-Mounted Permanent Magnet Motors Considering Saturation [20312]
Li Zhaokai, Chen Yuzheng, Huang Xiaoyan, Li Xinru, Ying Wucheng, Shen Boyang, Wu Lijian, Fang Youtong and Long Teng, *Zhejiang University, China; Universitu of Nottingham, United Kingdom; University of Cambridge, United Kingdom; University of Cambridge, China*

5:15PM | Correction of Finite-Element Calculated Efficiency Map using Experimental Measurements [19891]
Solmaz Kahourzade, Amin Mahmoudi, Wen Soong, Simone Ferrari and Gianmario Pellegrino, *University of Adelaide, Australia; Flinders University, Australia; Politecnico di Torino, Italy*

S127 | Thermal Analysis of Electric Machines

Room 338
Chairs: Mircea Popescu, Nick Simpson

4:00PM | Direct Air Cooling of High-Power Permanent Magnet Machines [19683]
Xiang Shen, Barrie Mecrow, Xu Deng, Christopher Donaghy-Spargo, Richard Whalley and Nilanjan Chakraborty, *Newcastle University, United Kingdom; Durham University, United Kingdom*

4:25PM | Direct Oil Cooling of End-Windings in Torus-Type Axial-Flux Permanent-Magnet Machines [20065]
Federico Marcolini, Giulio De Donato and Federico Caricchi, *University of Rome "La Sapienza", Italy*

4:50PM | Design Considerations of Windings formed with Hollow Conductors Cooled with Phase Change Material [20216]
Sabrina Ayat, Benjamin Daguse and Rabih Khazaka, *Safran Tech, France*

5:15PM | Resource Efficient Determination of Electrical Machine Thermal Parameters [20287]
Suzanne Collins, Dominic North, Philip H Mellor and Nick Simpson, *University of Bristol, United Kingdom*

S128 | PM Motor Drives

Room 339
Chairs: Lei Hao, Wu Lijian

4:00PM | Design Criteria for Flux-Weakening Control Bandwidth and Voltage Margin in IPMSM Drives Considering Transient Conditions [20752]
Jose Jacob, Omar Bottesi, Sandro Calligaro and Roberto Petrella, *Free University of Bolzano, Italy; University of Udine, Italy*

4:25PM | Study of Copper Loss by Inter Turn short fault of Interior Permanent Magnet Synchronous Motor [19284]
Seong-Hwan Im and Bon-Gwan Gu, *Kyungpook National University, Korea (South)*

4:50PM | A speed and current cascade Continuous Control Set Model Predictive Control architecture for synchronous motor drives [19556]
Paolo Carlet, Francesco Toso, Andrea Favato and Silverio Bolognani, *University of Padova, Italy*

5:15PM | Resolver Emulation for PMSMs Using Low Cost Hall Effect Sensors [19833]
Daniel Fernandez, Diego Fernandez, Maria Martinez, David Reigosa, Alberto B. Diez and Fernando Briz, *University of Oviedo, Spain*

S129 | Gate Drive and Auxiliary Circuit

Room 341
Chairs: Mark J Scott, Zheyu Zhang

4:00PM | A High Speed SiC Thyristor Gate Driver for Pulse Power Applications [20163]
Mohammed Agamy, Fengfeng Tao and Ahmed Elasser, *University at Albany - SUNY, United States; Tesla, United States; GE Global Research Center, United States*

4:25PM | Optimized Method for Protection of SiC JFET based Converters Against Failure of Auxiliary Power Supply [19719]
Rostan Rodrigues and Utkarsh Raheja, *ABB Inc, United States*

4:50PM | Output-Current Measurement of a PWM Inverter with a Tiny PCB Rogowski Sensor Integrated into an IGBT Module [20373]
Kazunori Hasegawa, Shun Sho, Tohru Kato, Mao Ichiki, Masanori Tsukuda and Ichiro Omura, *Kyushu Institute of Technology, Japan; National Institute of Advanced Industrial Scienc, Japan*

5:15PM | Design of Modular Auxiliary Gate Driver Power Supply for Medium Voltage Converter System [20646]
Sanket Parashar, RajKumar Kokkonda and Subhashish Bhattacharya, *NCSU (Power America), India; NCSU, India*

S130 | Wireless Power Transfer 4

Room 345
Chairs: Zhonghui Bing, Burak Ozpineci

4:00PM | Three-Phase Integrated PFC AC-AC Resonant Inverter with Weak Coupled Coils for Induction Heating Application [20126]
Ruan Gomes, Montie Vitorino, Diego Acevedo-Bueno and Mauricio Correa, *Federal University of Campina Grande, Brazil*

4:25PM | A Multi-MHz Large Air-gap Capacitive Wireless Power Transfer System Utilizing an Active Variable Reactance Rectifier Suitable for Dynamic Electric Vehicle Charging [20348]
Sreyam Sinha, Brandon Regensburger, Ashish Kumar and Khurram Afridi, *Cornell University, United States; University of Colorado Boulder, United States*

4:50PM | Comparison of Leakage Magnetic Field from Matched and Mismatched Double-D Coil based Wireless Charging System for Electric Vehicles [20614]
Mostak Mohammad, Jason Pries, Omer Onar, Saeed Anwar, Veda Galigekere, Gui-Jia Su and Jonathan Wilkins, *University of Akron, Ohio, United States; Oak Ridge National Laboratory, United States; University of Tennessee – Knoxville, United States*

5:15PM | A 2m Quasi-Wireless Capacitive Power Transfer System Using Earth Ground as the Current-Returning Path [19059]
Hua Zhang and Fei Lu, *Drexel University, United States*

Thursday, October 3 8:30AM – 10:10AM

S131 | Hybrid Energy Storage Systems

Room 344
Chairs: Wasi Uddin, Akanksha Singh

8:30AM | A Series-Parallel Switched-Capacitor Equalizer for the Hybrid Energy Storage System [19258]
Liu Lizhou, Han Peibang, Sun Wenbin, Mai Ruikun, He Zhengyou and Wu Dong, *Southwest Jiaotong University, China*

8:55AM | Energy Management of Multi-energy Storage Systems Using Energy Path Decomposition [19456]
Sima Aznavi, Poria Fajri, Arash Asrari and Reza Sabzehgar, *University of Nevada, Reno, United States; Southern Illinois University, United States; San Diego State University, United States*

9:20AM | An Improved Feed-Forward Load Compensation Method for Hybrid Energy Storage Systems [19902]
Yue Wu, Zhiwu Huang, Hongtao Liao, Yanhui Zhou, Yongjie Liu, Heng Li, Xiaoyong Zhang and Jun Peng, *Central south university, China*

9:45AM | An Integrated State of Health (SOH) Balancing Method for Lithium- Ion Battery Cells [20774]
Sifat Chowdhury, Mohammad Noor Shaheed and Yilmaz Sozer, *University of Akron, United States*

S132 | Power and Energy Management in Smart Grid and Microgrid Systems

Room 343
Chairs: Youim Tray, Zeljko Pantic

8:30AM | Reconfigurable and Dynamic Distribution Systems Enabled Using Self-Sustainable Minimal-Microgrids with Region Based Stability Guarantees [20328]
Yuxi Men, Xiaonan Lu, Jianzhe Liu, Chen Chen and Bo Chen, *Temple University, United States; Argonne National Laboratory, United States*

8:55AM | Coordinated Power and Energy Management Using Cluster of Microgrids to Improve Grid Availability and Resiliency [20549]
Somasundaram Essakiappan, Rasik Sarup, Ndeye Mbacke, Madhav Manjrekar, Stuart Laval and Kevin Schneider, *University of North Carolina at Charlotte, United States; Duke Energy, United States; Pacific Northwest National Laboratory, United States*

9:20AM | Stability Analysis for Power Management Between Standalone DC Microgrids with Constant Power Loads [19600]
Bhanu Babaiahgari, Yeonho Jeong and Jae Do Park, *University of Colorado Denver, United States*

9:45AM | A Partial Power Converter Interface for Battery Energy Storage Integration with a DC Microgrid [20327]
Vishnu Mahadeva Iyer, Srinivas Gulur, Subhashish Bhattacharya and Ramanujam Ramabhadran, *NC State University, United States; GE Aviation, United States*

S133 | Power Converters for Solid State Transformers

Room 345
Chairs: Alex Huang, Hui Li

8:30AM | Design of A Medium Voltage Solid-State Transformer based on Modular AC-AC Resonant Converter and an Input-Series-Output-Parallel Architecture [20693]
Xin Zhao, Yang Lei, Haoming Wang, Xiangjun Quan and Alex Q. Huang, *ECE, University of Texas at Austin, United States*

8:55AM | Voltage Balancing of Series Connected Clamping Diodes in Medium Voltage NPC Converter enabled by Gen-3 10 kV SiC MOSFETs for Asynchronous Micro-Grid Power Conditioning System [20422]
Venkat Nag Someswar Rao Jakka, Ashish Kumar, Sanket Parashar, Sagar Kumar Rastogi, Nithin Kolli, Ronak Jaiswal and Subhashish Bhattacharya, *NC State University, United States*

9:20AM | Solid State Transformer for Low-Voltage Distribution System with DC/DC Stage-Controlled Split-Capacitor [19557]
Shaodi Ouyang, Jinjun Liu, Shuguang Song, Xingxing Chen, Yue Yang and Hongda Wu, *Xi'an Jiaotong University, China*

9:45AM | Circulating Current Suppression in Multi-cell Series-parallel Converter for Cost-effective Medium-voltage Solid-state Transformer [20386]
Jehyuk Won, Hao Feng, Xinyu Liang, Srdjan Srdic and Srdjan Lukic, *North Carolina State University, United States*

S134 | Renewable Energy Integration

Room 342
Chairs: Jason Lai, Paolo Mattavelli

8:30AM | Active Harmonic Filtering in STATCOMs for Enhanced Renewable Energy Integration [19089]
Juan Carlos Perez Campion, Eneko Olea Oregi and Colin Edward Thomas Foote, *Electric Utility, Spain; Converter Design Company, Spain; Electric Utility, Scotland*

8:55AM | A Medium Voltage DC Collection Grid for Large Scale PV Power Plant with SCR Converter and Integrated Solid-State Transformer (SST) [20436]
Salwan Sabry, Erick I. Pool-Mazun and Prasad Enjeti, *Texas A&M University, United States*

9:20AM | Voltage and Power Balancing in Solar and Energy Storage Converters [19003]
Emanuel Serban, Martin Ordonez, Cosmin Pondiche and Dan Hulea, *University of British Columbia, Canada; Schneider Electric Solar Canada, Canada; University Politehnica of Timisoara, Romania*

9:45AM | Artificial Neural Network-Based Adaptive Voltage Regulation in Distribution Systems using Data-Driven Stochastic Optimization [20383]
Krishna Sandeep Ayyagari, Reynaldo Gonzalez, Yufang Jin, Miltiadis Alamaniotis, Sara Ahmed and Nikolaos Gatsis, *University of Texas at San Antonio, United States*

S135 | Electric Drivetrains

Room 340
Chairs: Subrata Saha, Sabrina Ayat

8:30AM | Development of a 100 kW SiC Switched Tank Converter for Automotive Applications [19406]
Ze Ni, Yanchao Li, Chengkun Liu, Mengxuan Wei and Dong Cao, *North Dakota State University, United States*

8:55AM | A Fault Tolerant Modulation Strategy for Dual Inverter Traction Drives [20239]
Rishi Menon, Sheldon Williamson, Najath Abdul Azeez and Arvind Kadam, *UOIT, Canada*

9:20AM | High-density High-power DC-to-DC Converter Architectures for Future Electrified Transportation Applications [20575]
Suman Dwari, Zhentao Stephen Du, Parikshith Channegowda and Parag Kshirsagar, *United Technologies Research Center, United States*

9:45AM | Evaluation of Posicast Compensator Robustness for the Reduction of Torsional Vibrations [20395]
Constanza Ahumada and Patrick Wheeler, *Universidad de Chile, Chile; University of Nottingham, United Kingdom*

S136 | Single Phase Multilevel Converters

Room 349
Chairs: Petar Grbovic, Marco di Benedetto

8:30AM | Multilevel Single-Phase PWM Converters with Shared Legs and Cascaded Transformers [19722]
Joao Paulo Ramos Agra Mello, Cursino Bradao Jacobina and Amanda Pereira Monteiro, *Federal University of Campina Grande, Brazil*

8:55AM | Single-Phase AC-DC-AC Multilevel Converter Based on Parallel-/Series-Connected Three-Leg Modules [20058]
Rodrigo Pereira de Lacerda, Cursino B. Jacobina and Edgard L. L. Fabricio, *Federal University of Campina Grande, Brazil; Federal Institute of Paraiba, Brazil*

9:20AM | A Single Phase Nine Level Multi Level Inverter for PV Applications [20212]
Sreekanth T., Abhijit Kshirsagar, Sanchit Mishra and Ned Mohan, *University of Minnesota, United States*

9:45AM | A Single-Phase to Single-Phase Three-Wire Power Converter Based on Two-Level and Three-Level Legs [20266]
Bruna Seibel Gehrke, Cursino Brandao Jacobina, Reuben Palmer R. Sousa, Italo Roger F. M. P. da Silva, Joao Paulo R. A. Mello and Nayara Brandao de Freitas, *Federal University of Campina Grande, Brazil; Federal Rural University of Pernambuco, Brazil*

S137 | Modular Multilevel Converters 2

Room 346
Chairs: Xiaofeng Yang, Qin Lei

8:30AM | Impact of the Circulating Current Control on Transient Submodule Voltage Stresses for Grid-Tied Modular Multilevel Converters During Grid Faults [20322]
Zhijian Yin, Huan Qiu, Yongheng Yang, Yi Tang and Huai Wang, *Aalborg University, Denmark; Nanyang Technological University, Singapore*

8:55AM | A Multilevel Chain-link Topology for Low Voltage, Variable Frequency Applications [20371]
Luca Tarisciotti, Alessandro Costabeber, Francesco Tardelli and Roberto Cardenas, *Universidad Andres Bello, Chile; University of Nottingham, United Kingdom; Amantys Power Electronics Limited, United Kingdom; University of Chile, Chile*

9:20AM | Integration of Coupled Inductors for Compact Design of Flying-Capacitor Modular Multilevel Converters [20381]
DucDung Le and Dong-Choon Lee, *Yeungnam University, Republic of Korea*

9:45AM | The Current Shaping Modular Multilevel DC/DC Converter with Current Doubling [19125]
Philippe Gray and Peter Lehn, *University of Toronto, Canada*

S138 | DC-DC Isolated Converter 3

Room 347
Chairs: Yan Xing, Martin Ordonez

8:30AM | Ultra-Wide Output Voltage Range DC Power Supply with Multiple Power Modules Series/Parallel Variable Structure and Automatic Voltage/Current Sharing [19530]
Mengxi Li, Hongfei Wu, Chengzhi Qu, Yuhui Ji, Yangjun Lu, Yan Xing and Kai Sun, *Nanjing University of Aeronautics and Astronauti, China; Shanghai Institute of Space Power-Sources, China; Tsinghua University, China*

8:55AM | Multi-cell Multi-port Bidirectional Flyback based on GaN devices [19816]
Ander Avila, Asier Garcia-Bediaga, Alberto Rodriguez, Luis Mir and Alejandro Rujas, *Ikerlan Technology Research Centre, Spain; Universidad de Oviedo, Spain; IKERLAN Technology Research Centre, Spain*

9:20AM | Design and Implementation of an Interleaved Forward Converter with Magnetizing Energy Recycled [19306]
Chuan Min Ke, Tsorng Juu Liang, Wei Jing Tseng and Guo Lung Jiang, *National Cheng Kung University, Taiwan*

9:45AM | Modal Analysis Method of DAB Based on Phase Shift Control [19150]
Liang Guan, Fan Xiao, Chunming Tu and Zheng Lan, *Hunan University, China; Hunan University of Technology, China*

S139 | Modulation 2

Room 350
Chairs: Liuchen Chang, Santanu Kapat

8:30AM | A Modulation method for DCX LLC Converter to Achieve Fixed Voltage Gain and Bidirectional Power Transfer with Power Limitation Capability [19596]
Chen Xiaoying, Guo Xu, Xie Shiming, Su Mei, Wang Hui, Liu Yonglu and Dan Hanbing, *Central South University, China*

8:55AM | Two new commutation methods based on state machine for three phase HF ac link inverter with passive loads [20098]
Minjeong Kim, Taoufik Sekkat, Michael Hornick, Kraig Orcutt and Robert Balog, *Texas A&M University, United States*

9:20AM | A Carrier-Based Discontinuous PWM for Three-Level T-type Converters with Neutral-Point Potential Balancing [20070]
Jiayu Zhou, Olorunfemi Ojo, Fen Tang, Josiah Haruna and Poh Chiang Loh, *BeiJinng Jiaotong University, China; Tennessee Tech University, United States; BeiJing Jiaotong University, China; Chinese University of Hong Kong, Hong Kong*

9:45AM | Low Harmonic Loss PWM for a Dual Inverter Drive using a Floating Capacitor Inverter [20325]
Sukhjit Singh, Perera Chatumal, Greg Kish and John Salmon, *University of Alberta, Canada*

S140 | Reliability Modeling and Monitoring

Room 328
Chairs: Frede Blaabjerg, Tomoyuki Mannen

8:30AM | Thermal Monitoring of Power Electronic Modules with Minimal Sensing Effort [19652]
Christoph van der Broeck and Rik De Doncker, *RWTH Aachen University, Germany*

8:55AM | Overload Operation of LV-Side Inverter in Smart Transformer [19968]
Rongwu Zhu, Raveendran Vivek and Marco Liserre, *Kiel University, Germany*

9:20AM | Real-Time Grid Impedance Estimation Using a Converter [19625]
Jarno Kukkola, Mikko Routimo and Marko Hinkkanen, *Aalto University, Finland*

9:45AM | A Carrier-based Modulation Method for the NPC Wind Power Converter Thermal Management During Low-Voltage Ride-Through [19913]
Jiuyang Zhou and Po-tai Cheng, *National Tsing Hua University, Taiwan*

S141 | Energy Storage System Control

Room 348
Chairs: Qin Lei, Jason Lai

8:30AM | Virtual Synchronous Machine Control for Low- Inertia Power System Considering Energy Storage Limitation [19752]
Chu Sun, Syed Qaseem Ali, Geza Joos and Francois Bouffard, *McGill University, Canada; OPAL-RT Technologies Inc., Canada*

8:55AM | Power Distribution and Individual Phase Control of Asymmetrical Three-Phase Cascaded Multilevel Hybrid Energy Storage System in Star Configuration [19784]
Yue Zhang, Zhao Liu, Jianshou Kong, Junmou Feng, Shanshan Zhao, Liang Dong, Feng Mengxuan and Qingyuan Hua, *Nanjing University of Science and Technology, China; Nanjing Rail Transit Systems Co., Ltd, China*

9:20AM | Cooperative Charging of Supercapacitor Trams with Current Ripple Suppression [19910]
Zhiwu Huang, Xianqi Lu, Hongtao Liao, Heng Li, Yongjie Liu, Fu Jiang, Yingze Yang and Jun Peng, *Central South University, China; Central South University, China*

9:45AM | Control of Circulating Current to Minimize the Rating of the Energy Storage Device in Modular Multilevel Converters [20652]
Mohammed Alharbi, Semih Isik and Subhashish Bhattacharya, *North Carolina State University, United States*

S142 | Electric Machines for Transportation 2

Room 337
Chairs: Andrea Cavagnino, Takashi Kato

8:30AM | Design of Hybrid Variable Flux Motors for Enhanced Wide-Speed Performance [19021]
Maged Ibrahim and Pragasen Pillay, *National Research Council Canada, Canada; Concordia University, Canada*

8:55AM | A Proposal of a Delta-Type Salient Pole Variable Flux Memory Motor Having Large Flux Barrier for Traction Applications [19750]
Ren Tsunata, Masatsugu Takemoto, Satoshi Ogasawara and Koji Orikawa, *Hokkaido University, Japan*

9:20AM | Design Considerations for Magnet Configurations in IPM Rotor for High Speed Traction Applications [20091]
Tausif Husain and Seong Taek Lee, *Borgwarner PowerDrive Systems, United States*

9:45AM | Design and Optimization of Synchronous Motors for Low-Voltage Electric Vehicles [19041]
Cristian Babetto, Grazia Berardi, Nicola Bianchi and Giorgio Benedetti, *University of Padova, Italy; Askoll Holding s.r.l., Italy*

S143 | High Speed and Bearingless Machines 2

Room 336
Chairs: Eric Severson, Wolfgang Gruber

8:30AM | Comprehension and Estimation of Windage Losses in Rotor Slotted Air Gaps of Electrical Machines using CFD-LES methods [19552]
Sara Sadr, Abdenour Abdelli, Ayoub Ben-Nachouane, Guy Friedrich and Stephane Vivier, *IFPEN, France; VALEO, France; UTC, France*

8:55AM | Printed Circuit Board Structural Properties and Spiral Groove Trace Conductors for Hydrodynamic Gap Maintenance in Axial Flux Rotating Machines [19732]
Ryan Knippel, Marisa Tisler and Daniel C. Ludois, *University of Wisconsin - Madison, United States*

9:20AM | A New Mechanical-Strength-Oriented Rotor Parametric Model Design for the Optimization of a Very-High-Speed IPMSM [20555]
Guoyu Chu, Alireza Pouramin, Rukmi Dutta, Faz Rahman, Howard Lovatt and Bulent Sarlioglu, *University of New South Wales, Australia; CSIRO, Australia; University of Wisconsin-Madison, United States*

9:45AM | Smart Current Limitation Technique for a Multiphase Bearingless Machine with Combined Winding System [20742]
Zhuang Wen, Giorgio Valente, Andrea Formentini, Luca Papini, Pericle Zanchetta and Christopher Gerada, *University of Nottingham, United Kingdom*

S144 | Electric Machines: Actuators, Linear, Non-conventional and Transformers

Room 338
Chairs: Bryan P. Ruddy, Jose Antonino-Daviu

8:30AM | Radial-Force-Based Swirling Actuator with Surface-Permanent-Magnet Structure for Low-Speed High-Torque Applications [19313]
Lingyu Chen, Adrien Thabuis, Akira Chiba, Masao Nagano and Kimiaki Nakamura, *Tokyo Institute of Technology, Japan; EPFL, Switzerland; Honda R&D Co., Ltd., Japan*

8:55AM | Novel Dual-Sided Permanent Magnet Machines with Different Stator Configurations [20640]
Hui Yang, Ya Li, Heyun Lin, Wei Liu and Xing Zhao, *Southeast University, China; Hong Kong Polytechnic University, China*

9:20AM | A Single-Phase Electromagnetic Transformer with an Adjustable Output Voltage [20750]
Junwei Cui, Liyan Qu and Wei Qiao, *University of Nebraska-Lincoln, United States*

9:45AM | Modeling and Design of a Linear Electric-Hydraulic Conversion Machine for Electrification of Off-Highway Vehicles [20761]
Anvar Khamitov, Jenny Swanson, James Van de Ven and Eric Severson, *University of Wisconsin-Madison, United States; University of Minnesota, United States*

S145 | IPM Motor Dirves

Room 339
Chairs: David Diaz Reigosa, Giulio De Donato

8:30AM | Remedial Strategies of Cascaded CSIs Fed Dual Three-phase PMSM Drives under One-phase Open-circuit faults [20686]
Pengcheng Liu, Zheng Wang, Xueqing Wang and Ming Cheng, *Southeast University, China*

8:55AM | Implementation of Low Inductance Permanent Magnet Machine Drive with LC Filter for Field Oriented Control [20339]
Cheng-Chung Hsu, Jyun-You Chen and Shih-Chin Yang, *National Taiwan University, Taiwan*

9:20AM | Closed-loop Current Control of Synchronous Motor Drives with Position Sensing Harmonics [20701]
Prerit Pramod and Krishna MPK Namburi, *Nexteer Automotive Corporation, United States*

9:45AM | Design and Robustness Analysis of 2DOF PI Synchronous-Frame Current Regulator for Salient PMSM Drives [19615]
Hussain Hussain, *Kuwait University, Kuwait*

S146 | SiC Reliability and Protection

Room 329
Chairs: Joseph Vitale, Huai Wang

8:30AM | Investigation of Current Mirror Based Overcurrent Protection for 1200V 800A High Power SiC MOSFET Modules [19675]
Yujia Cui, Peizhong Yi, Zhe Zhang and Lixiang Wei, *Rockwell Automation, United States; University of Connecticut, United States*

8:55AM | Investigation of Aging's Effect on the Conduction and Switching Loss in SiC MOSFETs [20331]
Fei Yang, Enes Ugur, Shi Pu, Bilal Akin and Mrinal Das, *The University of Texas at Dallas, United States; Texas Instruments, United States*

9:20AM | Investigation on Degradation of SiC MOSFET Under Accelerated Stress in PFC Converter [19309]
Jianjun Chen, Xi Jiang, Zongjian Li, Hengyu Yu and Jun Wang, *Hunan University, China*

9:45AM | Current Saturation Characteristics and Single-Pulse Short-Circuit Tests of Commercial SiC MOSFETs [20305]
Diang Xing, Boxue Hu, Susanna Yu, Yue Zhang, Tianshi Liu, Arash Salemi, Minseok Kang, Jin Wang and Anant Agarwal, *The Ohio State University, United States*

S147 | Magnetic Component Design

Room 341
Chairs: Jungwon Choi, Chengcheng Yao

8:30AM | Increase High Frequency Impedance of Ferrite Toroid Inductors Based on Electromagnetic Energy Analysis [19821]
Yiming Li, Juntao Yao and Shuo Wang, *University of Florida, United States*

8:55AM | Optimize the Winding Structure of Flyback Transformers with Arbitrary Phase-Shifted Current Waveforms [19824]
Yiming Li, Shuo Wang, Honggang Sheng and Srikanth Lakshmikanthan, *University of Florida, United States; Google Inc., United States*

9:20AM | An Integrated Passive Device for Multi-Channel LED Driver [19470]
Cheng Deng, Yun Yu and Andres Escobar Mejia, *Xiangtan Uinversity, China; Uinversity Tecnology de Pereira, Colombia*

9:45AM | Optimal Winding Layer Allocation for Minimizing Copper Loss of Secondary-Side Center-Tapped Forward Transformer with Parallel-Connected Secondary Windings [19973]
Tomohide Shirakawa, Umetani Kazuhiro, Hiraki Eiji, Ito Yuki and Hyodo Takashi, *Okayama University, Japan; OMRON Corporation, Japan*

Thursday, October 3 10:30AM – 12:10PM

S148 | Systems for Renewable Energy

Room 344
Chairs: Alex De Abreu-Garcia, Qiang Wei

10:30AM | Grid-connected Inverter Impedance Estimation Considering Grid Impedance and Frequency Coupling in the Stationary Frame [19947]
Junliang Liu, Xiong Du, Ying Shi and Heng-Ming Tai, *Chongqing University, China; University of Tulsa, United States*

10:55AM | A Closed-loop Global Synchronous PWM Method for Immunizing Parameters Uncertainty in Distributed Parallel-Connected VSIs [19982]
Tao Xu, Feng Gao, Tianqu Hao, Kangjia Zhou and Futian Qin, *Shandong University, China*

11:20AM | Reduced Voltage Stress Thirteen-Level Extendable Switched Capacitor Multilevel Inverter [20062]
Abhinandan Routray, Kharan Shiluveru, Akash Singh, Rajeev Kumar Singh and Ranjit Mahanty, *Indian Institute of Technology (BHU), Varanasi, India*

11:45AM | Medium Voltage DC Bus Enabled by Series Connection of SiC Mosfet Based Three Port DC-DC Converters [20638]
Ritwik Chattopadhyay, Viju Nair, Srinivas Gulur, Subhashish Bhattacharya and Paul R. Ohodnucki, *NC State University, United States; National Energy Technology Laboratory, United States*

S149 | Microgrid Control 1

Room 343
Chairs: Mauricio Cespedes, Thomas Podlesak

10:30AM | A Current Source Three-Phase AC-AC Converter using Current Unfolding and Active Damping Principles [20598]
N. Ha Pham, Tomoyuki Mannen and Wada Keiji, *University of Technology, Sydney, Australia; University of Tsukuba, Japan; Tokyo Metropolitan University, Japan*

10:55AM | Control Algorithms to Establish Hybrid AC/DC Distribution Systems Using Conventional Three Phase Inverters [20663]
Ali Elrayyah, *Qatar Environment and Energy Research Institute, Qatar*

11:20AM | Protection Coordination System Design for a Converter Dominated Standalone DC Microgrid [20414]
Md Rifat Kaisar Rachi, Mehnaz Akhter Khan and Iqbal Husain, *North Carolina State University, United States*

11:45AM | Enhanced Voltage Droop Control Strategy for DC Microgrid System with State Variable Feedback [20765]
Mohammad Noor Shaheed, Syed Mohammad Sifat Chowdhury, Yilmaz Sozer and De Abreu Garcia Alex, *University of Akron, United States*

S150 | Microgrid Control 2

Room 345
Chairs: Xiaoqiang Guo, Xin Zhang

10:30AM | Autotuning for Military Microgrids [19362]
Frank Bohn, Richard Bosse, Michael Gonzalez, Jaclyn Lynch, Thomas Podesak, Blane Wilson, Joseph Vitale, Stefan Siegfried and William Barnhill, *U.S. Army C5ISR Center, United States; Parsons Alpha Advanced Systems, United States*

10:55AM | A Distributed Economic Dispatch Algorithm for Islanding Microgrid Considering Unreliable Communication Links [20274]
Meiqin Mao, Chengqi He, Liuchen Chang and Yunhui Liu, *Hefei University of Technology, China*

11:20AM | Islanding of a Microgrid Using a Distributed Multi-Agent Control System [19692]
Mohamad Fares Al Jajeh, Geza Joos, Syed Qaseem Ali and Ilja Novickij, *McGill University, Canada; OPAL-RT Technologies Inc., Canada*

11:45AM | Development of a Converter Based Microgrid Test Platform [20542]
Dingrui Li, Yiwei Ma, Chengwen Zhang, He Yin, Ishita Ray, Yu Su, Lin Zhu, Fred Wang and Leon M Tolbert, *The University of Tennessee, Knoxville, United States*

S151 | Hybrid AC/DC Microgrids

Room 342
Chairs: Tsai-Fu Wu, Kai Sun

10:30AM | A Virtual Inertia Control Strategy of Interlinking Converters in Islanded Hybrid AC/DC Microgrid [19705]
Xiao Jingyi, Chen Alian, Lin Zhengyu and Xue Haihua, *Shandong University, China; Aston University, United Kingdom*

10:55AM | Mitigating Communication Delay Impact on Microgrid Stability Using a Compensator Based on Smith Predictor [19691]
Hadi Akbarihaghighat, Adel Nasiri and Necmi Altin, *University of Wisconsin-Milwaukee-Center for Su, United States; UW-Milwaukee, United States*

11:20AM | An Optimal-Oriented Quasi-Droop Control of Interlinking Converter in Hybrid Microgrid [20438]
Fanfan Lin, Xiaochao Hou, Xin Zhang and Huanyue Liao, *Nanyang Technological University, Singapore; Central South University, China*

11:45AM | A Compact Interlinking Converter Modular for Hybrid AC/DC/DS Microgrids with a Decentralized Power Management Strategy [19741]
Zhang Zhe, Jin Chi, Dong Chaoyu, Lin Pengfeng, Tang Yi and Wang Peng, *Nanyang Technological University, Singapore; Energy Research Institute at NTU, Singapore*

S152 | Applications of Electric Traction / Propulsion

Room 340
Chairs: Subrata Saha, Gilsu Choi

10:30AM | Reduction of AM Radio Noise of a VVVF Inverter for an Electric Railway Car and a Simulation Model of Noise Current [19004]
Satoshi Azuma, Daisuke Itoh, Takahito Ishida, Kengo Sugahara and Shigeo Morimoto, *Mitsubishi Electric Corp., Japan; Kindai University, Japan; Osaka Prefecture University, Japan*

10:55AM | A Partial Capacity Converter for Advanced Co-phase Traction Power Supply System [19979]
Yujie Hu, Zixin Li, Ming Lei, Cong Zhao, Hang Zhang, Ping Wang and Yaohua Li, *Institute of Electrical Engineering,CAS, China*

11:20AM | A Transformerless Non Cascaded Quadratic-based Step-Down Converter Without Pulsating Input Current for Automotive Applications [19588]
Carlos Arturo Antuna-Fiscal, Ma Guadalupe Ortiz-Lopez, Jesus Leyva-Ramos and Luis Humberto Diaz-Saldierna, *IPICYT, Mexico*

11:45AM | Traction Power Inverter Design for EV and HEV Applications at General Motors: A review [20777]
Mohammad Anwar, Mohammed Alam, Sean Gleason and Jeff Setting, *General Motors, United States*

S153 | Multilevel Converters Control

Room 349
Chairs: Pericle Zanchetta, Luca Solero

10:30AM | Current Control of a New Five-Level Nested T-type Converter with Model Predictive Control [19467]
Dianxun Xiao and Narimani Mehdi, *McMaster University, Canada*

10:55AM | Hybrid Model Predictive Control of Active-Neutral-Point-Clamped Multilevel Converters [19368]
Dehong Zhou, Zhongyi Quan and Yun Wei Li, *University of Alberta, Canada*

11:20AM | Deadbeat Control for Circulating Harmonic Currents Suppression of a Level-Increased NLM Based Modular Multilevel Converter [19894]
Xingxing Chen, Jinjun Liu, Shuguang Song, Shaodi Ouyang, Di Wang and Zhifeng Deng, *Xi'an Jiaotong University, China*

11:45AM | Novel Harmonic Control Method Combining Improved Nearest Level Control and Selective Harmonic Elimination Method [19634]
Yu Jin, Songda Wang, Qian Xiao, Yiqi Liu, Yunfei Mu, Ji Yanchao, Sanjay Kumar Chaudhary and Remus Teodorescu, *Harbin Institute of Techonlogy, China; Aalborg University, Denmark; Tianjin University, China; Northeast Forestry University, China*

S154 | Multilevel Converters Applications 2

Room 346
Chairs: Po Tai Cheng, Wuhua Li

10:30AM | A Fault-Tolerant Hybrid Cascaded H-Bridge Topology [19465]
Haider Mhiesan, Yam Siwakoti and Alan Mantooth, *University of Arkansas, United States; University of Technology Sydney, Australia*

10:55AM | Three-Port Full-Bridge Cell for Multilevel Converters with Battery Energy Storage [20103]
Sebastian Neira, Javier Pereda, Michael Merlin and Felix Rojas, *Pontificia Universidad Catolica de Chile, Chile; University of Edinburgh, United Kingdom; Universidad de Santiago de Chile, Chile*

11:20AM | Multi-port Converter with Square-wave-voltage Multilevel Converter and Active Power Filter Connected in Series [20365]
Jun-ichi Itoh, Mitsuru Miyashita, Keisuke Kusaka, Yuichi Noge and Masaki Ishibashi, *Nagaoka University of Technology, Japan; Tokyo University of Agriculture and Technology, Japan; Tokyo Metropolitan College of Industrial Tech., Japan*

11:45AM | Failure Mode Analysis of the 3-Phase 5-Level E-Type Converter [20203]
Marco di Benedetto, Alessandro Lidozzi, Luca Solero, Petar Grbovic and Fabio Crescimbini, *Roma Tre University, Italy; University of Innsbruck, Austria*

S155 | DC-DC Isolated Converter 4

Room 347
Chairs: Wenkang Huang, Kai Sun

10:30AM | Design and Implementation of a Dual-Input LLC Converter with Semi-Active Rectifiers for PV Applications [19277]
Xi Chen, Seyed Milad Tayebi and Issa Batarseh, *University of Central Florida, United States; University of Texas at Austin, United States*

10:55AM | Design and Implementation of Three-Level Half-Bridge Bidirectional CL3C Resonant DC Converter [19308]
Jun Xian Huang, Tsorng Juu Liang, Wei Jing Tseng and Zhao Wei Chen, *National Cheng Kung University, Taiwan*

11:20AM | High Frequency Transformer Core Loss Analysis in Isolated Modular Multilevel DC-DC Converter for MVDC Application [19700]
Rachit Agarwal, Sandro Martin, Yanjun Shi and Hui Li, *Center for Advanced Power Systems, FSU, United States*

11:45AM | A Zero-Current-Switched PWM Full Bridge DC-DC Converter [19305]
Anirban Pal and Kaushik Basu, *Indian Institute of Science, Bangalore, India*

S156 | Power Converter EMI 1

Room 350
Chairs: Shuo Wang, Hong Li

10:30AM | Common-Mode EMI Comparison of NSPWM, DPWM1, and SVPWM Modulation Approaches [20694]
Yichao Zhang, Cong Li, Michael Schutten, Carlos Feliz De Leon and Satish Prabhakaran, *GE Global Research Center, United States*

10:55AM | Active EMI Reduction Technique of Active Front End (AFE) Drives Based on Randomized Switching Frequency PWM [19603]
Zhe Zhang, Lixiang Wei, Peizhong Yi, Srikanta Murthy Puneeth and Cui Yujia, *University of Connecticut, United States; Rockwell Automation, Inc, United States; Rockwell Automation, United States*

11:20AM | Study on EMI Failure of Controller Area Network Caused by a Buck Converter [19974]
Ryo Shirai and Toshihisa Shimizu, *Tokyo Metropolitan University, Japan*

11:45AM | Spread Spectrum Technique for Current-Fed LLC Resonant Converter with Tight Output Voltage Regulation [19618]
Mina Kim, Hwa-Pyeong Park and Jee-Hoon Jung, *UNIST, Korea (South)*

S157 | Converter Control

Room 328
Chairs: Katherine Kim, Seth Sanders

10:30AM | Application of High Performance FPGA to Boost Bandwidth of SiC Shunt Active Power Filter [20727]
Li Yang, Yukun Luo, M.A. Awal, Wensong Yu and Iqbal Husain, *North Carolina State University, United States*

10:55AM | Drain-Source Synchronous Rectification Efficiency and Light-Load Stability Improvement through Multi-Level Turn-Off for LLC-based DC-DC Converters [19146]
Oscar Yu, Chih-Shen Yeh, Moonhyun Lee and Jih-Sheng Lai, *Future Energy Electronics Center, Virginia Tech, United States*

11:20AM | A Novel Dual-input Dual-output Converter and Dynamic Energy Management for PV/Battery Systems [19331]
Qingxin Tian, Guohua Zhou, Minrui Leng, Xianyan Fan and Tiesheng Yan, *Southwest Jiaotong University, China; Xihua University, China*

11:45AM | Design and Implementation of a Bipolar-Unipolar Switched Boundary Current Mode (BCM) Control GaN-Based Single-Phase Inverter [19949]
Kamal Sabi and Daniel Costinett, *University of Tennessee, United States*

S158 | Grid-Connected Converter Control 1

Room 348
Chairs: Brendan McGrath, Toshihisa Shimizu

10:30AM | On the Control of a Solid State Transformer for Multi-MW Utility-Scale PV-Battery Systems [20661]
Yibin Zhang, Oluwaseun Akeyo, Jiangbiao He and Dan Ionel, *University of Kentucky, United States*

10:55AM | Efficiency Improvement of a Dual-Input LLC Converter for PV Applications using Burst-mode Control Strategy [19278]
Xi Chen, Seyed Milad Tayebi and Issa Batarseh, *University of Central Florida, United States; University of Texas at Austin, United States*

11:20AM | Virtual Friction Control for Power System Oscillation Damping with VSC-HVDC Links [20210]
Alberto Rodriguez-Cabero, Javier Roldan-Perez, Milan Prodanovic, Jon Are Suul and Salvatore D'Arco, *IMDEA Energy Institute, Spain; SINTEF Energy Research, Norway*

11:45AM | Model Predictive Control of Cascaded Multilevel Battery Assisted Quasi Z-Source PV Inverter with Reduced Computational Effort [19472]
Abderezak Lashab, Dezso Sera and Josep Guerrero, *Aalborg University, Denmark*

S159 | PMSM and Wound Field Synchronous Machines

Room 337
Chairs: Rakib Islam, Rukmi Dutta

10:30AM | Comparative Analysis of Novel Fractional Slot Non-overlapping Winding Hybrid Excited Machines Having Different Consequent Pole Permanent Magnet Rotor Topologies [19239]
Shun Cai, Zi-Qiang Zhu, Srinivas Mallampalli, Jean-Claude Mipo and Sophie Personnaz, *University of Sheffield, United Kingdom; Valeo, France*

10:55AM | Multi-Material Magneto-Structural Topological Optimization of Wound Field Synchronous Machines [20275]
Feng Guo and Ian P. Brown, *Illinois Institute of Technology, United States*

11:20AM | Design of a Variable-Flux Permanent Magnet Machine using Alnico 9 and Comparison with a Baseline Interior Permanent Magnet Machine [20385]
Peng Peng and Julia Zhang, *the Ohio State University, United States; The Ohio State University, United States*

11:45AM | Self-Excited Diode Rectifying Wound-Field Synchronous Motor Utilizing Space Harmonics and Flux-Intensifying with Carrier Harmonics [20590]
Masahiro Aoyama and Toshihiko Noguchi, *Shizuoka University, Japan*

S160 | Switched Reluctance and Flux Switching Machines 2

Room 338
Chairs: Takashi Kosaka, Rajesh Deodhar

10:30AM | Analytical Derivation of Phase Current Waveform for Eliminating Torque Ripple and Input Current Ripple of Switched Reluctance Motors under Magnetically Saturated Operation [19852]
Takayuki Kusumi, Kosuke Kobayashi, Kazuhiro Umetani and Eiji Hiraki, *Okayama University, Japan*

10:55AM | Investigate of a Flux Switching Permanent Magnet Machine with Alternative Flux Bridges [19817]
Ziyi Liang, Yuting Gao, Dawei Li and Ronghai Qu, *Huazhong University of Science and Technology, China*

11:20AM | Surface-Mounted and Flux-Switching PM Structures Trade-off for Automotive Smart Actuators [20008]
Mostafa Ahmadi Darmani, Poskovic Emir, Gerd Bramerdorfer, Silvio Vaschetto, Andrea Cavagnino and Alberto Tenconi, *Politecnico di Torino, Italy; Universita' degli Studi di Padova, Italy; Johannes Kepler University Linz, Austria*

11:45AM | Investigation of the Self-Cooling Characteristics of a Novel Flux-Switching Permanent Magnet Machine [20138]
Hao Ding, William Sixel, Lewis Handycardenas and Bulent Sarlioglu, *WEMPEC, UW-Madison, United States; UW-Madison, United States*

S161 | Electric Drives for Transportation

Room 336
Chairs: Jiangbiao He, Di Pan

10:30AM | Design and Evaluation of a 150-kVA SiC-MOSFET-based Three-Level TNPC Phase-leg PEBB for Aircraft Motor Driving Application [20404]
Zhao Yuan, Amol Deshpande, Balaji Narayanasamy, Hongwu Peng, Asif Imran Emon, Reece Whitt, Bakhtiyar Mohammad Nafis, Fang Luo and David Huitink, *University of Arkansas, United States*

10:55AM | A Band-Pass Based Position Filter for Electrical Machines Against Low-Order Harmonic Distortion [20176]
Annegret Klein-Hessling, Iliya Ralev and Rik W. De Doncker, *RWTH Aachen University, Germany*

11:20AM | Brushless Fast Starter for Automotive Start/Stop Application [20121]
Lei Hao, Chandra Namuduri, Suresh Gopalakrishnan, Chunhao Lee and Neeraj Shidore, *General Motors, United States*

11:45AM | Advanced Control of Matrix Converter Drive with Active Damping of the Input Resonance [20679]
Galina Mirzaeva, Graham Goodwin, Pericle Zanchetta, Liliana De Lillo and Lee Empringham, *The University of Newcastle, Australia; the University of Nottingham, United Kingdom; The University of Nottingham, United Kingdom*

S162 | Model Predictive Control for Electric Drives

Room 339
Chairs: Shafiq Ahmed Odhano, Yukai Wang

10:30AM | Sequential MPC Strategy for High Performance Induction Motor Drives: a detailed analysis [20740]
Valerio Vodola, Shafiq Ahmed Odhano, Margarita Norambuena, Cristian Garcia, Silvio Vaschetto, Pericle Zanchetta, Jose Rodriguez and Radu Bojoi, *Politecnico di Torino, Italy; The University of Nottingham, United Kingdom; Universidad Tecnica Federico Santa Maria, Chile; Universidad de Talca, Curico, Chile; Universidad Andres Bello, Santiago, Chile*

10:55AM | A Modulated Model Predictive Torque and Flux Trajectories Control for IPMSM Drives [20481]
S M Showybul Islam Shakib, Dan Xiao, Rukmi Dutta, Kazi Saiful Alam, Ilham Osman and M. F. Rahman, *University of New South Wales (UNSW), Australia*

11:20AM | An Error Tracking Dead-Beat Model Predictive Torque Control for Open-Winding Permanent Magnet Synchronous Motor with Common DC Bus [19324]
Yifei Cheng, Dan Sun, Wenhan Chen and Heng Nian, *College of EE, Zhejiang University, China*

11:45AM | On-line Continuous Control Set MPC for PMSM Drives Current Loops at High Sampling Rate Using qpOASES [19555]
Francesco Toso, Paolo Gherardo Carlet, Andrea Favato and Silverio Bolognani, *University of Padova, Italy*

S163 | Magnetic Component and Modeling

Room 329
Chairs: Shuo Wang, Maeve Duffy

10:30AM | Integrated Matrix Transformer with Optimized PCB Winding for High-Efficiency High-Power-Density LLC Resonant Converter [20405]
Shuo Wang, Hongfei Wu, Fred Lee and Qiang Li, *Virginia Tech, United States; Nanjing Univ. of Aeronautics and Astronautics, China*

10:55AM | Soft Magnetic Materials Characterization for Power Electronics Applications and Advanced Data Sheets [19946]
Seung Ryul Moon, Paul Ohodnicki, Kevin Byerly and Richard Beddingfield, *National Energy Technology Laboratory, United States; ORISE fellow at NETL, United States*

11:20AM | Improved Inductance Calculation in Variable Power Inductors by Adjustment of the Reluctance Model through Magnetic Path Analysis [20152]
Sarah Saeed, Jorge Garcia, Marina S. Perdigao, Valter S. Costa, Bruno Baptista and Andre M. S. Mendes, *University of Oviedo, Spain; Instituto de Telecom., Polytechnic - ISEC, Portugal; Instituto de Telecom., Universidade de Coimbra, Portugal; WEGeuro - Industria Electrica, Portugal*

11:45AM | Data-driven Leakage Inductance Modeling of Common Mode Chokes [19579]
Zhou Dong, Ren Ren, Bo Liu and Fred Wang, *University of Tennessee, United States*

S164 | Gate Drive for Wide Band Gap Device 2

Room 341
Chairs: Maja Harfman Todorovic, Dong Jiang

10:30AM | Gate Drive for Very Fast Resonant Conversion using SiC Switch [19483]
Zikang Tong, Lei Gu, Kawin Surakitbovorn and Juan Rivas-Davila, *Stanford University, United States*

10:55AM | Variable Voltage Smart Gate Driver for Fast Switching and Cross-talk suppression of SiC MOSFET [20295]
Chunhui Liu, Zhengda Zhang, Yunpeng Si, Yifu Liu and Qin Lei, *Arizona State University, United States*

11:20AM | Development and Verification of Protection Circuit for Hard Switching Fault of SiC MOSFET by Using Gate-Source Voltage and Gate Charge [19419]
Shinya Yano, Yusuke Nakamatsu, Takeshi Horiguchi and Shinnosuke Soda, *Mitsubishi Electric Corp., Japan*

11:45AM | Voltage Balancing of Four Series-Connected SiC MOSFETs under 2 kV Bus Voltage using Active dv/dt Control [20410]
Emma Raszmann, Keyao Sun, Rolando Burgos, Igor Cvetkovic, Jun Wang and Dushan Boroyevich, *Virginia Tech, United States*

S165 | Topics in PV-Battery Systems

Room 344
Chairs: Rangarajan Tallam, Hengzhao Yang

2:10PM | Robust Allocation of Residential Solar Photovoltaic Systems Paired with Battery Units in South Australia [19333]
Mehrdad Aghamohamadi, Amin Mahmoudi and Mohammed Hamidul Haque, *Flinders University, Australia; University of South Australia, Australia*

2:35PM | A Symmetric Transformerless Hybrid Converter with Leakage Current Suppression [19519]
Zhongting Tang, Yongheng Yang, Mei Su, Hua Han and Frede Blaabjerg, *Central South University, China; Aalborg University, Denmark*

3:00PM | Flexible Control for PV Integrated Battery Energy Storage System [19608]
Yashi Singh, Bhim Singh and Sukumar Mishra, *IIT Delhi, India; IIT DELHI, India*

3:25PM | Battery Lifetime Analysis for Residential PV-Battery System used to Optimize the Self Consumption - A Danish Scenario [20181]
Didier Farinet, Mathias Maurer, Luca Vacca, Sergiu Spataru and Daniel-Ioan Stroe, *Aalborg University, Denmark*

S166 | Topics in Alternative Energy Systems

Room 329
Chairs: Ke Ma, David Dorrell

2:10PM | A Multifunctional Reduced Sensor Control for Grid-Interfaced Dual VSC Based Doubly Fed Induction Generator [19908]
Souvik Das, Sambasivaiah Puchalapalli and Bhim Singh, *Indian Institute of Technology, Delhi, India*

2:35PM | A Power Management Circuit for an Impact-type Piezoelectric Micro-wind Energy Harvester [19938]
Nan Chen, Tingcun Wei and Liu Yang, *Northwestern Polytechnical University, China*

3:00PM | Hybrid Fuel Cell/Supercapacitor Using a Series Converter [19804]
Apinya Siangsanoh, Wattana Kaewmanee, Roghayeh Gavagsaz Ghoachani, Matheepot Phattanasak, Mathieu Weber, Jean-Philippe Martin, Serge Pierfederici and Sophie Didierjean, *Universite de Lorraine, France; King Mongkut's University of Technology North Ba, Thailand; Shahid Beheshti University, Iran*

3:25PM | Optimal Variable Load Scheduling for Hybrid Energy Systems [20254]
Avinash Rajendra, Jun Zhang and Adel Nasiri, *University of Wisconsin-Milwaukee, United States*

S167 | Converters for Renewable Energy Systems

Room 342
Chairs: Junichi Itoh, Fei Gao

2:10PM | A Four-port Bidirectional DC-DC Converter for Renewable Energy-Battery-DC Microgrid System [20311]
Jiahong Ning, Jianwu Zeng and Xia Du, *Minnesota State University, Mankato, United States*

2:35PM | Transformerless Minimum Phase Interleaved Hybrid Converter with Low Leakage Current [20229]
Simanta Samal, Rajeev Kumar Singh and Ranjit Mahanty, *IIT(BHU), India*

3:00PM | A Novel Solar PV Inverter Topology Based on an LLC Resonant Converter [19693]
Necmi Altin, Saban Ozdemir and Adel Nasiri, *University of Wisconsin-Milwaukee, United States*

3:25PM | Grid Connection Power Converter and Speed Controller for Slip-Synchronous Wind Generators [19682]
Dillan Ockhuis and Maarten Kamper, *University of Stellenbosch, South Africa*

S168 | V2G and G2V

Room 343
Chairs: Ali Emadi, Burak Ozpineci

2:10PM | A Day-Ahead Peak Shaving Strategy Using Aggregated Electric Vehicles [19769]
Khizir Mahmud, Animesh K. Sahoo and Jayashri Ravishankar, *University of New South Wales, Australia*

2:35PM | DC Ripple Component Cancelation Method of Isolated AC-DC Converter with Matrix Converter for Input Current Harmonics Reduction [20479]
Shunsuke Takuma, Keisuke Kusaka and Jun-ichi Itoh, *Nagaoka University of Technology, Japan*

3:00PM | Analysis of Multi-Pickup Inductive Power Transfer System with LCC Compensation for Maglev Train [20580]
Shuo Wang, Zhenpo Wang, Junjun Deng, Ying Yang and David Dorrell, *Beijing Institute of Technology, China; University of KwaZulu-Natal, South Africa*

3:25PM | Time Synchronization and Encoded Wireless Gate Signal Transfer Method for High-power and Bi-directional Contactless Power Transfer System for V2G Application [19267]
Keisuke Ishikawa, Masanori Ishigaki, Kosuke Tahara, Makoto Kusakabe and Takahide Sugiyama, *Toyota Central R&D Labs, Japan*

S169 | Modular Converters for Smart Grids

Room 345
Chairs: Bhim Singh, Srdjan Lukic

2:10PM | Tree-shaped Networked Control System for Modular Power Converters with Sub-us Latency and ns-scale Synchronization Accuracy [19991]
Benoit Steinmann, Gabriel Fernandez and Nicolas Cherix, *imperix, Switzerland*

2:35PM | STATCOM Operation of Parallel-Hybrid Modular Multilevel Converter [20538]
Ibhan Chandrath, Siba Kumar Patro and Anshuman Shukla, *Indian Institute of Technology Bombay, India*

3:00PM | Low Loss Submodule Cluster for Modular Multilevel Converters Suitable for Implementation with SiC MOSFETs [19401]
Keijo Jacobs, Stefanie Heinig, Baris Ciftci, Norrga Staffan and Nee Hans-Peter, *KTH Royal Institute of Technology, Sweden*

3:25PM | System-Level Power Loss Evaluation of Modular Multilevel Converters [19645]
Yi Zhang, Huai Wang, Zhongxu Wang, Frede Blaabjerg and Maryam Saeedifard, *Aalborg University, Denmark; Georgia Tech, United States*

S170 | Other Topics in Transportation Electrification Applications

Room 340
Chairs: Arash Nassiri Bavili, Poria Fajri

2:10PM | A Low-inductance Sectional Busbar for Snuberless Operation of SiC-based EV Traction Inverters [20497]
Srdjan Srdic, Chi Zhang and Srdjan Lukic, *FREEDM Center at NC State, United States*

2:35PM | Optimization of DC-Link Decoupling Snubber Circuit for SiC-based EV Traction Inverters [20513]
Chi Zhang, Srdjan Srdic and Srdjan Lukic, *FREEDM Center at NC State, United States*

3:00PM | Optimal Blending of Regenerative and Friction Braking at Low Speeds for Maximizing Energy Extraction in Electric Vehicles [19455]
Shoeib Heydari, Poria Fajri, Reza Sabzehgar and Arash Asrari, *University of Nevada, Reno, United States; San Diego State University, United States; Southern Illinois University, United States*

3:25PM | FPGA Based High Bandwidth Motor Emulator for Interior Permanent Machine Utilizing SiC Power Converter [19536]
Yukun Luo, Ma Awal, Li Yang, Wensong Yu and Iqbal Husain, *North Carolina State University, United States*

S171 | DC-DC Isolated Converter 5

Room 347
Chairs: Somasundaram Essakiappan, Hidemine Obara

2:10PM | Voltage control method with Non-linear Compensation and DC-offset Elimination for One-leg T-type Dual Active Bridge Converter Using Multi-operation Mode [20427]
Hayato Higa, Hiroki Watanabe, Keisuke Kusaka and Jun-ichi Itoh, *Meidensha Corporation, Japan; Nagaoka University of Technology, Japan*

2:35PM | A Modulation Strategy Providing Efficiency Enhancement at Light Load for the DAB Converter with DC Blocking Capacitors [19192]
Peng Liu, Shanxu Duan and Hongsheng Hu, *Huazhong University of Science and Technology, China*

3:00PM | DCM Forward-Flyback Converter with Cockcroft-Walton Voltage Multiplier: Steady-state Analysis Considering the Influence of Parasitic Capacitances at Very Low Power Consumption and Very High Voltage Gain [19341]
Juan A. Serrano, Pedro Alou and Jesus A. Oliver, *Universidad Politecnica de Madrid, Spain*

3:25PM | 6.6 kW High-Frequency Full-Bridge LLC DC/DC Converter with SiC MOSFETs [19050]
Yuequan Hu, Jianwen Shao and Teik Siang Ong, *Wolfspeed, A Cree Company, United States*

S172 | Modular Multilevel Converters 1

Room 349
Chairs: Milijana Odavic, Frank Bohn

2:10PM | A Hybrid Nine-arm Modular Multilevel Converter Based on Half-Bridge and Unidirectional Current Full- Bridge Submodule [19189]
Futian Qin, Feng Gao, Tao Xu, Decun Niu and Zhan Ma, *Shandong University, China*

2:35PM | A Novel Modular Multilevel Converter with Coupled-inductor Semi-bridge Submodules [19607]
Dan Lyu, Yichao Sun, Carlos Teixeira, Brendan McGrath, Grahame Holmes and Qi Wang, *Nanjing Normal University, China; RMIT University, Australia*

3:00PM | Operation Range Analysis and Capacitor Voltage Regulation of A Dual-AC-Terminal MMC based on Bifurcated-Arm Topology [19780]
Lin Jin, Zhiquan Dong, Yan Deng, Leyuan Zhou, Yi Lu and Yong Yang, *Zhejiang University, China; State Grid Zhejiang Electric Power Research Inst, China; State Grid Zhejiang Electric Power Co. Ltd., China*

3:25PM | On Facilitating the Modular Multilevel Converter Power Scalability Through Branch Paralleling [20083]
Stefan Milovanovic and Drazen Dujic, *Ecole Polytechnique Federale de Lausanne (EPFL), Switzerland*

S173 | Multilevel Converters

Room 346
Chairs: Richard Bosse, Marcello Pucci

2:10PM | Capacitor Voltage Balancing Control of a Modular Matrix Converter in Conditions of Startup and Low Output Frequency [19783]
Kota Yamamoto, Koki Muku and Takaharu Takeshita, *Nagoya Institute of Technology, Japan*

2:35PM | Circulating Currents Suppression and Neutral-Point Potential Balancing [20128]
Jiayu Zhou, Olorunfemi Ojo, Josiah Haruna and Fen Tang, *Beijing Jiaotong University, China; Tennessee Tech University, United States; BeiJing Jiaotong University, China*

3:00PM | A Predictive Submodule Choosing Algorithm for Soft-Switching Modular Multilevel Converters with Nearest Level Modulation Scheme [19477]
Xueni Zhou, Lei Lin, Kai Hu, Chen Xu and Weihong Song, *Huazhong University of Science and Technology, China*

3:25PM | Arm-Current Sensor-less Control of MMC for Circulating Current Suppression [20199]
Avinash Reddy and Anshuman Shukla, *Indian Institute of Technology Bombay, India*

S174 | Grid-Connected Converter Control 2

Room 348
Chairs: Teuvo Suntio, Kyo-Beum Lee

2:10PM | An Accurate Power-flow Control Method with Harmonic Compensation in Voltage-source-inverter Grid-tied System [19514]
Mingzhi Gao, Bodong Li, Bin Zhao, Yue Li and Miao Yu, *Zhejiang University, China*

2:35PM | High-Frequency Harmonic Current Control of Power Converters [19658]
Sante Pugliese, Steffen Flacke, Zhixiang Zou and Marco Liserre, *Kiel University, Germany*

3:00PM | Linear Current Controller With Fast Transient Response and Low Switching Frequency [20072]
Diego Perez-Estevez and Jesus Doval-Gandoy, *University of Vigo, Spain*

3:25PM | Compensation Alternatives for Power Sharing Errors in Multi-Port Converters for Hybrid DC/AC Microgrids [20667]
Geber Villa, Sarah Saeed, Pablo Garcia, Carlos Gomez-Aleixandre and Ramy Georgious, *University of Oviedo, Spain*

S175 | Power Converter EMI 2

Room 350
Chairs: Shuo Wang, Hong Li

2:10PM | An Improved Variable Switching Frequency Modulation Strategy for Three-Level converters with Reduced Conducted EMI [19034]
Jianan Chen, Dong Jiang, Wei Sun, Zewei Shen and Yechi Zhang, *Huazhong University of Science & Technology, China*

2:35PM | A Voltage-injected Active Gate Driver for Improving the Dynamic Performance of SiC MOSFET [20551]
Hong Li, Yanfeng Jiang, Chao Feng and Zhichang Yang, *Beijing Jiaotong University, China*

3:00PM | Common-mode Current Analysis and Cancellation Technique for Dual Active Bridge Converter based DC System [20394]
Saurabh Kumar, Sai Kiran Voruganti and Ghanshyamsinh Gohil, *University of Texas at Dallas, United States*

3:25PM | Investigation of Radiated EMI in Non-isolated Power Converters with Power Cables in Automotive Applications [19825]
Juntao Yao, Mohammed El-Sharkh, Yiming Li, Zhedong Ma, Shuo Wang and Zheng Luo, *University of Florida, United States; Monolithic Power Systems, Inc., United States*

S176 | Design Optimization

Room 328
Chairs: Sombuddha Chakraborty, Carl Ho

2:10PM | Optimal Design of the Resonant Tank of the Soft-Switching Solid-State Transformer [20255]
Mickael J. Mauger, Prasad Kandula and Deepak Divan, *Georgia Institute of Technology, United States*

2:35PM | Levelized-Cost-of-Electricity-Driven Design Optimization for Medium-Voltage Transformerless Photovoltaic Converters [20401]
Gab-Su Seo, Satyaki Mukherjee, Jinia Roy, Kyle Goodrick, Rahul Mallik, Branko Majmunovic, Soham Dutta, Dragan Maksimovic and Brian Johnson, *National Renewable Energy Laboratory, United States; University of Colorado, United States; University of Washington, United States*

3:00PM | Reduction of Low-Frequency Ripples in Single-Phase Switched Boost Inverter using Active Power Decoupling [19869]
Pramit Nandi and Ravindranath Adda, *IIT Guwahati, India*

3:25PM | An Auxiliary Resonant Switching Arm for a Buck-Boost Converter [20418]
Jose Alejandro Pichardo Iniesta, Ismael Araujo Vargas and Ilse Cervantes Camacho, *Instituto Politecnico Nacional, Mexico*

S177 | Electric Machines: Diagnostics, Noise and Vibration 2

Room 338
Chairs: Shanelle Foster, Hamid Toliyat

2:10PM | On-Line Motor Insulation Capacitance Monitoring Using Low-Cost Sensors [19202]
Antonio Griffo, Igor Tsyokhla and Jiabin Wang, *The University of Sheffield, United Kingdom; Sphere Fluidics, United Kingdom*

2:35PM | Remaining Useful Life Estimation of Stator Insulation Using Particle Filter [19371]
William Jensen and Shanelle Foster, *Michigan State University, United States*

3:00PM | An Improved Broadband Common-mode Electrical Machine Model for Online Condition Monitoring of Stator Insulation Degradation [19534]
Dayong Zheng and Pinjia Zhang, *Tsinghua University, China*

3:25PM | Flux-based Detection of Non-adjacent Rotor Bar Damage in Squirrel Cage Induction Motors [19815]
Yonghyun Park, Hanchun Choi, Sang Bin Lee and Konstantinos Gyftakis, *Korea University, Korea, Republic of; University of Edinburgh, Great Britain*

S178 | Permanent Magnet Machines 2

Room 337
Chairs: Sara Roggia, Khwaja Rahman

2:10PM | Line-Start Axial-Flux PM Motors: Introduction of a New Machine Topology [20031]
Solmaz Kahourzade, Amin Mahmoudi, Rahil Ravji and Wen Soong, *University of Adelaide, Australia; Flinders University, Australia*

2:35PM | Flux Weakening Surface Mounted Permanent Magnet Servo Motors Design with Enhanced Self-Sensing Properties [20097]
Huthaifa Flieh, Timothy Slininger, Shao-Chuan Chien, Li-Hsing Ku and Robert Lorenz, *WEMPEC - University of Wisconsin Madison, United States; Motor Drive Solution BU, Delta Electronics, Inc, Taiwan*

3:00PM | Maximum Torque Per Ampere Control of Interior Permanent Magnet Synchronous Motor via Optimal Current Excitation [20166]
Taowen Chen, Pengyuan Chen, Jingchen Liang, Sen Li and Babak Fahimi, *The University of Texas at Dallas, United States*

3:25PM | Multi-Harmonic Design and Optimization of PMSMs [20719]
Gerd Bramerdorfer, Stephan Lanser and Wolfgang Amrhein, *Johannes Kepler University Linz, Austria; ASA Astrosysteme GmbH, Austria*

S179 | Induction Motor Drives 2

Room 339
Chairs: Thomas Wolbank, Giacono Scelba

2:10PM | Torque Ripple Reduction in Stator Resistance Estimation using DC Current Injection for Induction Motor Sensorless Drives [19836]
Jiwon Yoo, Joohyun Lee, Seung-Ki Sul and Noor Aamir Baloch, *Seoul National University, Korea, Republic of; Yaskawa Electric Corporation, Japan*

2:35PM | Guidelines for Selecting Minimum Capacitance for a Floating Bridge Dual Inverter Drive [19234]
Chatumal Perera, Gregory J. Kish and John Salmon, *University of Alberta, Canada*

3:00PM | Control of Five-Phase Open-End Induction Machine Drive Topology with Floating Capacitors at optimized DC Voltage [19584]
Xiangwen Sun, Zicheng Liu, Dong Jiang and Wubin Kong, *Huazhong University of Science and Technology, China*

3:25PM | Speed Adaptive Voltage Closed-Loop Field-Weakening Control for Induction Motor Drives [19206]
Bo Wang, Jing Zhang, Yong Yu, Xu Zhang and Dianguo Xu, *Harbin Institute of Technology, China*

S180 | Switched Reluctance Motor Drives

Room 336
Chairs: Prerit Pramod, Zhe Zhang

2:10PM | Modeling of a Bearingless Synchronous Reluctance Motor With Combined Windings [19931]
Maksim Sokolov, Wolfgang Gruber, Seppo Saarakkala and Marko Hinkkanen, *Aalto University, Finland; Johannes Kepler University Linz, Austria*

2:35PM | Current Harmonics Injection Method for Simultaneous Torque and Radial Force Ripple Mitigation to Reduce Acoustic Noise and Vibration in SRM [20772]
Omer Gundogmus, Yilmaz Sozer, Lavanya Vadamodala, John Kutz, Joshua Tylenda and Ronnie Wright, *University of Akron, United States; DCS Corporation, United States; TARDEC, United States*

3:00PM | Flux Profiling Control-Based Noise and Vibration Reduction of SR Motor for Automobile Traction Drive [19499]
Takashi Kosaka, Sungyong Shin, Soshi Morishita, Daisuke Mizutani, Hiroaki Matsumori and Nobuyuki Matsui, *Nagoya Institute of Technology, Japan*

3:25PM | Small Signal Model of Mutually Coupled Switched Reluctance Motors Based on Net Flux Method [20734]
Siddharth Mehta, Iqbal Husain, Prerit Pramod and Md Ashfanoor Kabir, *North Carolina State University, United States; Nexteer Automotive, United States; ABB Corporate Research, United States*

S181 | Advanced Material and Passive Devices

Room 341
Chairs: Mona Ghassemi, Jon Zhang

2:10PM | Loss and Thermal Modeling of Metal Oxide Varistors (MOV) Under Standard Current Surge Mission Profile [19923]
Ionut Vernica, Per Thastrup Jensen, Huai Wang, Francesco Iannuzzo, Susanne Otto and Frede Blaabjerg, *Aalborg University, Denmark; FORCE Technology, Denmark; Aalbog University, Denmark*

2:35PM | Computationally Efficient Estimation of the Electric-Field Maximums for the MFT Insulation Coordination [19399]
Marko Mogorovic and Drazen Dujic, *PEL, EPFL, Switzerland*

3:00PM | Nonlinear Resistive Electric Field Grading in High-Voltage, High-Power Wide Bandgap Power Module Packaging [20460]
Maryam Mesgarpour Tousi and Mona Ghassemi, *Virginia Polytechnic Institute and State Univers, United States*

3:25PM | Design of Low Inductance Busbar for 500 kVA Three-Level ANPC Converter [19585]
Handong Gui, Ruirui Chen, Jiahao Niu, Zheyu Zhang, Fred Wang, Leon M. Tolbert, Daniel Jes Costinett, Benjamin J. Blalock and Benjamin B. Choi, *University of Tennessee, Knoxville, United States; Clemson University, United States; NASA Glenn Research Center, United States*

NOTES

TECHNICAL PROGRAM SCHEDULE

PLENARY POSTER SESSIONS

ECCE's poster sessions gives our attendees a unique opportunity to engage in discussions with more than 300 presenters in an interactive way.

Monday, September 30 **5:00PM – 7:30PM**

S31 | Alternative Energy Systems and Grid Connection

Room Exhibit Hall
Chairs: Ke Ma, Akshay Rathore

P101 | Feed-forward Controlled Single-Switch Three-Phase Wind Power Converter with Harmonic Injection Mechanism [19018]
Ray-Lee Lin and Lung-Shing Lin, *National Cheng Kung University, Taiwan*

P102 | On the Efficiency of Series-Connected Offshore DC Wind Farm Configurations [19094]
Marten Pape and Mehrdad Kazerani, *University of Waterloo, Canada*

P103 | An Improved Modulation Strategy for Single-Phase Quasi-Single-Stage AC-DC Converter [19137]
Xiaoguang Li, Fengjiang Wu and Jianyong Su, *Harbin Institute of Technology, China*

P104 | Multi-Frequency Signal Synthesis for Accurate Fuel Cell Impedance Estimation [19144]
Fabusuyi Akindele Aroge, Paul Barendse and Jessica Chamier, *University of Cape Town, South Africa*

P105 | A Novel Control Scheme for High Efficiency Fuel Cell Power Systems in Parallel Structure [19259]
Yeonho Jeong, Ronald Rorrer, Byoung-Hee Lee and Jae-Do Park, *University of Colorado Denver, United States; Hanbat National University, Korea, Republic of*

P106 | Experimental Studies on a Current-source Converter-based Wind Power Plant Composed of Series-connected Wind Turbine Generators and Synchronous-compensator-commutated Thyristor Inverter [19317]
Ken-ichiro Yamashita, Fujio Tatsuta and Shoji Nishikata, *Salesian Polytechnic, Japan; Tokyo Denki University, Japan*

P107 | Frequency Support Enhancement of a Permanent Magnet-based Adjustable-speed Pumped Storage Hydropower Plant [19358]
Jinho Kim, Eduard Muljadi, Chartan Erol Kevin, Henry Oberneyer and Lindsay George, *Auburn University, United States; National Renewable Energy Laboratory, United States; Obermeyer Hydro, INC., United States; Small Hydro Consulting, LLC, United States*

P108 | Power Quality Improvement in PMSG Based Hydro-BES System Operating in Isolated Remote Areas Using CF-FLL Control [19389]
Vineet P Chandran, Shadab Murshid and Bhim Singh, *Indian Institute of Technology, Delhi, India*

P109 | Active Power Limit for DFIG-Based Wind Turbine under Weak Grid [19772]
Xiang Guo, Xudong Zou, Congcong Jiang, Donghai Zhu, Yihang Yang, Li Peng and Xinchun Lin, *Huazhong University of Science and Technology, China*

P110 | Energy Harvesting from Moving Vehicles on Highways [20776]
Fubing Han, Abdul W. Bandarkar and Yilmaz Sozer, *University of Akron, United States*

P111 | An Approach in Torque Control of Hydraulic Wind Turbine Powertrains [20225]
Rasoul Akbari, Afshin Izadian and Weissbach Robert, *PhD student at IUPUI, United States; Associate Professor at IUPUI, United States*

P112 | Five-level gird-connected ANPC inverter with novel energy transfer strategy to be used for battery energy storage system [20370]
Hamid Reza Teymour, Reza Sabzehgar, Mohammad Rasouli, Danny Sutanto and Kashem Muttaqi, *Jabil Circuit, United States; San Diego State University, United States; Penn State Behrend, United States; University of Wollongong, Australia*

S32 | Grid Applications of Power Electronics

Room Exhibit Hall
Chairs: Zhe Zhang, Srdjan Lukic

P301 | Online Stabilization of DC Power Distribution Systems Applying MIMO-Identification Method and Resonance-Enhanced Voltage Controller [19710]
Hessamaldin Abdollahi, Tomi Roinila, Silvia Arrua and Enrico Santi, *University of South Carolina, United States; Tampere University of Technology, Finland*

P302 | A Proposed Capacitor Voltage-Balancing Strategy for Double-Y STATCOM Operated Under Unbalanced Conditions [19903]
Ehsan Behrouzian, Massimo Bongiorno, Jan R Svensson and Aravind Mohanaveeramani, *Chalmers university of technology, Sweden; Chalmers University of Technology, Sweden; ABB Corporate research, Sweden*

P303 | Controller Design of Parallel Buck Voltage Balancers for Bipolar DC Microgrids [20144]
Luis Herrera, Dane DiMaria, Chad Miller and Bang-Hung Tsao, *University at Buffalo, United States; Air Force Research Laboratories, United States; University of Dayton Research Institute, United States*

P304 | Robust Control for Islanded and Seamless Mode Switching of Wind-PV-Grid Tied Generation System [19523]
Seema Kewat and Bhim Singh, *IIT Delhi, India, India*

P305 | A Hybrid Method for Islanding Detection of Inverter Interfaced Distributed Generators Utilizing Superimposed Component of d-axis Voltage [19166]
Diptak Pal, Bijaya Ketan Panigrahi and Seema Kewat, *Indian Institute of Technology Delhi, India*

P306 | A Reliable Suppression Method of High Frequency Circulating Current in Parallel Grid Connected Inverters [19442]
Sungjoon Cho, Yun Jang, Sebong Jeon and Kyo-Beum Lee, *Ajou University, Korea, Republic of*

P307 | Back-to-Back 31 Levels Modular Multilevel Converter with EtherCAT Communication [20631]
Chagn-Hwan Park, Belete Belayneh Negesse, Chan-Ki Kim and Jang-Mok Kim, *Pusan National University, Korea (South); KEPCO Research Institute, Korea (South)*

P308 | Operation of MMC Based HVDC Under SM Failure at Sending End Converter [19353]
Richa Kumar, Abdul Beig, Khaled Al-Jaafari and Jayashree Rj, *B.S.Abdur Rahman Crescent Institute of Science a, India; Khalifa University of Science and Technology, United Arab Emirates*

P309 | A DC Circuit Breaker with Artificial Zero Current Interruption [20545]
Shrishti Singh, Subhashish Bhattacharya and Leonard White, *North Carolina State University, United States*

P310 | The Impact of Multi-Terminal DC Grids on AC Line Overload Alleviation: A Model Predictive Approach [20743]
Mahmoud Mehrabankhomartash and Maryam Saeedifard, *Georgia Tech, United States*

P311 | Flexible Intelligent Real-time dc-ac grid Emulator (FIRE): Power Electronic Hardware-in-the-Loop (PE-HIL) Amplifier [19671]
Suman Debnath, Sheng Zheng, Nathaniel Watson, Steven Campbell, Rong Zeng and Madhu Chinthavali, *Oak Ridge National Laboratory, United States*

P312 | Systematic Characterization of Power Hardware-in-the-Loop Evaluation Platform Stability [20338]
Jing Wang, Blake Lundstrom, Ismael Mendoza and Annabelle Pratt, *National Renewable Energy Laboratory, United States*

P313 | Identification of Grid Impedance During Severe Faults [19132]
Robert Eric Betz and Mads Graungaard Taul, *University of Newcastle, Australia, Australia; Aalborg University, Denmark*

P314 | A Bidirectional Single-Stage Isolated AC-DC Converter for Electric Vehicle Chargers [19688]
Leonardo Adriano Ramos, Rafael Felipe Van Kan, Marcello Mezaroba, Alessandro Luiz Batschauer and Cassiano Rech, *Santa Catarina State University - UDESC, Brazil; Federal University of Santa Maria - UFSM, Brazil*

P315 | Development of Submodule Test Equipment for MMC-Based VSC-HVDC System [20136]
Chang-Yeol Oh, Ki Ryong Kim, Ho Sung Kim, Jong-Pil Lee and Tae-Jin Kim, *Korea Electrotechnology Research Institute, Korea (South)*

P316 | Switching Device Number Reduction for Three-Phase Cascade-Modular Solid-State Transformer System with Employment of Three-Phase T-Type Converter [19801]
Hoai Nam Le, Satoshi Nagai, Keisuke Kusaka and Junichi Itoh, *Nagaoka University of Technology, Japan*

P317 | Short Circuit Protection for AC Solid State Power Controller Based on GaN [20474]
Zixuan Zhao and Li Wang, *Nanjing University of Aeronautics & Astronautics, China*

P318 | A Reconfigurable Test Bed for Experimental Studies on Islanded Hybrid AC/DC Microgrids [19030]
Mahmoud Allam, Marten Pape and Mehrdad Kazerani, *University of Waterloo, Canada*

P319 | A 2kV Intelligent DC Solid State Circuit Breaker Using Series Connected SiC JFETs [19285]
Dong He, Zhikang Shuai, Wei Wang, Ying Cheng, Lei Yu and Z.John Shen, *Hunan University, China; Electric Power Research Institute, China Souther, China; Illinois Institute of Technology, United States*

P320 | High Efficiency Isolated Resonant PFC Converter for Two-stage AC-DC Converter with Enhanced Performance [19453]
Sung-Ho Lee and Min-Jae Kim, *Korea Atomic Energy Research Insititute (KAERI), Korea (South); Pohang Accelerator Laboratory (PAL), Korea (South)*

S33 | Power Converters for Datacenters and LED Drivers

Room Exhibit Hall
Chairs: Ray-Lee Lin, Yu-Chen Liu

P501 | Efficient Power Transfer to Data Center Racks using Medium Voltage Inductive Coupling [20214]
Suvendu Samanta, Richard Beddingfield, Isaac Wong and Subhashish Bhattacharya, *North Carolina State University, Raleigh, NC, United States; National Energy Technology Laboratory, United States*

P502 | A Current Sensorless Coulomb-Counting Method for Enhanced Battery SOC Estimation Accuracy [20227]
Zakariya Dalala, Osama Saadeh and Ala Hussein, *German Jordanian University, Jordan; Yarmouk University, Jordan*

P503 | Predicting Lithium-ion Battery Resistance Degradation in a Log-Linear Model [19614]
Soren Byg Vilsen, Soren Knudsen Kaer and Daniel-Ioan Stroe, *Aalborg University, Denmark*

P504 | An Ideal Current-Source Gate Driver for Buck VRMs [20488]
Iman Abdali Mashhadi, Seyedali Seif Kashani, Behzad Poorali and Majid Pahlevani, *Queen's University, Canada*

P505 | A Multiplexing Off-Line LED Driver Achieves High Power Factor and Flicker-Free Operation [20337]
Peng Fang, Yan-Fei Liu and P.C. Sen, *University of Minnesota, United States; Queen's University, Canada*

S34 | Inductive Power Transfer & Charging Techniques

Room Exhibit Hall
Chairs: Omer Onar, Jason Pries

P701 | Challenges in the Z-Class Compatible Inductive Power Transfer System Considering the Wide Varying Range of the Coupling Coefficient [19516]
Hua Zhang, Ying Mei, Chong Zhu, Yao Wang, Sheng Zheng and Fei Lu, *Drexel University, United States; Zhejiang University, China; Shanghai Jiao Tong University, China; Oak Ridge National Lab, United States*

P702 | An Universal On-board Battery Charger with Wide Output Voltage Range for Electric Transportation [20048]
Jaya Sai Praneeth A v, Deepa Vincent and Sheldon S Williamson, *University of Ontario Institute of TechnologY, Canada*

P703 | Enhanced Rotary Transformer-Based Field Excitation System for Wound Rotor Synchronous Motor [20143]
Josiah Haruna, Tsarafidy Raminosoa and Jonathan Wilkins, *Tennessee Tech University, United States; Oak Ridge National Laboratory, United States*

P704 | Coupled-Inductor Bidirectional DC-DC Converter for EV Charging Applications with Wide Voltage Conversion Ratio and Low Parts Count [20165]
Agasthya Ayachit, Saad Ul Hasan, Yam Siwakoti, Mohamad Abdul-Hak, Marian K. Kazimierczuk and Frede Blaabjerg, *Mercedes-Benz Research and Development N America, United States; University of Technology Sydney, Australia; Wright State University, United States; Aalborg University, Denmark*

P705 | Transformer-less Medium Voltage EV Chargers [20211]
Muhammad Alvi and Venkataramanan Giri, *University of Wisconsin-Madison WEMPEC, United States*

P706 | Design Considerations of a Bipolar Track for Dynamic Electric Vehicle Charging [20300]
Weitong Chen, Feiyang Lin, Grant Covic and John Boys, *The University of Auckland, New Zealand*

P707 | Leakage Current Mitigation of Non-Isolated Integrated Chargers for Electric Vehicle [20462]
Yue Zhang, William Perdikakis, Yizhou Cong, Xiao Li, Mohamed Elshaer, Yousef Abdullah, Jin Wang, Ke Zou, Zhuxian Xu and Chingchi Chen, *The Ohio State University, United States; Ford Motor Company, United States*

P708 | Passive Reflection Winding for Ferrite-less Double D Topology for Roadway IPT Applications [20470]
Matthew Pearce, Grant Anthony Covic and John Talbot Boys, *The University of Auckland, New Zealand*

P709 | Empirical Closed-Form Analysis for Inductance and Coupling Coefficient Calculation for Ferrite-Based Matched Inductive Charging Systems [20554]
Benny Varghese, Abhilash Kamineni and Regan Zane, *Utah State University, United States*

P710 | A Novel Maximum Efficiency Point Tracking Technique for Modular Paralleled Electric Vehicle Charging System [19344]
Zhuang Lin, Xuexiao Luo, Yajuan Jiang, Lingli Fan, Yuefei Wu and Yingqi Zhang, *LG Electronics China R&D Center, China*

P711 | Natural convection cooled SiC-based LLC Resonant Converters in Wide Voltage Range Battery Charger Application [19430]
Rui Zhou, Qianqian Jiao and Yincan Mao, *EnerSys, United States*

P712 | High Performance Active Battery Management System with Multi-Winding Transformer [19347]
Umberto Abronzini, Ciro Attaianese, Matilde D'Arpino, Mauro Di Monaco, Francesco Porpora and Giuseppe Tomasso, *University of Cassino and Southern Lazio, Italy; OSU Center for Automotive Research, United States*

P713 | Medium Voltage Dual Active Bridge Using 3.3 kV SiC MOSFETs for EV Charging Application [20574]
Lee Gill, Takayuki Ikari, Toshihiro Kai, Bo Li, Khai Ngo and Dong Dong, *Virginia Tech, United States*

P714 | A Parallel Topology for Modularized IPT Systems [19195]
Hongsheng Hu, Tao Cai, Xiaoming Zhang, Jintao Niu, Hao Feng and Shanxu Duan, *Huazhong University of Science and Technology, China; North Carolina State University, United States*

S35 | DC-DC Converters

Room Exhibit Hall
Chairs: Arijit Banerjee, Jungwon Choi

P901 | Analysis and Implementation of a New Non-isolated High-Voltage Gain Boost Converter [19396]
Anh Dung Nguyen, Jih-Sheng Lai and Huang-Jen Chiu, *Virginia Tech, United States; Taiwan Tech, Taiwan*

P902 | A Novel Circuit Topology and Its Design for Class-E^2 DC-DC Converter [19842]
Yusuke Ogi, Fumiya Ebihara, Xiuqin Wei and Hiroo Sekiya, *Chiba Institute of Technology, Japan; Chiba University, Japan*

P903 | In-situ Direct Magnetic Loss Measurement in a DC-DC Converter [20145]
Jinyeong Moon, *Florida State University, United States*

P904 | 400 V to 12 V Step-down DC-DC Power Converter Based on the Differential Concept [20002]
Neilor Colombo Dal Pont, Matheus Schramm Dall'Asta, Jessika Melo de Andrade, Telles Brunelli Lazzarin and Brad Lehman, *Federal University of Santa Catarina, Brazil; Northeastern University, United States*

P905 | Multi-resonant Non-Inverting Buck-Boost Converter [20030]
Dulika Nayanasiri, Pasan Gunawardena and Yunwei (Ryan) Li, *Univeristy of Alberta, Canada; University of Moratuwa, Sri Lanka; University of Alberta, Canada*

P906 | An IPOS LLC Converter with Current Sharing Capability [19386]
Yucen Li, Shuai Shao, Hui Chen, Junming Zhang and Kuang Sheng, *Zhejiang University, China; Zhejiang University City College, China*

P907 | A Comprehensive Analysis of Gate Drive Delay in CLLC Converters and Its Compensation Method [19378]
Huan Chen, Hongsheng Chong, Kai Sun, Zheyuan Yi, Shujun Mu and Yang Mei, *Tsinghua University, China; Nation Institute of Clean and Low Carbon Energy, China; North China University of Technology, China*

P908 | Improvement on Transient Performance of Cooperative Triple-Phase-Shift Control for Dual Active Bridge DC-DC Converter [19128]
Jianyong Su, Suhua Luo and Fengjiang Wu, *Harbin Institute of Technology, China*

P909 | An Improved Power Processing Unit for Multi-Mode Monopropellant Electrospray Thrusters for Satellite Propulsion Systems [19334]
Kartikeya Veeramraju and Jonathan Kimball, *Missouri S&T, United States*

P910 | A Soft-switching Current-fed Isolated Bidirectional DC-DC Converter with Low Circulating Power and Easy-implemented Control Strategy [19930]
Zhao Zhang, Zhiying Wu, Shaojun Xie, Xiaoyu Ma, Jinming Xu and Miao Liu, *Nanjing University of Aeronautics and Astronauti, China*

P911 | A Two-Stage Isolated Converter without Intermediate Capacitor for Wide Voltage Range Applications [19742]
Pengyu Jia, Zehui Huang, Yaozong Hao, Qian Chen and Shengwen Fan, *North China University of Technology, China; State Grid Zhejiang Electric Power Corporation, China*

P912 | Analytical Solution For Minimum RMS Current and Reactive Power Modulation of A Soft Switched Dual Active Bridge Converter [20426]
Amit Bhattacharjee, Xi Chen and Issa Batarseh, *UCF, United States*

P913 | The Multi-Phase Input-Parallel Output-Parallel (IPOP) Dual Active Bridge (DAB) with Current Sharing and the Optimum Integrated Transformer to Improve Power Density and Efficiency [20205]
Wucheng Ying, Hui Zhao, Yanfeng Shen, Zhaokai Li, Hao Hu and Teng Long, *University of Cambridge, United Kingdom*

P914 | Time-Domain Analysis of APWM-Frequency Modulated Low-Q LLC Resonant Converter for Wide Input and Load Range Applications [19766]
Abhishek Awasthi, Amit Kumar, Snehal Bagawade and Praveen Jain, *Queen's University, Canada*

P915 | Four-Port Bidirectional Dual Active Bridge Converter for EVs Fast Charging [20124]
Maurizio La Mendola, Marco di Benedetto, Alessandro Lidozzi, Luca Solero and Stefano Bifaretti, *Roma Tre University, Italy; University of Roma Tor Vergata, Italy*

P916 | Digitally-assisted Hysteresis Voltage Prediction Control for Series-Form Switch-Linear Hybrid Envelope Tracking Power Supply [19411]
Ying Li, Xinbo Ruan, Yazhou Wang and Chengxiang Zhang, *Nanjing Univ. of Aero. and Astro., China*

P917 | Current Balancing Technique in Symmetrical Configuration of Quad-Active-Bridge Converter using Integrated Magnetic Current Balancing Cells [19789]
Nabeel Naseem, Honnyong Cha and Jong-Soo Kim, *Kyungpook National University, Korea, Republic of; Daejin University, Korea, Republic of*

P918 | Fault-Tolerant Bidirectional Series Resonant DC-DC Converter with Minimum Number of Components [20080]
Dmitri Vinnikov, Chub Andrii, Korkh Oleksandr and Malinowski Mariusz, *TalTech University, Estonia; Warsaw University of Technology, Poland*

P919 | Development of a High Power Density GaN-based Transistor Low-Voltage High-Current Phase-Shift Full-Bridge Current Doubler Converter for Electric Vehicles [19874]
Sangjin Kim, Adhistira Madhyasta Naradhipa and Sewan Choi, *Seoultech, Korea (South)*

P920 | A Small Signal Model of Dual Bridge Series Resonant DC/DC Converter for Power Electronic Traction Transformer [19382]
Yang Bo, Ge Qiongxuan, Zhao Lu, Zhou Zhida and Li Yaohua, *Institute of Electrical Engineering, CAS, China, China; Institute of Electrical Engineering, CAS,China, China*

P921 | Analysis and Design of SR Driver Circuit for LLC DC-DC Converter Under High Load Current Application [20675]
Xiang Zhou, Bo Sheng, Wenbo Liu, Yang Chen, Andrew Yurek, Yan-fei Liu and Paresh C Sen, *Queen's University, Canada, Canada*

P922 | Simultaneous Model Based Control of a Non-Inverting Buck-Boost Converter for PFC Applications at a Reduced Current Stress [20771]
Velasquez Franklin, Akarsh Murthy and Mohamed Badawy, *San Jose State University, United States*

P923 | Class E Resonant Low dv/dt Rectifier Using Common Grounded Switch Controlled Capacitor [19756]
Yuki Hirama, Yoshikazu Sakai and Hirotaka Koizumi, *Tokyo University of Science, Japan*

P924 | Exact Steady-State Analysis of The Phase-Shifted Dual-Input LLC Converter [20454]
Abdullah Alhatlani, Sumana Ghosh, Issa Batarseh and Nasser Kutkut, *University of Central Florida, United States; Advanced Charging Technologies, United States*

P925 | Stacked DC-DC Converter with Wide Voltage Range [19115]
Liming Liu, Sandeep Bala and Francisco Canales, *ABB Inc., United States; ABB, Switzerland*

S36 | Power Converter Control

Room Exhibit Hall
Chairs: John Lam, Han Peng

P1101 | Novel Switching Control Method for Synchronous Rectifier of Phase-Shifted Full-Bridge Converter in Light-Load Conditions [19109]
Sunho Lee, Junhyuk Lee, Usman Ali Khan and Jung-Wook Park, *Yonsei University, Korea (South)*

P1102 | Zero Sequence Circulating Current Reduction of Paralleled Converters With Interleaved Discontinuous PWM [19297]
Hanwei Xu, Lie Xu, Kui Wang, Zedong Zheng and Yongdong Li, *Tsinghua University, China*

P1103 | Design and Control of a Modular 48/400V Power Converter for the Grid Integration of Energy Storage Systems [20026]
Miguel Crespo, Pablo Garcia, Ramy Georgious, Geber Villa and Jorge Garcia, *University of Oviedo, Spain*

P1104 | LMI-based Control Design to Enhance Robustness of Synchronous Power Controller [20237]
Ngoc Bao Lai, Andres Tarraso and Pedro Rodriguez, *University Loyola Andalucia, Spain; Universitat Politecnica de Catalunya, Spain*

P1105 | All-Fixed Switching Frequency Control of CRM Boost PFC Converter Based on Variable Inductor in a Wide Input Voltage Range [19133]
Zhen Zhang, Kai Yao, Chunwei Ma, Jienan Chen, Lingge Li, Chanbo Guan and Chengjian Wu, *Nanjing University of Science and Technology, China*

P1106 | Optimized Carrier Disposition Based Discontinuous Pulse-width Modulation Method for three-level NPC Converters [19351]
Meiqi Wang, Lie Xu, Bo Yang, Jing Li, Chunyang Gu, He Zhang, Gerada Chris and Yongdong Li, *University of Nottingham Ningbo China, China; Tsinghua University, China; Xi'an University of Technology, China; University of Nottingham, United Kingdom*

P1107 | FS-MPC Algorithm for Optimized Operation of a Hybrid Active Neutral Point Clamped Converter [19679]
Mateja Novak, Victor Ferreira, Markus Andresen, Tomislav Dragicevic, Frede Blaabjerg and Marco Liserre, *Aalborg University, Denmark; Kiel University, Germany*

P1108 | Virtual DC Generator Control Strategy Based on Differential Compensation [20349]
Na Zhi, YouGuo Ding and Liang Du, *Xi'an University of technology, China; Temple University, United States*

P1109 | Optimal Dual Constant Switching Frequency Control for CRM Buck-Buck/Boost PFC Converter [19136]
Chunwei Ma, Kai Yao, Chengjian Wu, Jienan Chen, Lingge Li, Chanbo Guan and Zhen Zhang, *Nanjing University of Science and Technology, China*

P1110 | An Enhanced Power Decoupling Control for Grid-connected Capacitive-Coupling Inverters [19381]
Wenyang Deng, Ningyi Dai, Lao Keng-Weng and Josep M. Guerrero, *University of Macao, China; University of Macao, Macau; University of Aalborg, Denmark*

P1111 | Carrier-Based MPC For Grid-Tied Interleaved 2L-VSIs with Zero-Sequence Circulation Elimination [19763]
Changpeng Jiang, Zhongyi Quan, Dehong Zhou and Yunwei Li, *University of Alberta, Canada*

P1112 | Improved Voltage Control Scheme for Single-Phase UPS Inverter with Repetitive Current Controller [20451]
Seunghoon Baek, Younghoon Cho and Sijun Yeo, *Konkuk University, Korea (South); Sungshin Electric Co., Ltd, Korea (South)*

P1113 | A Simplified Voltage Balancing Control of a Modular Medium-Frequency Transformer-Based Current Source Converter [19140]
Qiang Wei, David Xu, Bin Wu and Navid R. Zargari, *Lakehead University, Canada; Ryerson University, Canada; Rockwell Automation Canada, Canada*

P1114 | State-Space Control for LCL Filters: Comparison Between the Converter and Grid Current Measurements [19390]
F. M. Mahafugur Rahman, Jarno Kukkola, Ville Pirsto, Mikko Routimo and Marko Hinkkanen, *Aalto University, Finland; ABB Drives, Finland*

P1115 | Low-Frequency Oscillation Suppression in Series Resonant Dual-Active-Bridge Converters under Fault Tolerant Operation [19858]
Yiwei Pan, Yongheng Yang, Jinwei He, Ariya Sangwongwanich and Frede Blaabjerg, *Aalborg University, Denmark; Tianjin University, China*

P1116 | Grid Impedance Identification Using the VSC Switching Ripple [20075]
Diego Perez-Estevez and Jesus Doval-Gandoy, *University of Vigo, Spain*

P1117 | An FPGA-based Switch-mode Power Amplifier using Boundary Control to achieve High System Bandwidth [20452]
Zhuang Zhang, Carl Ngai Man Ho and Wenxun Xiao, *Univerisity of Manitoba, Canada; South China University of Technology, China*

P1118 | Segmented Constant-On-Time Control Method for CRM Buck-Buck/Boost PFC Converter [19196]
Jienan Chen, Kai Yao, Bin Fang, Lingge Li, Chanbo Guan, Chengjian Wu, Zhen Zhang, Chunwei Ma and Huili Zhang, *Nanjing University of Science and Technology, China*

P1119 | Nested-Loop Control for a Bidirectional Cuk-Inverter [19925]
Linda Shelembe and Paul Barendse, *University of Cape Town, South Africa*

P1120 | Optimal Frequency and Critical Soft Switching Control of DC/DC Converter [20150]
Zhou Liwei and Preindl Matthias, *Columbia University, United States*

P1121 | Spatial Repetitive Controller based Harmonic Mitigation Methodology For Wide Varying Base Frequency Range [20528]
Hao Zeng, Christoph van der Broeck, Robert Lorenz and Rik De Doncker, *University of Wisconsin-Madison WEMPEC, United States; RWTH Aachen University ISEA, United States; University of Wisconsin-Madison WEMPEC, Germany; RWTH Aachen University ISEA, Germany*

P1122 | A Novel Model Predictive Current Control Strategy for Non-Isolated Single-Phase Grid-Connected Inverter [19201]
Qi Liu, Jian Yang, Dong ran Song and Guo xun Xiao, *Central South University, China; Changsha Best Electrical Technology Co., Ltd, China*

P1123 | A Novel Dual Phase Shift Modulation for Dual-Active-Bridge Converter [19492]
Song Chi, Peng Liu, Xue Li, Mocheng Xu and Shanhu Li, *Hebei University of Technology, China*

P1124 | Cable Overcurrent Control Strategy of Stand-Alone Brushless Doubly-Fed Power Generation System [19934]
Debin Zhang, Yu Chen, Jingyuan Su and Yong Kang, *Huazhong University of Science and Technology, China*

P1125 | Switching Losses Reduction of Grid-tied Inverters With Variable Switching Frequency Discontinuous PWM [19296]
Hanwei Xu, Lie Xu, Kui Wang, Zedong Zheng and Yongdong Li, *Tsinghua University, China*

P1126 | Predictive Switching Sequence-based Control for Constant Power Load [19601]
Debanjan Chatterjee and Sudip Mazumder, *University of Illinois at Chicago, United States*

P1127 | Thermal Stress Reduction for DC-link Capacitors of Three-phase VSI with Multiple PWM Switching Patterns [19941]
Koroku Nishizawa, Jun-ichi Itoh, Satoru Fujita, Akihiro Odaka, Akio Toba and Hidetoshi Umida, *Nagaoka University of Technology, Japan; Fuji Electric Co., Ltd., Japan*

P1128 | An Optimized SM Fault-Tolerant Control Method for MMC-based HVDC Applications [20235]
Mohammed Alharbi, Semih Isik and Subhashish Bhattacharya, *North Carolina State University, United States*

P1129 | Wear-Out Failure of a Power Electronic Converter Under Inversion and Rectification Modes [19643]
Saeed Peyghami, Davari Pooya, Zhou Dao, Fotuhi-Firuzabad Mahmud and Blaabjerg Frede, *Aalborg University, Denmark; Aalborg Universit, Denmark; Sharif University of Technology, Iran; Aalborg university, Denmark*

P1130 | Control Scheme for LLC Resonant Converter with Improved Performance Under Light Loads and Wide Input-Output Voltage Variation [19857]
Jaspreet Narli, Hossein Dehghani Tafti, Josep Pou, Ghias Farivar, Koh Leong Hai and Nguyen Xuan Bac, *Energy Research Institute at NTU, Singapore; Nanyang Technological University, Singapore*

S37 | Induction and Synchronous Machines

Room Exhibit Hall
Chairs: Ramakrishnan Rajavenkitasubramony, Alireza Fatemi

P1301 | 48V Starter-Generator Induction Machine with Pole Changing Windings [19088]
Srinivas Mallampalli, Zi-Qiang Zhu, Jean-Claude Mipo and Sophie Personnaz, *University of Sheffield, United Kingdom; Valeo, France*

P1302 | A Fault Tolerant Induction Motor Drive [19095]
Fangbo Liu, Barrie Mecrow, Alexander C. Smith, Bernardo Alvarenga and Xu Deng, *Newcastle University, United Kingdom; Manchester University, United Kingdom; Federal University of Goias (UFG), Brazil*

P1303 | Rotor Fault Detection of Squirrel Cage Induction Motor Using Spectrum Analysis of Dynamic Simulation and Experimental Validation [19275]
Ariunbolor Purvee, Enkhbat Tsend-Ayush, Natsagdorj Erdenetsogt and Robert Morelos-Zaragoza, *German Mongolian Institute for Resources & Techn, Mongolia; Mongolian University of Science and Technology, Mongolia; Mongolian National Defense University, Mongolia; San Jose State University, United States*

P1304 | Online Estimation of Rotor Temperature in Induction Motors Based on Parameter Identification [20049]
Haisen Zhao, Hassan Eldeeb, Jinyu Wang, Yang Zhan, Guorui Xu and Osama A. Mohammed, *North China Electric Power University, China; Florida International University, United States*

P1305 | A Study on Efficiency of Magnetic Levitation Trains using Linear Induction Motor by Slip Pattern [20358]
Seo Hyunuk, Lim Jaewon, Park Sang Uk and Mok Hyung Soo, *Konkuk University, Korea, Republic of; KIMM, Korea, Republic of*

P1306 | Real-time Loss Minimizing Control of Induction Machines for Dynamic Load Profiles under Deadbeat-Direct Torque and Flux Control [20509]
Yuying Shi, Robert Lorenz and Bulent Sarlioglu, *University of Wisconsin-Madison, United States*

P1307 | On Shortening the Numerical Transient in Time-Stepping Finite Element Analysis of Induction Motor Under Broken Rotor Bar Faults [19438]
Hossein Nejadi Koti, Hao Chen, Yue Sun and Nabeel A. O. Demerdash, *Marquette University, United States*

P1308 | Induction Machine Efficiency at Variable Frequencies [19904]
Emmanuel Agamloh, Andrea Cavagnino and Silvio Vaschetto, *Baylor University, Waco, Texas, United States; Politecnico di Torino, Italy*

P1309 | Design of a PM-Assisted Synchronous Reluctance Motor Utilizing Additive Manufacturing of Magnetic Materials [19343]
Maged Ibrahim, Fabrice Bernier and Jean-Michel Lamarre, *National Research Council of Canada, Canada*

P1310 | Comparison of two Analytical Methods for Calculating the Maximum Mechanical Stress in the Rotor of High Speed Assisted Synchronous Reluctance Machines [19550]
Iman Kleilat, Khadija El Kadri Benkara, Guy Friedrich, Stephane Vivier, Nazih Moubayed and Rabih Dib, *UTC, France; UL, Lebanon*

P1311 | Stochastic Analysis for Influence of Manufacturing Tolerance of Permanent Magnet on Performance of IPMSM [19888]
Deok-Jae Kwon, Jun-Hyuk Im, Seung-Tae Lee and Jin Hur, *Incheon National Univeristy, Korea (South); Wiseworks, Korea (South)*

P1312 | Online Diagnosis and Severity Estimation of Partial and Uniform Irreversible Demagnetization Fault in Interior Permanent Magnet Synchronous Motor [19922]
Zia Ullah, Seung-Tae Lee, Mudassir Raza Siddiqi and Jin Hur, *Incheon University, Korea, Korea, Republic of*

P1313 | FEA based Separation of Torque Components in Interior Permanent Magnet Machines [20680]
Mohamed Zubair M Jaffar and Iqbal Husain, *North Carolina State University, United States*

P1314 | Modeling of Electromagnetic Torque in Synchronous Reluctance Machines using Inductance Harmonics [20735]
Mazharul Chowdhury, Mohammad Islam and Iqbal Husain, *Halla Mechatronics, United States; North Carolina State University, United States*

P1315 | Scalability of Synchronous Reluctance Machines Considering Thermal Performance [19983]
Yawei Wang, Michele Bonfante, Nicola Bianchi and Roberto Petrella, *University of Padova, Italy; University of Udine, Italy*

P1316 | Synchronous Reluctance Rotor Design Considerations based on Winding Configuration [20546]
Dheeraj Bobba, Gerd Bramerdorfer, Hao Ding, Siegfried Silber and Bulent Sarlioglu, *Univ. of Wisconsin-Madison, United States; Johannes Kepler University Linz, Austria; Linz Center of Mechatronics, Austria*

P1317 | Influence of Rotor Pole Number on Performance of Novel Slot Permanent Magnet Machines with Complementary Rotors [19100]
Qingsong Wang, Martin Ordonez, Junnian Wang, Mohammad Saket and Rouhollah Shafaei, *University of British Columbia, Canada; Jilin University, China*

P1318 | A Novel Dual-Sided PM Machine with Stator Spoke-Type PM Structure [19173]
Ya Li, Hui Yang, Heyun Lin, Wei Liu and Shukang Lyu, *Southeast University, China*

P1319 | Influence of Rotor Damping Structures of Synchronous Generator on Damping Torque Coefficient during Large Disturbance [19475]
Guorui Xu, Jingdi Zhou, Zhiqiang Li, Haisen Zhao, Zhiwei Cao and Jihao Wang, *North China Electric Power University, China; China Electric Power Research Institute, China; Electric Power Research Institute of Shandong Po, China*

P1320 | Evaluation of Slotless Permanent Synchronous Motor with Toroidal Winding [19606]
Ho-Young Lee, Eui-Chun Lee, Gi-Ju Lee and Soon-O Kwon, *Korea Institute of Industrial Technology(KITECH), Korea, Republic of*

P1321 | Wound Field Synchronous Machine with Segmented Rotor Laminations and Die Compressed Field Winding [20028]
Mohamad Salameh, Thomas Spillman, Mahesh Krishnamurthy, Daniel C. Ludois and Ian P. Brown, *Illinois Institute of Technology, United States; University of Wisconsin-Madison, United States*

P1322 | Investigation of Rotor Designs of Variable-Flux Interior Permanent Magnet Synchronous Machines for Traction Applications [20218]
Cong Ma and Tausif Husain, *BorgWarner Inc., United States*

P1323 | Electromagnetic Forces On Coils And Bars Inside The Slot of Hydro-Generator [20281]
Barvir Sanosian, Philippe Wendling, Tan Pham and Willian Akaishi, *Stantec Consulting Services Inc., United States; Altair, United States; Solar Turbines, United States*

P1324 | Analytical Model and Sensitivity Analysis of Tooth-Coil-Winding Permanent Magnet Synchronous Machine with Modular U-Shape Stator [20445]
Carlos Madariaga, Werner Jara, Juan Tapia, Javier Riedemann, Gerd Bramerdorfer, Pablo Castro and Bulent Sarlioglu, *Pontificia Universidad Catolica de Valparaiso, Chile; University of Concepcion, Chile; Johannes Kepler University Linz, Austria; University of Wisconsin-Madison, United States*

P1325 | Extended Field Weakening Range in Slotless/Coreless Permanent Magnet Machines [20676]
Md Sariful Islam, Rajib Mikail and Iqbal Husain, *North Carolina State University, United States; ABB Inc., United States*

P1326 | Sliding Mode Current Control of Mutually Coupled Switched Reluctance Machines using a Three-phase Voltage Source Converter [19594]
Kun Hu, Jin Ye and Javad Mohammadpour Velni, *University of Georgia, United States*

P1327 | A Modest Attempt on the Electromagnetic Design and Performance Prediction of Turbo Wound-Field Flux Switching Synchronous Condensers [20464]
Udochukwu B. Akuru and Maarten J. Kamper, *Stellenbosch University, South Africa*

S38 | Control of Electric Drives

Room Exhibit Hall
Chairs: Luca Zarri, Milijana Odavic

P1501 | Current Ripple Reduction for Dual-Segment Three-phase PMSM with ZCMV PWM Scheme through Neutral Point Separation [19049]
Zewei Shen, Dong Jiang, Zicheng Liu and Dawei Li, *Huazhong University of Science and Technology, China*

P1502 | An Advanced Harmonic Compensation Strategy for Dual Three Phase Permanent Magnet Synchronous Machines Considering Different Angle Displacements [19232]
Jin Xu, Milijana Odavic and Zi-Qiang Zhu, *The University of Sheffield, United Kingdom*

P1503 | A Nonlinear Control of Synchronous Reluctance Motors (SynRM) Based on Feedback Linearization Considering the Self and Cross-Saturation Effects [19410]
Angelo Accetta, Maurizio Cirrincione, Marcello Pucci and Antonino Sferlazza, *INstitute for Marine engineering (INM), Italy; University of the South Pacific, Fiji; University of Palermo, Italy*

P1504 | Torque Ripple Minimization of Four-Phase Switched Reluctance Motor Using Direct Torque Control with an Innovative Switching Sequence Scheme [19490]
Krishna Reddy Pittam, Deepak Ronanki, Parthiban Perumal, Abdul R. Beig and Sheldon S. Williamson, *National Institute of Technology Karnataka, India; University of Ontario Institute of Technology, Canada; Khalifa University, United Arab Emirates*

P1505 | On the Concept of Four Nearest Space Vector Modulation for Multi Source Inverters [20662]
Omid Salari, Hashtrudi Zaad Keyvan, Bakhshai Alireza, Amit Kumar and Praveen Jain, *Queens university, Canada; Queens University, Canada*

P1506 | Power Decoupling Technique for Reducing DC-Link Capacitor of Switched Reluctance Machine Drives [20721]
Md Ehsanul Haque, Anik Chowdhury and Yilmaz Sozer, *University of Akron, United States*

P1507 | Analytic MTPA Solution for Synchronous Reluctance Machine [19911]
Wonhee Lee, Kwanghee Nam and Jaehong Kim, *POSTECH, Korea, Republic of; Chosun University, Korea, Republic of*

P1508 | A Simpler Gopinath-Style Flux Observer without a Constant Speed Assumption for Low and High Sampling-to-Fundamental Frequency Ratios for Induction Machines [20323]
Austin Gaspar, Yang Xu and Robert Lorenz, *University of Wisconsin-Madison, United States*

P1509 | Improved Finite Control Set Model Predictive Control for Permanent Magnet Synchronous Motor Drives with Current Ripple Minimization [20178]
Guanghan Zhao, Shamsuddeen Nalakath and Ali Emadi, *McMaster University, China; McMaster University, Canada*

P1510 | Rotor Position Estimation Error Analysis of Indirect High Frequency Signal Injection Method for Sensorless Starting Control of Aircraft Starter-Generator [19854]
Heng Lu, Jiadan Wei, Hua Xue, Zhuoran Zhang and Xianghao Kong, *Nanjing University of Aeronautics and Astronauti, China*

P1511 | A Novel Virtual Space Vector Modulation Scheme for Three-Level NPC Power Converter with Neutral-Point Voltage Balancing and Common-Mode Voltage Reduction for Electric Starter/Generator System in More-Electric-Aircraft [19355]
Feng Guo, Tao Yang, Serhiy Bozhko and Patrick Wheeler, *The University of Nottingham, United Kingdom*

P1512 | Grid-Connected Induction Motor Using a Floating DC-Link Converter under Unbalanced Voltage Sag [20047]
Maxsuel Ferreira Cunha, Cursino Brandao Jacobina and Nayara Brandao de Freitas, *Federal University of Campina Grande (UFCG), Brazil*

P1513 | Robust Signal Offset Identification for Sensorless Control of Induction Machines at Rated Load using One-Active Modulating Pulse Excitation [19823]
Eduardo Rodriguez Montero, Markus Vogelsberger, Felix Baumgartner and Thomas Wolbank, *Technical University of Vienna, Austria; Bombardier Transportation Austria GmbH, Austria*

P1514 | Dual Converter for Connection of a Doubly-Fed Induction Generator to a DC-Microgrid [19417]
Emerson de Lacerda Soares, Cursino Brandao Jacobina, Victor Felipe Moura Bezerra Melo, Nady Rocha and Edison Roberto Cabral da Silva, *Federal University of Campina Grande, Brazil; Federal University of Paraiba, Brazil*

P1515 | Quantitative Characterization Comparison between Six Step and Field Oriented Control Methods for Permanent Magnet Brushless DC Motors [20397]
Feilang Li, Wenxi Yao and Kevin Lee, *Zhejiang University, China; Eaton Corporation, United States*

P1516 | A Full-Speed Range Hybrid PWM Strategy for High-Speed Permanent Magnet Synchronous Machine Considering Mitigation of Current Harmonics [19214]
Yang Liang, Deliang Liang, Shaofeng Jia, Shuaijun Chu and Jiangbiao He, *Xi'an Jiaotong University, China; University of Kentucky, United States*

P1517 | Comparative Study on Decoupling Synchronous Current Proportional-Plus-Integral Regulator Design in High Speed PMSM Drives [20396]
Xiaolong Zhang, Yuyao Wang, Kiruba Sivasubramaniam Haran and Philip Krein, *University of Illinois at Urbana-Champaign, United States*

S39 | SiC Devices and Applications

Room Exhibit Hall
Chairs: Bilal Akin, David Feng

P1701 | A 400V/300A Ultra-Fast Intelligent DC Solid State Circuit Breaker Using Parallel Connected SiC JFETs [19263]
Wei Wang, Zhikang Shuai, Ying Cheng, Dong He, Xue Yang, Jinyong Lei and Z.John Shen, *Hunan University, China; Electric Power Research Institut, China; Illinois Institute of Technology, United States*

P1702 | Analysis of Antiparallel Diode Connection for Hybrid Si/SiC Based ANPC for PV Applications [20018]
Satish Belkhode, Anshuman Shukla and Suryanarayana Doolla, *IIT Bombay, India*

P1703 | Analytical Switching Model of the 1200V SiC MOSFET in a High-voltage High-frequency Pulsed Power Converter for Plasma Generation [20248]
Qunfang Wu, Mengqi Wang, Weiyang Zhou, Xiaoming Wang and Guanliang Liu, *University of Michigan-Dearborn, ECE Department, United States*

P1704 | Comparison of Traditional and Monolithic JBS Integrated SiC MOSFETs in Si/SiC Hybrid Switch Based Inverter [20101]
Jiajun Yu, Zongjian Li, Zhizhi He, Xi Jiang, Chao Zhang and Jun Wang, *Hunan University, China, China*

P1705 | Current-dependent Variable Switching Strategy for Si/SiC Hybrid Switch-based Single-phase Inverter [19448]
Zeng Liu, Zishun Peng, Xiaogui Peng and Jun Wang, *Hunan University, China*

P1706 | Design and Testing of a Modular Multilevel Converter Submodule Based on 10 kV SiC MOSFETs [19591]
Xingxuan Huang, James Palmer, Shiqi Ji, Li Zhang, Fred Wang, Leon Tolbert and William Giewont, *University of Tennessee, Knoxville, United States; EPC Power, United States*

P1707 | Evaluation and Characterization of Parallel Connected Ultra-Low Inductance 400A SiC MOSFET Modules [19988]
Eddy Aeloiza, Arun Kadavelugu, Rostan Rodrigues, Mika Niemi, Markus Oinonen and Veli-Matti Leppanen, *ABB Inc., United States; ABB Motion, Finland*

P1708 | Experimental Investigation and Verification of States Affecting the Performance of 3C-SiC-on-Si Schottky Barrier Diodes [19669]
Anastasios Arvanitopoulos, Fan Li, Mike Jennings, Samuel Perkins, Konstantinos N. Gyftakis, Marina Antoniou, Phil Mawby and Neophytos Lophitis, *Coventry University, United Kingdom; University of Warwick, United Kingdom; Swansea University, United Kingdom; The University of Edinburgh, United Kingdom*

P1709 | Measurement of Important Circuit Parasitics for Switching Transient Analysis of SiC MOSFET and Schottky Diode Pair [19898]
Shamibrota Kishore Roy and Kaushik Basu, *Indian Institute of Science, India*

P1710 | Medium Voltage (13.8 kV) Transformer-less Grid-Connected DC/AC Converter Design and Demonstration Using 10 kV SiC MOSFET with High Frequency [19230]
Shiqi Ji, Xingxuan Huang, James Palmer, Li Zhang, Fred Wang, Leon Tolbert and William Giewont, *University of Tennessee, Knoxville, United States; EPC Power, United States*

P1711 | Characterization and Modeling of SiC MOSFETs Turn On in a Half Bridge Converter [19075]
Mario Pulvirenti, Luciano Salvo, Giacomo Scelba, Angelo Giuseppe Sciacca, Massimo Nania, Giuseppe Scarcella and Mario Cacciato, *STMicroelectronics, Italy; University of Catania, Italy*

P1712 | Multiple-Step Commutation Scheme for Avoiding High dv/dt in Modular Multilevel Converter with 10 kV SiC MOSFETs [19577]
Li Zhang, Shiqi Ji, Xingxuan Huang, James Everette Palmer, Giewont William, Fred Wang and Leon M Tolbert, *University of Tennessee, United States; EPC Power, United States*

P1713 | Optimal DC-Link RC Snubber Design for SiC MOSFET Applications [19687]
Zheng Chen, Julius Rice, Jianwen Shao and Yuequan Hu, *Wolfspeed, A Cree Company, United States*

P1714 | Performance Comparison of the Auxiliary Resonant Commutated Pole Inverter (ARCP) using SiC MOSFETs or Si IGBTs [19662]
Wenzhi Zhou, Xibo Yuan and Ian Laird, *University of Bristol, United Kingdom*

P1715 | Performance Improvement of Dual Active Bridge DC-DC Converter Using Cost-Effectiveness Si/SiC Hybrid Switch [19616]
Zongjian Li, ZhiZhi He, Jiajun Yu, Xi Jiang and Jun Wang, *Hunan University, China*

P1716 | SiC-hybrid Based Railway Inverter for Metro Application with 3.3kV Low Inductance Power Modules [19509]
Alejandro Rujas, Victor M Lopez, Irma Villar, Txomin Nieva and Ivan Larzabal, *IKERLAN Technology Research Centre, Spain; CAF Power&Automation, Spain*

P1717 | Switching Behavior Method to Estimate the Intrinsic Gate Resistance of a Transistor by Using the Gate Plateau Voltage [19622]
Tatsuya Yanagi and Ken Nakahara, *Rohm Co., Ltd., Japan*

P1718 | Testing and Validation of 10 kV SiC MOSFET Based 35 kVA MMC Phase-leg for Medium Voltage (13.8 kV) Grid [20084]
James Palmer, Shiqi Ji, Xingxuan Huang, Li Zhang, William Giewont, Fred Wang and Leon Tolbert, *University of Tennessee, Knoxville, United State, United States; EPC Power, United States, United States*

S40 | Emerging Design and Applications of Energy Conversion

Room Exhibit Hall
Chairs: Fei Lu, Salman Harasis

P1901 | Miniature High-Voltage DC-DC Power Converters for Space and Micro-Robotic Applications [19074]
Sanghyeon Park, Aaron Goldin and Juan Rivas-Davila, *Stanford University, United States*

P1902 | Consensus Control for CC-CV Charging of Supercapacitors [20453]
Xiaoyong Zhang, Yexin Liao, Heng Li, Yongjie Liu, Rui Zhang, Zhiqiang Meng, Jun Peng and Zhiwu Huang, *Central south university, China; Central South University, China*

P1903 | Aging Condition Assessment for Live XLPE-Type Cables through Precise High Frequency Impedance Phase Detection [20775]
Okan Boler, Yilmaz Sozer, Alex De Abreu Garcia and John Lauletta, *University of Akron, United States*

P1904 | A Cost-effective, Compact, Automatic Testing System for Dynamic Characterization of Power Semiconductor Devices [19959]
Avishek Ghosh, Carl Ngai Man Ho and Jared Prendergast, *University of Manitoba,*

Tuesday, October 1 **10:30AM – 12:10PM**

S57 | Energy Storage Systems

Room Exhibit Hall
Chairs: Adel Nasiri, Ke Ma

P2101 | Residential (Secondary-Use) Energy Storage System with Modular Software and Hardware Power Electronic Interfaces [19359]
Michael Starke, Mahdu Chinthavali, Zeng Rong, Zheng Sheng, Campbell Steven, Smith Mitch and Dean Benjamin, *Oak Ridge National Lab, United States; University of Tennessee, United States*

P2102 | Energy Storage Systems Based on Sodium Metal Halides Batteries [19480]
Mauro Boi, Daniele Battaglia, Andrea Salimbeni and Alfonso Damiano, *Universita degli Studi di Cagliari, Italy*

P2103 | Measuring Individual Battery Dimensional Changes for State-of-Charge Estimation using Strain Gauge Sensors [19571]
Ryan Hickey and Thomas Jahns, *University of Wisconsin - Madison, United States*

P2104 | Direct Comparison of State-of-Charge and State-of- Energy Metrics for Li-Ion Battery Energy Storage [19572]
Ryan Hickey and Thomas Jahns, *University of Wisconsin - Madison, United States*

P2105 | High-Efficiency Silicon Carbide (SiC) Converter Using Paralleled Discrete Devices in Energy Storage Systems [20204]
Zheyu Zhang, Hao Tu, Xu She, Tomas Sadilek, Ramanujam Ramabhadran, Huan Hu and William Earls, *General Electric, United States; North Carolina State University, United States; United Technologies, United States*

P2106 | Battery Loss Modelling Using Equivalent Circuits [20222]
Siwei Liu, Andrew Forsyth and Rebecca Todd, *University of Manchester, United Kingdom*

P2107 | Nonlinear Control Design for Bidirectional Synchronous Buck-Boost Converters used in Residential Battery Storage Systems [20294]
Andres Salazar, Alberto Berzoy and Javad Mohammadpour, *sonnen Inc, United States; University of Georgia, United States*

P2108 | Li-ion Batteries Parameter Estimation Using Converter Excitation and Fusion Methods [20341]
Irene Pelaez, Pablo Garcia, Geber Villa and Sarah Saeed, *University of Oviedo, Spain; University of Oviedo, Egypt*

P2109 | Measurement and Estimation of the Equivalent Circuit Parameters for Multi-MW Battery Systems [20539]
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P2110 | Power Allocation for Energy Stored Quasi-Z-Source Inverter Based on the Power Loss Modelling [20643]
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P2112 | Battery Internal Resistance Estimation Using a Battery Balancing System Based on Switched Capacitors [20718]
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P2113 | Impact of Energy Storage System Response Speed on Enhanced Frequency Response Services [20179]
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P2114 | Evaluation of BESS Management Strategies for Grid Primary and Enhanced Frequency Response [20190]
Yiheng Hu, Xihai Cao, Nigel Schofield and Nan Zhao, *University of Huddersfield, United Kingdom; University College Dublin, Ireland; University of Huddersfield, Ireland; University College Dublin, United Kingdom*

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P2301 | Grid Interfaced PV System Using a Generalized Mixed p-Norm Adaptive Filtering Algorithm [20107]
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P2302 | Enhancing Power System Transient Stability by Virtual Synchronous Generator Control Using Wide-Area Measurements [20217]
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P2303 | Neural Network Based Control Algorithm for Solar PV Interfaced System [19602]
Pavitra Shukl and Bhim Singh, *Indian Institute of Technology Delhi, India*

P2304 | Improvement of Grid Current Quality for Droop-Controlled Grid-Connected Inverters under Distorted Grid Conditions [19890]
Baojin Liu, Jinjun Liu and Zeng Liu, *Xi'an Jiaotong University, China*

P2305 | Synchronization and Current Sharing for Nonlinear-oscillator-based Inverters in Islanded Three-phase Microgrid [19546]
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P2307 | LCL-Filter Design to Suppress Transient Overshoots of Grid-Connected Inverters under Grid Voltage Fluctuations or Faults [20591]
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P2308 | Analysis of the Parallel Operation Between Synchronverters and PLL-Based Converters [19651]
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P2309 | Analysis and Mitigation of Voltage Measurement Errors for Three-Phase Parallel Voltage Source Inverters [19745]
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P2310 | Selective Harmonic Elimination and Balancing of Capacitor Voltage in Hybrid Cascaded Multilevel Inverter Using Model Predictive Control [20069]
Abhinandan Routray, Rajeev Kumar Singh and Ranjit Mahanty, *Indian Institute of Technology (BHU), Varanasi, India*

P2311 | Leakage Current Mitigation in Transformerless Z-Source/Quasi Z-Source PV Inverters: An Overview [19680]
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P2312 | Impedance Characterization of Utility-Scale Renewable Energy and Storage Systems [19701]
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P2313 | A DC Component Suppression Technique Based on Virtual Capacitors [19797]
Bo Long, Wenting Fang and Udaya K. Madawala, *University of Electronic Science and Technology, China; University of Auckland, New Zealand*

P2314 | Influence of the ICFF Decoupling Technique on the Stability of the Current Control Loop of a Grid-Tied VSC [20340]
Leonardo Marin, Rebecca Rye, Tarraso Andres, Candela Jose Ignacion and Rodriguez Pedro, *Polytechnic University of Catalonia, Spain; Virginia Polytechnic Institute and State Univers, United States; Loyola University, Spain*

P2315 | Active Compensator for Multi-Paralleled Grid-Tied Inverters under variable Grid Conditions [19489]
Peng Yuqi, He Yuanbin and Hang Lijun, *Hangzhou Dianzi University, China*

P2316 | Reactive Power Injection and SOGI Based Active Anti-Islanding Protection Method [20224]
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P2317 | A Grid-compatible Virtual Oscillator Controller: Analysis and Design [20419]
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P2502 | Thermal Modeling of a Lithium-Ion Battery Pack in a Plug-in Electric Vehicle [19586]
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P2503 | A Selection Switch Based Cell-to-cell Battery Voltage Equalizer with Reduced Switch Count [19889]
Shimul K Dam and Vinod John, *Indian Institute of Science, India*

P2504 | A Three-Level DC-DC Converter for Battery Impedance Spectroscopy [19998]
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P2505 | Modelling and Simulation of Fuel Cell/Supercapacitor Passive Hybrid Vehicle System [19932]
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P2506 | Online Adaptive SOC Estimation Via information on Linear Regression Model based SOH for Electric-Powered Application [20669]
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Chairs: Arijit Banerjee, Jungwon Choi

P2701 | WBG Partial Power Processing: A New PFC Design with Interleaved MHz- Frequency GaN and Low-Frequency Si Phases [19549]
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P2702 | Reconfigurable Universal Buck-Boost PFC with Ultra Wide Input Voltage Range [20177]
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P2703 | A New AC/DC Half-Bridge/String-Inverter Hybrid-Structured Isolated Bi-directional Converter [20525]
Reza Emamalipour and John Lam, *York University, Canada*

P2704 | Low Frequency Finite Set Model Predictive Control for Seven-Level Modified Packed U-Cell Rectifier [20767]
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P2705 | A Two-phase Three-dimension Common Capacitor LLC Resonant Converter [20071]
Wenhui Mo, Xiumei Yue, Kui Li, Xinyue Chen and Hongliang Wang, *Hunan University, China*

P2706 | A Multimode Bridge-less SiC-Based AC/DC Step-up Converter with a Dual Active Auxiliary Circuit for Wind Energy Conversion Systems with MVDC Grid [20402]
Mehdi Abbasi and John Lam, *York University, Lassonde School of Engineering, Canada*

P2707 | 3-Level Asymmetric Full-Bridge Soft-Switched PWM Converter for 3-Phase Unfolding Based Battery Charger Topology [20602]
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P2708 | Experimental Validation of Single-Stage Three-Phase Non-Isolated Cuk Rectifier [20681]
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P2710 | A Novel Auxiliary Resonant Snubber Inverter Using Wide Bandgap Devices [19496]
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P2711 | Design and Implementation of Parallel Dual-Frequency Single-Phase Grid-Connected Inverter [19629]
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P2712 | An Improved Time-Delay Compensation Scheme for Enhancing Control Performance of Digitally Controlled Grid-Connected Inverter [19641]
Yinglin Jin, Tianzhi Fang and Kai Yao, *Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Science and Technology, China*

P2713 | A High Power Density Three Phase Inverter for Microcars Based on 100V/600A Six-pack MOSFET Module [19794]
Dongmyoung Joo, Yong-Su Noh, Jin-Hong Kim, Joon Sung Park, Byoung-Jo Hyon and Jun-Hyuk Choi, *Intelligent Mechatronics Research Center, Korea, Korea (South)*

P2714 | Single-Phase Cascaded-Transformer Converter with Two DC Links [20036]
Nayara Brandao de Freitas, Cursino Brandao Jacobina and Maxsuel Ferreira Cunha, *Federal University of Campina Grande (UFCG), Brazil*

P2715 | A Modified Lyapunov-based Control Strategy for a Single-Phase VSI with a Load Estimator [20303]
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P2716 | Gain Enhancement of Switched Boost Inverter Using a Novel PWM Scheme [20558]
Anil Gambhir and Santanu Mishra, *IIT Kanpur, India*

P2717 | Implementation and Comparison of Active and Reactive Power Flow Control Methods in a Single Phase Grid-Connected Microgrid [20625]
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P2718 | A Single-Stage Three-Phase Split-Y-Source Inverter [19443]
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P2719 | A Variable Switching Frequency Virtual Space Vector Pulse-Width Modulation Based on the Current Ripple Prediction [19471]
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P2720 | Zero-sequence Component Injection ZVS-PWM for Three-phase Grid Inverter with Arbitrary Power Factor Angle [19703]
Yuying Wu, Ning He and Dehong Xu, *Zhejiang University, China*

P2721 | Reduction of DC-link Ripples for SiC-based Three-phase Four-wire Inverters with Unbalanced Loads [20054]
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P2722 | A Novel Three-Phase H7 Current-Source Inverter with Improved Reliability [20125]
Fazal Akbar and Honnyong Cha, *Kyungpook National University, Korea (South)*

P2723 | Control of a Three-Phase Grid-Tied Inverter Designed for Discontinuous Current Mode Operation [20515]
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P2724 | A Single-Stage Isolated Three-Phase Bidirectional AC/DC Converter for High-Power Applications [19997]
Ling Gu and Kai Peng, *Nanjing University of Science and Technology, China*

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P2902 | High-Frequency Noise Suppression in a Buck-Converter System Based on SiC Devices [19537]
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P2903 | Pulse Width Modulation-Based Common-Mode Noise Source Characterization of Three-Phase Two-Level Split-Source Inverter [19357]
M. S. Hassan and Masahito Shoyama, *Kyushu University, Japan*

P2904 | Current-bias Dependent Permeability of Powder and Amorphous Core Induced Unbalanced DM Impedance and Mixed-mode Noise [19686]
Ren Ren, Bo Liu, Zhou Dong and Fred Wang, *University of Tennessee at Knoxville, United States; United Technologies Research Center, United States*

P2905 | On the Stability of Virtual Inertia Control Implemented by Grid-Connected Power Converters with Delay Effects [19644]
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P2906 | Transient Angle Stability Comparison of Paralleled VSGs system and Hybrid System Comprised by VSG and Diesel Generator [19280]
Huijie Cheng, Ying Cheng, Zhikang Shuai, Chao Shen, Zhiyong Yuan, Ke Zhou and John Shen, *Hunan University, China; China Souther Power Grid, China; Guangxi Power Grid Co., Ltd., China; Illinois Institute of Technology, United States*

P2907 | Re-synchronization Capability Analysis of Virtual Synchronous Generators in Microgrids [20409]
Chao Shen, Ying Cheng, Zhikang Shuai, Jinyong Lei, Ke Zhou, John Shen and Huijie Cheng, *Hunan University, China; China Southern Power Grid, China; Illinois Institute of Technology, United States*

P2908 | Universal Active Power Filter Based on Three Three-Leg Converters and a Single DC-link [20074]
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P2909 | Cascaded Dual Output Multilevel Converter to Enhance Power Delivery and Quality [20739]
Vijesh Jayan and Amer Ghias, *Nanyang Technological University, Singapore*

P2910 | A Single-Objective FCS-MPC Method for Three-Level APF [19291]
Bo Peng and Guorong Zhang, *Hefei University of Technology, China*

P2911 | A New Fault-Tolerant Control Method for CHB Inverter to Increase Maximum Output Voltage [19451]
Saeed Ounie, Mehdi Narimani, Navid Zargari and Zhongyuan Cheng, *McMaster University, Hamilton, ON, Canada, Canada; Rockwell Automation, Cambridge, ON, Canada, Canada*

P2912 | Detecting Method for an Open-Switch Fault of SiC MOSFET and Si IGBT in Hybrid ANPC Inverter System [19886]
Bong-Hyun Kwon, Kyu-Chul Bae, Seok-Min Kim and Kyo-Beum Lee, *LSIS, Korea, Republic of; Ajou University, Korea, Republic of*

P2913 | Model Based Parametric Fault Detection in Power Electronic Circuits [19916]
Kang Yue, Yu Liu, Rong He, Minfan Fu and Haoyu Wang, *ShanghaiTech University, China*

P2914 | Arc Fault Detection in DC Distribution Using Semi-Supervised Ensemble Machine Learning [20078]
Vu Le, Xiu Yao, Chad Miller and Bang-Hung Tsao, *University at Buffalo, United States; Air Force Research Laboratory, United States; University of Dayton Research Institute, United States*

P2915 | A Data-driven RUL Prediction Method Enhanced by Identified Degradation Model for Lithium-ion Battery of EVs [20353]
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P2916 | Online Monitoring Method for a DC-Link Capacitor in an AC/DC/AC Converter [20251]
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P2917 | Junction Temperature Model and Degradation Effect in IGBT Multichip Power Modules [20154]
Fernando Gonzalez-Hernando, Jon San-Sebastian, Asier Garcia-Bediaga, Manuel Arias and Alejandro Rujas, *IKERLAN TECHNOLOGY RESEARCH CENTRE, Spain; Oviedo University, Spain; IKERLAN Technology Research Centre, Spain*

P2918 | A Nonintrusive IGBT Open-Circuit Fault and Current Sensor Fault Diagnosis Method for Grid-Tied Three-phase Three-wire Inverter with Two Current Sensors [19717]
Zhan Li, Pat Wheeler, Alan Watson, Alessandro Costabeber, Zhihong Bai, Xin Zhang, Bohui Zhao and Hao Ma, *Zhejiang University, Nanyang Technological Univ., China; University of Nottingham, United Kingdom; Zhejiang University, China; Nanyang Technological University, Singapore*

P2919 | Fault Detection of Switch Mode Power Converters Based on Radiated EMI Analysis [20756]
Mohammad Arifur Rahman, Elham Pazouki, Yilmaz Sozer and Alex De Abreu, *University of Akron, United States; Rockwell Automation, United States*

P2920 | MOSFET Junction Temperature Measurements using Conducted Electromagnetic Emissions and Support Vector Machines [20455]
Justin Demus, Viktoriia Sysoeva, Qianyi Cheng, Matt Boubin, Ahmed Siraj and Mark Scott, *Miami University, United States*

P2921 | Grid Voltage Estimation and Feedback Linearization based Control of a Three phase Grid Connected Inverter under Unbalanced Grid Conditions with LCL Filter [20182]
Vikram Roy Chowdhury and Jonathan Kimball, *Missouri University of Science and Technology, United States*

P2922 | A New Fault-Tolerant Method for 5-Level Active Neutral Point Clamped Inverter Using Sinusoidal PWM [19486]
Peter Azer, Saeed Ouni and Mehdi Narimani, *ECE Department, McMaster University, Canada*

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P3101 | High Torque Density Fractional-Slot Concentrated-Winding Axial-Flux Permanent-Magnet Machine with Modular SMC Stator [19990]
Weiwei Geng, Zhuoran Zhang and Qiang Li, *Nanjing University of Science and Technology, China; Nanjing University of Aeronautics and Astronauti, China*

P3102 | 2-D Modeling and Experimental Testing of Single Rotor and Dual Stator Axial-Flux Permanent Magnet Machine [20191]
Calvin Corey, Ju Hyung Kim and Bulent Sarlioglu, *DRS Naval Power Systems and U.W. Madison, United States; University of Wisconsin, Madison, United States*

P3103 | Design of a Novel Axial Flux Permanent Magnet Assisted Synchronous Reluctance Motor [20766]
Md Tawhid Bin Tarek and Yilmaz Sozer, *University of Akron, United States*

P3104 | Basic Design of an Ultra-lightweight Machine Based on Magnetic Resonance Coupling and Influence of AC Losses due to High Frequency [19062]
Kazuto Sakai and Kenta Takishima, *Toyo University, Japan*

P3105 | Comparison of Different Capacitor Tuning Criteria in Air-cored Resonant Induction Machines [19238]
Zhao Jin, Matteo F. Iacchetti, Alexander C. Smith, Rajesh P. Deodhar and Keisuike Mishima, *The University of Manchester, United Kingdom; IMRA Europe SAS, United Kingdom; Aisin Seiki Co., Ltd., Japan*

P3106 | Synthesis of an Equivalent pi-model of Two-winding Transformer and Resonance Frequency Estimation Using Lumped Circuit Parameters [20171]
Annoy Kumar Das and Baylon G. Fernandes, *Indian Institute of Technology, Bombay, India, India*

P3107 | A Novel Modular Transverse Flux Linear Permanent Magnet Vernier Machine with Halbach Arrays and Consequent Poles [20372]
Rui Li, Ronghai Qu, Dawei Li, Yuting Gao and Chaojie Shi, *Huazhong University of Science and Technology, China*

P3108 | Analytic Magnetic Field Modelling Approach for Iron-less Tubular Permanent Magnet Linear Synchronous Motors [20444]
Matthew Forbes, William S. P. Robertson, Anthony C. Zander and Johannes J. H. Paulides, *University of Adelaide, Australia; Advanced Electromagnetics Group, Netherlands*

P3109 | Converter-fed Induction Motor Efficiency Measurement Under Variable Frequency/ Load Points: An extension of the IEC/TS 60034-2-3 [19188]
Muhammad Aminu, John Mushenya, Paul Barendse and Mohammed Azeem Khan, *University of Cape Town, South Africa*

P3110 | Electromagnetic and Thermal Behavior of a Triple Redundant 9-phase PMASynRM with Insulation Deterioration Fault [19235]
Yanwen Shi, Jiabin Wang, Rongguang Hu and Bo Wang, *University of Sheffield, United Kingdom; Southeast University, China*

P3111 | Minimization of AC Losses in Permanent Magnet Machines by Transposed Coil Connection [20502]
Liu Jingyi, Fan Xinggang, Li Dawei, Qu Ronghai and Fang Haiyang, *Huazhong University of Science and Technology, China*

P3112 | Spatial MMF Harmonic Mitigation in Aluminum-Cage Induction Motors [19395]
Andrea Cavagnino, Silvio Vaschetto, Luca Ferraris, Zbigniew Gmyrek, Emmanuel Agamloh and Gerd Bramerdorfer, *Politecnico di Torino, Italy; Lodz University of Technology, Poland; Baylor University, Waco, Texas, United States; Johannes Kepler University Linz, Austria*

P3113 | On the Accuracy and Improvement of FE-Based Electric Machine Evaluation Concerning Soft Magnetic Material Modeling [19909]
Gerd Bramerdorfer, Gereon Goldbeck and Martin Kitzberger, *Johannes Kepler University Linz, Austria*

P3114 | Impact of Local Degradation in Soft Magnetic Materials on Performance of Permanent Magnet Synchronous Machines [20175]
Gereon Goldbeck, Gerd Bramerdorfer and Wolfgang Amrhein, *Johannes Kepler University, Austria*

P3115 | On Shortening the Numerical Transient in Time-Stepping Finite Element Analysis of Induction Motors Under Static and Dynamic Eccentricity Faults [19439]
Hossein Nejadi Koti, Hao Chen, Yue Sun and Nabeel A. O. Demerdash, *Marquette University, United States*

P3116 | An Upper Bound of the Torque Production for Round Rotor Wound Field Synchronous Machines and its Electromagnetic Scalability [19753]
Baoyun Ge, *Independent Researcher, United States*

P3117 | Conjugate Heat Transfer and CFD Modeling of Self-ventilated Traction Motors [19880]
Luca Boscaglia, Fabio Bonsanto, Aldo Boglietti, Shafigh Nategh and Claudio Scema, *Politecnico di Torino, Italy; Ansys Inc., Italy; ABB AB, Sweden*

P3118 | Design of a High Bandwidth Open Loop Motor System Considering Electrical and Mechanical Time Constants [19936]
Soo-Hwan Park, Jin-Cheol Park, Ji-Min Kim, Ho-Young Lee, Soon-O Kwon and Myung-Seop Lim, *Hanyang University, Korea, Republic of; Samsung Electronics, Korea, Republic of; Korea Institue of Industrial Technology, Korea, Republic of; Yeungnam University, Korea, Republic of*

P3119 | Automated HF Modelling of Induction Machines Considering the Effects of Aging [20748]
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Vandana Rallabandi, Peng Han, Murat G. Kesgin, Narges Taran and Dan M. Ionel, *GE Research, United States; University of Kentucky, United States*

P3121 | Performance Impacts of Practical Fabrication Tradeoffs for a Radial Flux Coaxial Magnetic Gear with Halbach Arrays and Air Cores [20691]
Matthew C. Gardner, Matthew Johnson and Hamid A. Toliyat, *Texas A&M University, United States; US Army Research Laboratory, United States*

P3122 | Study on AC Resistance of Winding According to Configuration of Strands [19702]
Jun-Woo Chin, Kyoung-Soo Cha, Jin-Cheol Park, Jung-Pyo Hong and Myung-Seop Lim, *Hanyang University, Korea, Republic of; Yeungnam University, Korea, Republic of*

P3123 | Winding Material Effect on High Speed Brushless Permanent Magnet Machines [20708]
Giuseppe Volpe, Mircea Popescu, Ian Foley and James Goss, *Motor Design ltd., United Kingdom; Motor Design Ltd., United Kingdom; Equipmake ltd., United Kingdom*

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P3302 | Reliability Evaluation of DC-link Capacitors in Multi-drive Systems [19424]
Shili Huang, Haoran Wang, Dinesh Kumar, Guorong Zhu and Huai Wang, *Wuhan University of Technology, China; Aalborg University, Denmark; Danfoss Drives A/S, Denmark*

P3303 | Real-time Bond Wire Lift-off Monitoring Via Module Integrated Current Sensors [20208]
Minhao Sheng, Muhammad H. Alvi and Robert D. Lorenz, *University of Wisconsin-Madison, WEMPEC, United States*

P3304 | 3-D Point Magnetic Field Detection for Compact Current Sensing in Three-Phase Busbars and Cables [20202]
Muhammad Alvi, Minhao Sheng, Robert Lorenz and Thomas Jahns, *University of Wisconsin-Madison WEMPEC, United States*

P3305 | Fault-tolerant control of Dual Three-phase PMSM Drives fed by T-type Three-level Inverters [19611]
Xueqing Wang, Zheng Wang, Pengcheng Liu and Ming Cheng, *Southeast University, China*

P3306 | Analytical Method for Extraction of Stray Capacitance in Single-Layer CM Chokes [19081]
Guangdong Dong, Fanghua Zhang, Yan Liu, Wuji Meng and Ce Xu, *Nanjing University of Aeronautics & Astronautic, China*

P3307 | DC Bus Utilization Analysis with Bootstrap Based Power Supply [19757]
Willy Sedano, Peizhong Yi, Brian Brown and Lixiang Wei, *Intern Electrical Engineering, United States; Project Hardware Engineer, United States; SR.Harware Development Engineer, United States; Principal Engineer, United States*

P3308 | Magnetic Model Identification for Synchronous Reluctance Motors Including Transients [20621]
Ludovico Ortombina, Dario Pasqualotto, Fabio Tinazzi and Mauro Zigliotto, *University of Padova, Italy*

P3309 | Back-to-back Starting of Large-capacity Synchronous Condenser with Virtual Synchronous Generator [19129]
Liang Tao, Jianjun Sun, Qian Tao, Yibo Cui and Xiaoming Zha, *Wuhan University, China; Hubei Electric Power Research Institute, China*

P3310 | DC-link Capacitor Reduction in Low Voltage and High Power Integrated Modular Motor Drives [19966]
Andrew Hopkins, Bernhard Hopfensperger and Phil Mellor, *University of Bristol, United Kingdom; OTH Regensburg, Germany*

P3311 | Power Routing to Enhance the Lifetime of Multiphase Drives [19877]
Victor Ferreira, Rodrigo Bastos, Tamires Souza, Marco Liserre and Braz Cardoso, *University of Kiel, Germany; Federal University of Minas Gerais, Brazil*

P3312 | Comparative Analysis of Static Eccentricity Faults of Double Stator Single Rotor Axial Flux Permanent Magnet Motors [20764]
Md Tawhid Tarek, Shuvajit Das and Yilmaz Sozer, *University of Akron, United States*

S64 | Advanced Power Devices, Modules and Gate Drives

Room Exhibit Hall
Chairs: Jun Wang, Ahmed Elasser

P3501 | Turn-off Period Improved Switching Model of SiC Devices with Stray Capacitances and Inductances [19977]
Yue Xie, Yiyang Yan, Shaokang Luan, Cai Chen and Yong Kang, *Huazhong University of Science and Technology, China*

P3502 | Voltage Balancing Control with Active Gate Driver for Series Connected SiC MOSFETs [20420]
Inhwan Lee, Lu Yue and Xiu Yao, *University at Buffalo, United States*

P3503 | A High Power Density Two-Stage GaN-Based Isolated Bi-Directional DC-DC Converter [19919]
Shaokang Luan, Zongheng Wu, Zhiwei Wang, Xinmin Liu, Cai Chen and Yong Kang, *Huazhong University of Science and Technology, China*

P3504 | Paralleling GaN Switches for Low Voltage High Current Half-bridges [19621]
Johannes Burkard and Juergen Biela, *ETH Zurich, Switzerland*

P3505 | Si and GaN Devices in Quasi Resonant Flyback Converters for Wall Charger Applications [19933]
Giovanni Susinni, Giuseppe Mauromicale, Angelo Raciti, Santi Agatino Rizzo, Filadelfo Fusillo, Agatino Palermo, Rosario Scollo and Filippo Scrimizzi, *University of Catania, Italy; STMicroelectronics, Italy*

P3506 | Review and Bandwidth Measurement of Coaxial Shunt Resistors for Wide-Bandgap Devices Dynamic Characterization [20382]
Wen Zhang, Zheyu Zhang and Fred Wang, *University of Tennessee, United States; Clemson University Restoration Institute, United States*

P3507 | Condition Monitoring the Forced Air Cooling System Using the Natural Frequency of Thermal Network [19255]
Jun Zhang, Xiong Du, Rui Du and Pengju Sun, *Chongqing University, China*

P3508 | Investigation of Performance Degradation in Power MOSFET under OFF-State Avalanche Breakdown Test [20233]
Chi Xu, Yang Fei, Bilal Akin and Yogesh Ramadass, *The University of Texas at Dallas, United States; Texas Instruments, United States*

P3509 | Active Switching with SiC MOSFETs [20533]
Patrick Palmer, Jin Zhang and Edward Shelton, *Simon Fraser University, Canada; University of Cambridge, United Kingdom*

P3510 | Design of Drive Parameters Considering Crosstalk Suppression in SiC MOSFETs Application [20472]
Shengsheng Liu, Hua Lin, Tao Wang and Chunhui Liu, *Huazhong University of Science and Technology, China; Arizona State University, United States*

P3511 | High-isolation Low-coupling-capacitance Standalone Gate Drive Power Supply for SiC-Based Medium-voltage Power Electronic Systems [20599]
Srdjan Srdic, Fei Teng and Srdjan Lukic, *North Carolina State University, United States*

P3512 | Load Current and Temperature Dependent Optimization of Active Gate Driving Vectors [20642]
Toru Sai, Koutaro Miyazaki, Hidemine Obara, Tomoyuki Mannen, Keiji Wada, Ichiro Omura, Makoto Takamiya and Takayasu Sakurai, *The University of Tokyo, Japan; Yokohama National University, Japan; Tokyo Metropolitan University, Japan; Kyushu Institute Technology, Japan*

P3513 | A Circuit for Testing dv/dt Immunity of Isolated Drivers and Current Sense Amplifiers [19711]
Tanya Gachovska, Gabriel Scarlatescu and Jerry Hudgins, *Solantro Semiconductors Corp, Canada; University of Nebraska Lincoln, United States*

P3514 | Closed Loop dv/dt Control for Equal Voltage Sharing Between Series Connected SiC MOSFETs [19660]
Vaibhav Pawaskar and Ghanshyamsinh Gohil, *The Univeristy of Texas at Dallas, United States*

P3515 | A Method to Contain the Temperature Rise of a Press Pack Thyristor during a Short Circuit Protection Operation [19849]
Erfan Bashar, Ruizhu Wu, Li Ran, Jose Ortiz Gonzalez, Arne Benjamin Renz, Guy Baker, Mike Jennings, Philip Mawby, Tim Green and Dan Rogers, *University of Warwick, United Kingdom; Swansea University, United Kingdom; Imperial College London, United Kingdom; University of Oxford, United Kingdom*

P3516 | A Method to Minimize Junction Temperature Difference of Dies in Multichip Power Modules [19774]
Cheng Zhao, Laili Wang, Yunfei Xu, Fengtao Yang, Jianpeng Wang, Zhiyuan Qi and Zhizhao Niu, *Xi'an Jiaotong University, China; State Key Laboratory of APTT Beijing 102209, China*

P3517 | Designing Power Modules for Degradation Sensing [19564]
Timothy Polom, Christoph van der Broeck, Rik De Doncker and Robert Lorenz, *University of Wisconin-Madison, United States; RWTH Aachen University, Germany; University of Wisconsin-Madison, United States*

S65 | Wireless Power Transfer 1

Room Exhibit Hall
Chairs: Mohamed Badawy, Shuvajit Das

P3701 | Multi-layer Non-uniform Series Self-resonant Coil for Wireless Power Transfer [19345]
Ruiyang Qin and Daniel Costinett, *The University of Tennessee, United States*

P3702 | A 22 kW-85 kHz Three-phase Wireless Power Transfer System with 12 coils [20189]
Keisuke Kusaka, Rintaro Kusui, Jun-ichi Itoh, Daisuke Sato, Shuichi Obayashi and Masaaki Ishida, *Nagaoka University of Technology, Japan; Nagaoka Motor Development Co., Ltd.,, Japan; Toshiba Corporation, Japan*

P3703 | An Optimal Driving Strategy for Maximum Electro-optical Conversion Efficiency of Laser Diode in Laser Power Transmission System [19131]
Siyu Feng, Ke Jin, Qi Hui and Li Wang, *Nanjing University of Aero. and Astronautics, China*

P3704 | Analyzing Resonant Points of SLLD Circuit to Achieve MPPT for Capacitive-Coupling Wireless Power Transfer [20033]
Yashwanth Bezawada, Fu Ruiyun and Zhang Yucheng, *Old Dominion University, United States; Mercer University, United States*

P3705 | Efficiency Optimization of Series/Series-Parallel IPT System with Load-Independent Output Voltage and Zero Input Phase Angle [19175]
Zhicong Huang, Zhijian Fang, Chi-Seng Lam, Pui-In Mak and Rui Paulo Martins, *University of Macau, Macau; China University of Geosciences (Wuhan), China*

P3706 | A New Bi-directional Wireless EV Charging Controller Tolerant to Large Pad Misalignments [19707]
Yeran Liu, Udaya Madawala, Ruikun Mai and Zhengyou He, *Southwest Jiaotong University, China; University of Auckland, New Zealand*

P3707 | Double-side Phase Shift Control for Impedance Matching in Wireless High Power Transfer [20010]
Yongbin Jiang, Min Wu, Zexian Zeng, Jing Sun, Yonghui Liu, Laili Wang and Yue Wang, *Xi'an Jiaotong University, China*

P3708 | General Analysis of LC Resonance Principles for Inductive Power Transfer Systems [19416]
Yang Chen, Naijian Yang, Qiao Li, Ruimin Dai, Zhengyou He and Ruikun Mai, *Southwest Jiaotong University, China*

Tuesday, October 1 2:00PM – 3:40PM

S66 | Solar Energy Systems

Room Exhibit Hall
Chairs: Ahmed Elasser, Yongheng Yang

P3901 | A Novel Solar Harvesting Wireless Sensor Node with Energy Management System: Design & Implementation [19104]
Jordan Henry, Dhimiter Qendri, Mohamed Youssef and Rudy Lang, *University of Ontario Institute of Technology, Canada*

P3902 | A Study of Partially-Shaded PV Modules with Overlapping Diodes [19119]
Zaid Alqaisi and Yousef Mahmoud, *Student, United States; Professor, United States*

P3903 | A CMOS-Based Energy Harvesting Approach for Laterally-Arrayed Multi-Bandgap Concentrated Photovoltaic Systems [19126]
Haoquan Zhang, Konstantin Martynov, Duanhui Li and David J. Perreault, *Massachusetts Institute of Technology, United States; Analog Devices Inc., United States*

P3904 | Direct Frequency Control Based MPPT Algorithm of LLC Resonant Converter for Photovoltaic System [19154]
Yizhan Zhuang, Fei Liu, Xiangjing Zhang, Xiaoguang Diao, Jianbo Jiang and Jianjun Sun, *Wuhan University, China*

P3905 | Distributed Maximum Power Point Tracking Control under Sudden Partial Shade Using an Isolated Modular Boost Converter for Automotive Application [19165]
Yusuke Zushi, Yoshiyuki Nagai, Tsutomu Tanimoto and Yosuke Tomita, *Nissan Motor Co., Ltd., Japan*

P3906 | Updated Electrochemical Model of Micro Photosynthetic Power Cells [19250]
Tamanwe Payarou, Pragasen Pillay and Muthukumaran Packirisamy, *Concordia University, Canada*

P3907 | Grid Integration of a Three Phase Multifunctional SECS Using Lorentzian Adaptive Filter Based Control with Impulsive Disturbance Rejection Capability [19391]
Syed Bilal Qaiser Naqvi, Shailendra Kumar, Bhim Singh and Yashi Singh, *Indian Institute of Technology Delhi, India*

P3908 | Analysis of solar panel's lumped equivalent circuit parameters using LASSO [19731]
Martin Garaj, Shu-hung Henry Chung, Alan Wai-lun Lo and Huai Wang, *City University of Hong Kong, Hong Kong; Chu Hai College of Higher Education, Hong Kong; Aalborg University, Denmark*

P3909 | An Integrated PV-Battery Soft-switched Power Converter with MPPT and Voltage Regulation [20330]
Sanjida Moury and John Lam, *York University, Canada*

P3910 | Dimension and Mechanical Structure Design of Low-Cost Heliostats in Concentrated Solar Power Plants [20685]
Shen Zhang, Abdulaziz M. Qwbaiban, Jeongmin Huh and Thomas G. Habetler, *Georgia Institute of Technology, United States*

P3911 | Differential Power Processing Architecture with Virtual Port in Series and MPPT in Submodule Level [19335]
Lyuyi Lin, Junming Zhang and Yan Deng, *Zhejiang University, China*

S67 | Power and Energy Management for Smart Grids

Room Exhibit Hall
Chairs: Christina DiMarino, Jin Ye

P4101 | Event-Triggered based Distributed Secondary Control for Islanded AC Microgrids Considering Unreliable Communications [19636]
Meng Xiaoxiao, Zhou Niancheng, Wang Qianggang and Liao Jianquan, *Chongqing University, China*

P4102 | Multi-Agent System-based Distributed Energy Management in Smart Grid Under Uncertainty [19271]
Md Habib Ullah, Anas Alseyat and Jae-Do Park, *University of Colorado Denver, United States*

P4103 | Distributed Event-Driven Power Sharing Control for CCVSI-Based Distributed Generators in AC Islanded Microgrids [19282]
Jingang Lai, Xiaoqing Lu, Antonello Monti and Rik W. De Doncker, *RWTH Aachen University, Germany; Wuhan University, China*

P4104 | Optimal WT, PV and BES based Energy Systems for Standalone Households in South Australia [19512]
Rahmat Khezri, Amin Mahmoudi and Mohammed Haque, *Flinders University, Australia; University of South Australia, Australia*

P4105 | Optimal Capacity of PV and BES for Grid-connected Households in South Australia [19511]
Rahmat Khezri, Amin Mahmoudi and Mohammed Haque, *Flinders University, Australia; University of South Australia, Australia*

P4106 | An Advanced Framework for Electric Vehicles Interaction with Distribution Grids Based on Q-Learning [20527]
Qiyun Dang, Di Wu and Benoit Boulet, *McGill Univesity, Canada*

P4107 | Networked Control and Optimization for Widescale Integration of Power Electronic Devices in Residential Homes [20139]
Michael Starke, Mahdu Chinthavali, Chris Winstead, Zeng Sheng, Teja Kuruganti, Steven Campbell, Rong Zeng, Xue Yaosuo and Chuck Thomas, *Oak Ridge National Lab, United States; Electric Power Research Institute, United States*

P4108 | Generalized Energy Storage Configuration Method Based on Bi-level Optimization for Distribution Power System with High Penetration of Renewable Energy [20465]
Meiqin Mao, Xun Jiang, Yunhui Liu, Liuchen Chang and Yangyang Wang, *Hefei University of Technology, China*

P4109 | Secondary Control for DC Microgrids with Optimal Sparse Feedback [20482]
Jianzhe Liu, Xiaonan Lu and Chen Chen, *Argonne National Laboratory, United States; Temple University, United States*

P4110 | High-Performance Adaptive Control for Inverter-Based Residential Microgrids [19529]
Cheng Wang and Liqun He, *Nanjing University of Science and Technology, China; Soochow University, China*

S68 | Electric Propulsion & Other E-transportation Applications

Room Exhibit Hall
Chairs: Tausif Husain, Mohammad Islam

P4301 | A Stabilization Method of the Current Controller in the Over-modulation Region for NEV Traction Motor [19428]
Sang Min Kim, *Hyundai Mobis, Korea (South)*

P4302 | Performance of a Hybrid Powertrain Employing a Magnetic Power Split Device [19565]
Khoa Dang Hoang, Kais Atallah, Milijana Odavic, Jeff Birchall and Stuart Calverley, *The University of Sheffield, Sheffield, United Kingdom; Magnomatics Limited, Sheffield, United Kingdom*

P4303 | Design of Multi-layer IPMSM using Ferrite PM Considering Mechanical and Electrical Characteristics [19841]
Young-Hoon Jung, Ki-O Kim and Jung-Pyo Hong, *Hanyang University, Korea (South)*

P4304 | A Temperature-Suppression Power Allocation Strategy for Hybrid Energy Management of EVs [19955]
Zhiwu Huang, Yinhui Le, Hongtao Liao, Yanhui Zhou, Yue Wu, Heng Li, Shuo Li, Xianqi Lu and Jun Peng, *Central south university, China; Central South University, China; Changsha University of Science & Technology, China*

P4305 | Suppressing gate voltage oscillation in paralleled SiC MOSFETs for HEV/EV traction inverter application [19071]
Fan Xu and Lihua Chen, *Ford Motor Company, United States*

S69 | AC-AC and Multilevel Power Converters

Room Exhibit Hall
Chairs: Lixiang Wei, Stefano Bifaretti

P4501 | A Novel Space Vector Overmodulation Strategy Based on the Rectifier Stage for Indirect Matrix Converter [19289]
Zhaoyang Jin, Shanhu Li, Wensheng Wang, Xu Liu, Yiping Liu and Bingnan Ji, *Hebei University of Technology, China; Tianjin Power Street Light Management Department, China; Zhengzhou Yutong Bus. CO.,LTD, China*

P4502 | A Predictive-Control-Based Over-Modulation Method for Third-Harmonic Injection Two-Stage Matrix Converter [19554]
Xida Chen, Hui Wang, Yao Sun, Mei Su and Wenjing Xiong, *Central South University, China*

P4503 | A Single-Phase Hybrid Six-Leg AC-DC-AC Multilevel Converter [19655]
Andre Elias Lucena Costa, Cursino Brandao Jacobina and Nady Rocha, *Federal University of Campina Grande, Brazil; Federal University of Paraiba, Brazil*

P4504 | A Single-Phase AC-DC-AC Five-leg Multilevel Converter [19656]
Andre Elias Lucena Costa, Cursino Brandao Jacobina, Nady Rocha and Phelipe Leal Serafim Rodrigues, *Federal University of Campina Grande, Brazil; Federal University of Paraiba, Brazil*

P4505 | Three-Phase Hybrid AC-DC-AC Voltage/Current Source Converter for Wind Energy Conversion Systems [20090]
Nayara Santos, Mauricio Correa, Montie Vitorino and Louelson Costa, *Federal University of Campina Grande, Brazil*

P4506 | Expand Output Voltage Range of AC/AC Converter Using Reversible Indirect Matrix Converter (R-IMC) [20236]
Kodai Okuzono, Sho Tomita and Hitoshi Haga, *Nagaoka University of Technology, Japan*

P4507 | Three-Phase Four-Wire AC-DC-AC Converter With Shared Legs [20576]
Alan Felinto, Cursino Jacobina, Edgard Fabricio and Lacerda Rodrigo, *Federal University of Campina Grande, Brazil; Federal Institute of Paraiba, Brazil*

P4508 | New Two-to-Three-Phase AC-AC Indirect Matrix Converter with Open-end Rectifier Stage [20636]
Andre Ramalho, Montie Vitorino, Mauricio Correa and Edgar Braga-Filho, *Federal University of Campina Grande, Brazil*

P4509 | A Dual Mode 5-Level Inverter with Wide Input Voltage Range [19786]
Yam Siwakoti, Teng Long, Reza Barzegarkhoo and Frede Blaabjerg, *University of Technology Sydney, Australia; University of Cambridge, United Kingdom; Aalborg University, Denmark*

P4510 | Cascaded Multilevel Rectifiers with Reduced Number of Controlled Switches for Open-End Winding PMSM [20059]
Amanda Pereira Monteiro, Cursino Brandao Jacobina, Filipe Antonio Da Costa Bahia and Reuben Palmer Rezende de Sousa, *Federal University of Campina Grande, Brazil*

P4511 | A novel Three Phase Multilevel Inverter Topology with Reduced Device Count for Open End Winding Motor Drives [20221]
Salvatore Foti, Antonio Testa, Giacomo Scelba, Tommaso Scimone, Salvatore De Caro, Luigi Danilo Tornello and Giuseppe Scarcella, *University of Messina, Italy; University of Catania, Italy*

P4512 | Novel Active Nested Neutral-Point Piloted Nine-level Converter [20568]
Ahmed Hussein and Amer Ghias, *Nanyang Technological University, Singapore*

P4513 | Comparison of PIR and MPC Control Schemes to Reduce Circulating Currents in a Modular Multilevel Converter Terminal [20259]
Ana Julieth Marin-Hurtado, Walter Julian Gil-Gonzalez, Andres Escobar-Mejia and Cheng Deng, *Universidad Tecnologica de Pereira, Colombia; Xiangtan University, China*

P4514 | A New DC Fault Blocking Capability Technique for Modular Multilevel Converters [19450]
Iman Aghabali and Mehdi Narimani, *McMaster University, Canada*

P4515 | A New 7-Level Voltage Source Converter for Medium-Voltage Application [19498]
Niloufar Keshmiri and Mehdi Narimani, *McMaster University, Canada*

S70 | Converter Modeling, Control and Design 2

Room Exhibit Hall
Chairs: Meiqin Mao, Raja Ayyanar

P4701 | Multifrequency Impedance Model for Parallel Single-phase Grid-connected Parallel Inverters for Analysis on Circulating Resonant Current [19928]
Miao Liu, Qi Wei, Shaojun Xie, Qiang Qian, Xu Jinming and Zhang Zhao, *Nanjing University of Aeronautics and Astronauti, China*

P4702 | Common Mode Voltage Reduction of Single-Phase Quasi-Z-Source Inverter Based Photovoltaic System [19851]
Yushan Liu, Yaosuo Xue and Hexu Sun, *Beihang University, China; Oak Ridge National Laboratory, United States; Hebei University of Technology, China*

P4703 | Quasi-Two-Level Flying-Capacitor-Converter for Medium Voltage Grid Applications [19993]
Stefan Mersche, Daniel Bernet and Marc Hiller, *Karlsruher Institut fuer Technologie, Germany*

P4704 | Parameter Optimization Based on the Minimum Peak Current Curve for LCC Resonant Converters Operating in DCM [19779]
Zhigang Chen, Jun Liu, Shengwen Fan, Chaonan Tong and Shuo Liu, *University of Science and Technology Beijing, China; North China University of Technology, China*

P4705 | Digital Interleaving Control for Two-Phase TCM GaN Totem-Pole PFC to Reduce Current Distortion [19740]
Qingxuan Ma, Qingyun Huang, Ruiyang Yu, Tianxiang Chen and Alex Huang, *University of Texas at Austin, United States*

P4706 | Average Modeling of Active Neutral Point Clamped Inverter [19866]
Jagath Vallabhai Missula, Ravindranath Adda and Praveen Tripathy, *IIT Guwahati, India*

P4707 | A Lifetime-Aware Control Strategy for Parallel Charging Systems of Energy Storage Light Rail [19944]
Yongjie Liu, Zhiwu Huang, Hongtao Liao, Heng Li, Yue Wu, Yanhui Zhou, Fu Jiang and Jun Peng, *Central south university, China*

P4708 | Auto-tuned Model Parameters in Predictive Control of Power Electronics Converters [20485]
Mitchell Easley, Amin Yousefzadeh Fard, Fariba Fateh, Mohammad B Shadmand and Haitham Abu-Rub, *Kansas State University, United States; Texas A and M University at Qatar, Qatar*

P4709 | Switching Transient Analysis of SiC MOSFET based MMC Motor Drive Systems [20529]
Xiao Li, Yue Zhang, Ziwei Ke, Jianyu Pan, Niu Jia, Risha Na, Longya Xu and Jin Wang, *The Ohio State University, United States*

P4710 | Control Strategies For Parallel Connected IGBT Modules [20241]
Tianqi Zhang, Patrick Palmer, Edward Shelton, Xueqiang Zhang and Teng Long, *University of Cambridge, United Kingdom; Simon Fraser University, Canada*

P4711 | Reachability Analysis of Dual Active Bridge DC - DC Converters [19971]
Heqiang Wang, Zefan Tang, Yan Li and Peng Zhang, *University of Connecticut, United States*

P4712 | Real-time Identification Method for LCL Filters Used With Grid Converters [19393]
Ville Pirsto, Jarno Kukkola, F. M. Mahafugur Rahman and Marko Hinkkanen, *Aalto University, Finland*

P4713 | Impacts of Switched-Diode Capacitor Stages on the Flying Capacitor Multilevel Flyback Converter [19227]
Santino Graziani and Brandon Grainger, *University of Pittsburgh, United States*

P4714 | Interactions of Capacitor Voltage Ripple with the Circulating Current and Output Current Controllers in Low-Capacitance Modular Multilevel Converters [19322]
Sumeet Singh Thakur, Milijana Odavic and Zhu Zi-Qiang, *University of Sheffield, United Kingdom*

P4715 | Modelling of Bidirectional CLLC Resonant Converter Operating under Frequency Modulation [19229]
Lais Farias Martins, David Andrew Stone and Martin Paul Foster, *University of Sheffield, England*

P4716 | A Model Predictive Control Scheme Formulation for Active Rectifiers with LCL Filter [20596]
Joseph Benzaquen, Aswad Adib, Fariba Fateh and Behrooz Mirafzal, *Kansas State University, United States*

P4717 | An Approach to Increase the Bandwidth of Current Controllers for Grid-tied Converters with LCL Filter [19965]
Marcos Assuncao, Luiz Ribeiro, Jose Matos and Francisco Freijedo, *UFMA/Brazil, Brazil; Ecole Polytechnique Federale de Lausanne, Switzerland*

P4718 | Deep Learning Neural Networks for Heat-Flux Health Condition Monitoring Method of Multi-Device Power Electronics System [20122]
Borong Hu, Zedong Hu, Li Ran, Phil Mawby, Chunjiang Jia, Chong Ng and Paul McKeever, *University of Warwick, United Kingdom; Offshore Renewable Energy Catapult, United Kingdom*

P4719 | Leakage Current Mitigation in Current-Source Converter based Transformerless Photovoltaic System using Optimized Space Vector Modulation [20264]
Hang Gao, Shuai Wang, Dewei Xu, Bin Wu and Navid R. Zargari, *Ryerson University, Canada; Rockwell Automation Canada, Canada*

P4720 | Dealing with Sub-optimality in Multistep Model Predictive Control for Transient Operations [20430]
Roky Baidya, Ricardo Aguilera, Pablo Acuna, Petros Karamanakos, Tobias Geyer, Chirstian Rojas Monroy and Dylan Lu, *Chittagong University of Eng & Technology, Bangladesh; University of Technology Sydney, Australia; RMIT University, Australia; Tampere University of Technology, Finland; ABB Corporate Research, Switzerland; Universidad Tecnica Federico Santa Maria, Chile*

S71 | Transportation, Application, NVH and Diagnosis of Electrical Machines

Room Exhibit Hall
Chairs: Pinjia Zhang, Grant Pitel

P4901 | Asymmetrical Design in Electrical Machines [19369]
Xikai Sun, Gennadi Sizov and Mike Melfi, *Rockwell Automation, China; Rockwell Automation, United States*

P4902 | Visualization of Multi-Objective Switched Reluctance Machine Optimization under Multiple Operating Conditions with t-SNE [20579]
Shen Zhang, Shibo Zhang, Sufei Li, Liang Du and Thomas G. Habetler, *Georgia Institute of Technology, United States; Northwestern University, United States; Ansys Inc., United States; Temple University, United States*

P4903 | Partitioned Stator- Flux Switching Machine Utilizing Different Magnet Grades [20689]
Ali Al-Qarni and Ayman EL-Refaie, *Marquette University, United States*

P4904 | MTPA Control Strategy for Six-phase DC-biased Hybrid Excitation Vernier Reluctance Machines [19178]
Zhiyue Yu, Huida Gao, Liang Chang, Wubin Kong, Chun Gan and Ronghai Qu, *Huazhong University of Science and Technology, China*

P4905 | Design and Evaluation of Single-Layer Dual-Stator 6/4 FSPM Machine with Toroidal Winding [20299]
Mingda Liu, William Sixel, Yingjie Li, Jagadeesh Tangudu, Vladimir Blasko and Bulent Sarlioglu, *University of Wisconsin-Madison, United States; United Technology Research Center, United States*

P4906 | CFD Based Design of an Impeller for a Novel Integrated Motor-Compressor System [20757]
Abdul Wahab Bandarkar, Yilmaz Sozer and J. Alex De Abreu-Garcia, *University of Akron, United States*

P4907 | Carrier Electromagnetic Vibration of DC Voltage Difference in Permanent Magnet Synchronous Motor with Distributed Winding [19035]
Takafumi Hara, Toshiyuki Ajima, Katsuhiro Hoshino and Akihiro Ashida, *Hitachi, Ltd., Japan; Hitachi Automotive Systems Ltd., Japan*

P4908 | Lifetime of Machines Undergoing Thermal Cycling Stress [19203]
Antonio Griffo, Igor Tsyokhla and Jiabin Wang, *The University of Sheffield, United Kingdom; Sphere Fluidics, United Kingdom*

P4909 | Comparative Study of Electromagnetic Force Characteristics of Flux Reversal PM Machines with Asymmetrical and Symmetrical Stators [19211]
Wei Liu, Hui Yang, Heyun Lin, Shukang Lyu and Ya Li, *Southeast University, China*

P4910 | A Comprehensive Analysis of the Acoustic Noise in an Interior Permanent Magnet Traction Motor [19233]
Jianbin Liang, Yihui Li, Christopher Mak, Berker Bilgin, Dhafar Al-Ani and Ali Emadi, *McMaster University, Canada*

P4911 | The Influence of Flux-Barriers Distribution on Vibrations in Synchronous Reluctance Machine [19342]
Emanuel Castagnaro and Nicola Bianchi, *University of Padova, Italy*

P4912 | A Novel Monitoring Technique Using Common-mode Voltages for the Transformer Energized by VSCs [19491]
Geye Lu and Pinjia Zhang, *Tsinghua University, China*

P4913 | Misalignment and rotor Fault Severity Indicators Based on the Transient DWT Analysis of Stray Flux Signals [19547]
Pedro A. Pastor-Osorio, Jose Antonino-Daviu and Alfredo Quijano-Lopez, *Universitat Politecnica de Valencia, Spain*

P4914 | Vibration Analysis of Internal Permanent Magnet Synchronous Machines Under Asymmetric Three-Phase Current Condition [19958]
Guo Jiaxiong, Fang Haiyang, Li Dawei, Qu Ronghai, Xu Yunsong, Pei Tonghai and Zhao Yu, *Huazhong University of Science and Technology, China*

P4915 | Rotor UMP & Mechanical Response in HSPMSM in Typical Running Conditions [20041]
Yu-Ling He, Gaurang Vakil, Mahir Al-Ani, Peng Gao, David Gerada and Chris Gerada, *North China Electric Power University, China; University of Nottingham, United Kingdom; Tianjin University, China*

P4916 | Bearing Fault Detection Using Low-Frequency Total Components in phase current [20061]
Jun-Hyuk Im, Jun-Kyu Park and Jin Hur, *Incheon National University, Korea (South); University of Padova, Italy*

P4917 | Flexibility of Remediation Methods for Winding Open Circuit Faults in a Multiphase PM Machine Considering Iron Losses Minimization [20155]
Fan Wu and Ayman EL-Refaie, *Marquette University, United States*

P4918 | Robust Inter-turn Short-circuit Detection in PMSMs with Respect to Current Controller Bandwidth [20200]
Shaopo Huang, Elias G. Strangas, Anmol Aggarwal, Kui Li and Feng Niu, *Hebei University of Technology, China; Michigan State of University, United States*

P4919 | A Multi-sensor Fusion Scheme for Broken Rotor Bar and Air-gap Eccentricity Detection of Induction Machines [20477]
Genyi Luo, Thomas Habetler and Jed Hurwitz, *Georgia Institute of Technology, United States; Analog Devices, United Kingdom*

P4920 | Fault Diagnosis and Isolation of an Electro-Pump using Neural Data Fusion [20592]
Saeid Jorkesh, Javad Poshtan and Majid Poshtan, *IUST, Iran; California Polytechnic State University(Calpoly), United States*

P4921 | Design and Experimental Validation of a Delta Connected 36-Slot 28-Pole Permanent Magnet Machine for Hybrid Traction Applications [19009]
Boris Dotz and Dieter Gerling, *Valeo Siemens eAutomotive Germany GmbH, Germany; Universitaet der Bundeswehr Muenchen, Germany*

P4922 | A Copper Rotor Induction Motor Solution for Electrical Vehicles Traction System [19065]
Mircea Popescu, Nicolas Riviere, Marco Villani, Giuseppe Fabri, Lino Di Leonardo and Giuseppe Volpe, *Motor Design Ltd., United Kingdom; University of Aquila, Italy; Motor Design ltd., United Kingdom*

P4923 | Comparison of Bar-Wound Windings Permanent Magnet Machine with Different Cross-Sectional Shape for Hybrid Electric Vehicle [19152]
Yu Zhao, Dawei Li, Tonghao Pei, Jiaxiong Guo and Ronghai Qu, *Huazhong University of Science & Technology, China*

P4924 | Improvement of Field-Weakening Performance of IPM Machines with Salient Pole Shoe Rotors [19364]
Nan Zhao and Nigel Schofield, *University College Dublin, Ireland; University of Huddersfield, United Kingdom*

P4925 | Electro-Mechanical Challenges in the Design of a High-Speed-High-Power-PMSM Rotor for an Aerospace Application [19423]
Nicola Chiodetto, Barrie Mecrow, Rafal Wrobel and Timothy Lisle, *Newcastle University, United Kingdom; Newcastle Univesity, United Kingdom*

P4926 | Performance comparison of Rare earth and Non-Rare Earth based SPM machines with High Silicon Steel [20174]
Zhentao Stephen Du and Jagadeesh K. Tangudu, *United Technologies Research Center, United States*

P4927 | Modeling, Design and Control of Wound-Field Synchronous Motor for High Energy Efficiency of Electric Vehicle [20188]
Min-Ro Park, Dong-Min Kim, Young-Hoon Jung, Myung-Seop Lim and Jung-Pyo Hong, *Hanyang University, Korea, Republic of; Yeungnam University, Korea, Republic of*

P4928 | Non-Dominated Sorting Genetic Algorithm Based Investigation of Optimal Odd Slot Numbers for Stator Shifted Fractional-Slot Wound PMSMs [20537]
Shruthi Mukundan, Himavarsha Dhulipati, Eshaan Ghosh, Guodong Feng, Jimi Tjong and Narayan Kar, *University of Windsor, Canada*

P4929 | Rotor Configuration Comparison for the Design of a PM Conical Machine [20606]
Sara Roggia, Gaetano Roggia, Francesco Cupertino and Galea Michael, *SAFRAN Tech, France; IDIADA, Spain; Politecnico di Bari, Italy; University of Nottingham, United Kingdom*

P4930 | Design of a Highly Integrated Electric-Hydraulic Machine for Electrifying Off-Highway Vehicles [20760]
Fnu Nishanth, Garrett Bohach, James Van de Ven and Eric Severson, *University of Wisconsin - Madison, United States; University of Minnesota - Twin Cities, United States*

P4931 | Finite Element Simulation based method for Design and Optimization of Flux Switching Motor for EV/HEV Traction Application [20717]
Krishan Kant, Lakshmi Varaha Iyer, James Kirtley and Gerd Schlager, *Massachusetts Institute of Technology, United States; Magna International Inc., United States*

P4932 | Motor Trends: Effects of Era, Age, and Maintenance on Failure Rates [19432]
Andrew Stringer, Christopher Thompson and Carolina Barriga, *U.S. Army Corps of Engineers, United States*

S72 | Integrated Electric Drives and Control

Room Exhibit Hall
Chairs: Fernando Briz, Mahesh Swamy

P5101 | Silicon Carbide JFET Super-Cascodes for Normally-On Current Source Inverter Switches in Medium Voltage Variable Speed Electrostatic Drives [19681]
Peter Killeen, Aditya N. Ghule and Daniel C. Ludois, *University of Wisconsin - Madison, United States*

P5102 | High Temperature Design of a GaN Based Modular Integrated Drive with Natural Cooling Using Metal Clad PCBs [20379]
Yousef Abdullah, Xiao Li, Ke Wang, Jin Wang, Liming Liu and Sandeep Bala, *The Ohio State University, United States; ABB, United States*

P5103 | The Optimal Direct Torque Control Strategy for Open-Winding Permanent Magnet Synchronous Motor in Variable DC Voltage Conditions [19865]
Wenjie Tao, Jiadan Wei, Jianhao Ji, Zhuoran Zhang and Xianghao Kong, *Nanjing University of Aeronautics and Astronauti, China*

P5104 | Analytical Formulation of a Maximum Torque per Ampere (MTPA) Technique for SynRMs Considering the Magnetic Saturation [19213]
Angelo Accetta, Maurizio Cirrincione, Maria Carmela Di Piazza, Giuseppe La Tona, Massimiliano Luna and Marcello Pucci, *INM-CNR, Italy; University of the South Pacific (USP), Fiji*

P5105 | A Generalized Self-Sensing Method for Induction Machines Based on Vector Tracking Using Deadbeat-Direct Torque and Flux Control [20180]
Yang Xu, Chikara Morito and Robert Lorenz, *University of Wisconsin-Madison, United States; Toshiba Mitsubishi-Electric Industrial Sys Corp, Japan*

P5106 | Sliding Mode Speed Estimators for the Induction Motor - a Performance Comparison at Low Speed [19582]
Mihai Comanescu, *Penn State Altoona, United States*

P5107 | A Real-time Sinusoidal Voltage-adjustment Power Supply Based on Wide-band-gap Devices for Linear Power Amplifier [19323]
Xiaofeng Ding and Jiawei Cheng, *Beihang University, China*

P5108 | Comprehensive Analysis of Extended Electro Motive Force Observers for Position Estimation in Interior Permanent Magnet Synchronous Machines [20088]
Abdelrahman Elsman, Fabio Giulii Capponi and Federico Caricchi, *University of Roma "La Sapienza", Italy*

P5109 | SiC Inverter for Electric Vehicles with Improved Trade-off between Reduced Switching Losses and Increased Radiation Noise [19828]
Emori Kenta, Jumpei Niida, Takuya Hara, Akinori Okubo, Keiichiro Numakura and Tetsuya Hayashi, *NISSAN Motor Co., Ltd., Japan; Nissan Motor Co., Ltd., Japan*

P5110 | Design of a SiC-based 5-Level Stacked Multicell Converter for High Speed Motor Drives [20494]
Jianghui Yu, Rolando Burgos, Qiong Wang and Ismail Agirman, *CPES, Virginia Tech, United States; CPES, Virgina Tech, United States; United Technologies Corporation, United States*

P5111 | Adaptive H-Infinity-Based Variable Structure Control for Permanent-Magnet Synchronous Motor-Driven Uncertain Linear Stage via Self-Learning Recurrent Fuzzy-Wavelet-Neural-Network [20355]
Fayez EL-Sousy, Mahmoud Amin and Osama Mohammed, *Prince Sattam bin Abdulaziz University, Saudi Arabia; Manhattan College, United States; Florida International University, United States*

P5112 | Improved Self-Sensing Estimation Accuracy and System Bandwidth via Negative Sequence Image Tracking [20439]
Timothy Slininger, Huthaifa Flieh, Chien Shao-Chuan, Li-Hsing Ku and Robert Lorenz, *WEMPEC - University of Wisconsin - Madison, United States; Motor Drive Solution BU, Delta Electronics, Inc, Taiwan*

P5113 | Model Predictive Speed Control with Dynamic Reference for Electric Drive of Permanent Magnet Synchronous Machine [20081]
Luocheng Wang, Tao Han and Tiefu Zhao, *University of North Carolina at Charlotte, United States*

P5114 | Phase Delay Analysis of Current Sampling in Inverter-Fed Induction Machines [19148]
Lei Jin, Haihui Lu, Zhendong Zhang and Timothy Rowan, *Rockwell Automation, Inc., China; Rockwell Automation, Inc., United States*

S73 | Material, Passive Devices and Packaging

Room Exhibit Hall
Chairs: Fang Luo, Cai Chen

P5301 | Industrial 650V 4-Pack Super-Junction MOSFET Module using Transfer Molding Process [20352]
Jangmuk Lim, Jihwan Seong, Sang Won Yoon, You Suk Kim, Hun-chang Im and Won Sik Hong, *Hanyang University, Korea (South); IA powertron, Korea (South); Korea Electronics Technology Institute(KETI), Korea (South)*

P5302 | Loss Prediction of Medium Voltage Power Modules: Trade-offs between Accuracy and Complexity [19927]
Jannick Kjaer Jorgensen, Nicklas Christensen, Dipen Narendra Dalal, Asger Bjorn Jorgensen, Hongbo Zhao, Stig Munk-Nielsen and Christian Uhrenfeldt, *Aalborg University, Denmark*

P5303 | GaN Module Design Recommendations Based on the Analysis of a Commercial 3-Phase GaN Module [20112]
John Brothers and Troy Beechner, *Mainstream Engineering Corporation, United States*

P5304 | Accurate Characterization and Emulation of Active Bridge Magnetic Efficiencies with Novel Excitation Circuit [19340]
Richard Beddingfield, Subhashish Bhattacharya and Paul Ohodnicki, Jr., *ORISE Fellow, National Energy Technology Lab, United States; North Carolina State University, United States; National Energy Technology Lab, United States*

P5305 | Comparative Analysis of Magnetic Core Loss Measurement Methods with Arbitrary Excitations [19405]
Zhedong Ma, Juntao Yao, Yiming Li and Shuo Wang, *University of Florida, United States*

P5306 | Filter Design for AFE Rectifier using SiC MOSFET [19379]
Xikai Sun and Lixiang Wei, *Rockwell Automation, China; Rockwell Automation, United States*

P5307 | Investigation of Design Methodology of Planar Transformers for EV On Board Chargers [19573]
Zhengda Zhang, Chunhui Liu, Yunpeng Si, Yifu Liu, Qin Lei and Sheng Ai, *Arizona State University, United States; Huanzhong University of Science and Technology, China*

P5308 | Novel PCB Integrated Magnetic Component Design for Reduced AC Power Losses [20540]
Gennadi Sizov, Zoran Vrankovic and Gary Skibinski, *Rockwell Automation, United States*

P5309 | Shielding of Leakage Flux Induced Losses in High Power, Medium Frequency Transformers [19338]
Richard Beddingfield, Subhashish Bhattacharya and Paul Ohodnicki, Jr., *ORISE Fellow, National Energy Technology Lab, United States; North Carolina State University, United States; National Energy Technology Lab, United States*

P5310 | Electrical Insulation Packaging for a 20 kV High Density Wide Bandgap Power Module [20504]
Maryam Mesgarpour Tousi and Mona Ghassemi, *Virginia Tech, United States*

P5311 | 50kW Nano-Crystalline Core Based Three Port Transformer for Triple Active Bridge Converter [20659]
Ritwik Chattopadhyay, Srinivas Gulur, Viju Nair, Subhashish Bhattacharya and Paul R. Ohodnicki, *NC State University, United States; National Energy Technology Laboratory, United States*

P5312 | Lifetime Estimation of DC-Link Electrolytic Capacitor for Smart Transformer LV Side Inverter [19956]
Rongwu Zhu and Marco Liserre, *Kiel University, Germany*

P5313 | A High Power Density Thermal Management Approach Using Multi-PCB Distributed Cooling (MPDC) Structure [20673]
Wenbo Liu, Andrew Yurek, Yang Chen, Bo Sheng, Xiang Zhou and Yan-Fei Liu, *Queen's University, Canada*

P5314 | A Novel Digital Active Gate Driver For High-Power IGBT to Reduce Switching Losses And Stresses [19723]
Yatao Ling, Zhengming Zhao and Yicheng Zhu, *Tsinghua University, Beijing , China, China*

S74 | Wireless Power Transfer 2

Room Exhibit Hall
Chairs: Choi Uimin, Okan Boler

P5501 | Design of a Downscaled Dynamic Wireless EV Charging System for Traffic Intersection Application [20186]
Qingwei Zhu, Yanjie Guo, Lifang Wang and Chenglin Liao, *The University of Manchester, United Kingdom; Institute of Electrical Engineering, China*

P5502 | Induction Application to Aircraft Ice Protection System [20692]
Irma Villar, Ugaitz Iruretagoyena, Ana Cardenas and Francisco Redondo, *IKERLAN, Spain; AIRBUS D&S, Spain*

P5503 | A Novel Self-adaptive Wireless Power Transfer System to Cancel the Reactance of the Series Resonant Tank and Deliver More Power [19367]
Lixin Shi, Pedro Alou, Jesus A. Oliver and Jose A. Cobos, *Universidad Politecnica de Madrid, Spain*

P5504 | Impacts of the Detuning of Compensation Inductances to the Performance of a Double-Sided LC-Compensated CPT System [19420]
Hua Zhang, Chong Zhu and Fei Lu, *Drexel University, United States; Shanghai Jiao Tong University, China*

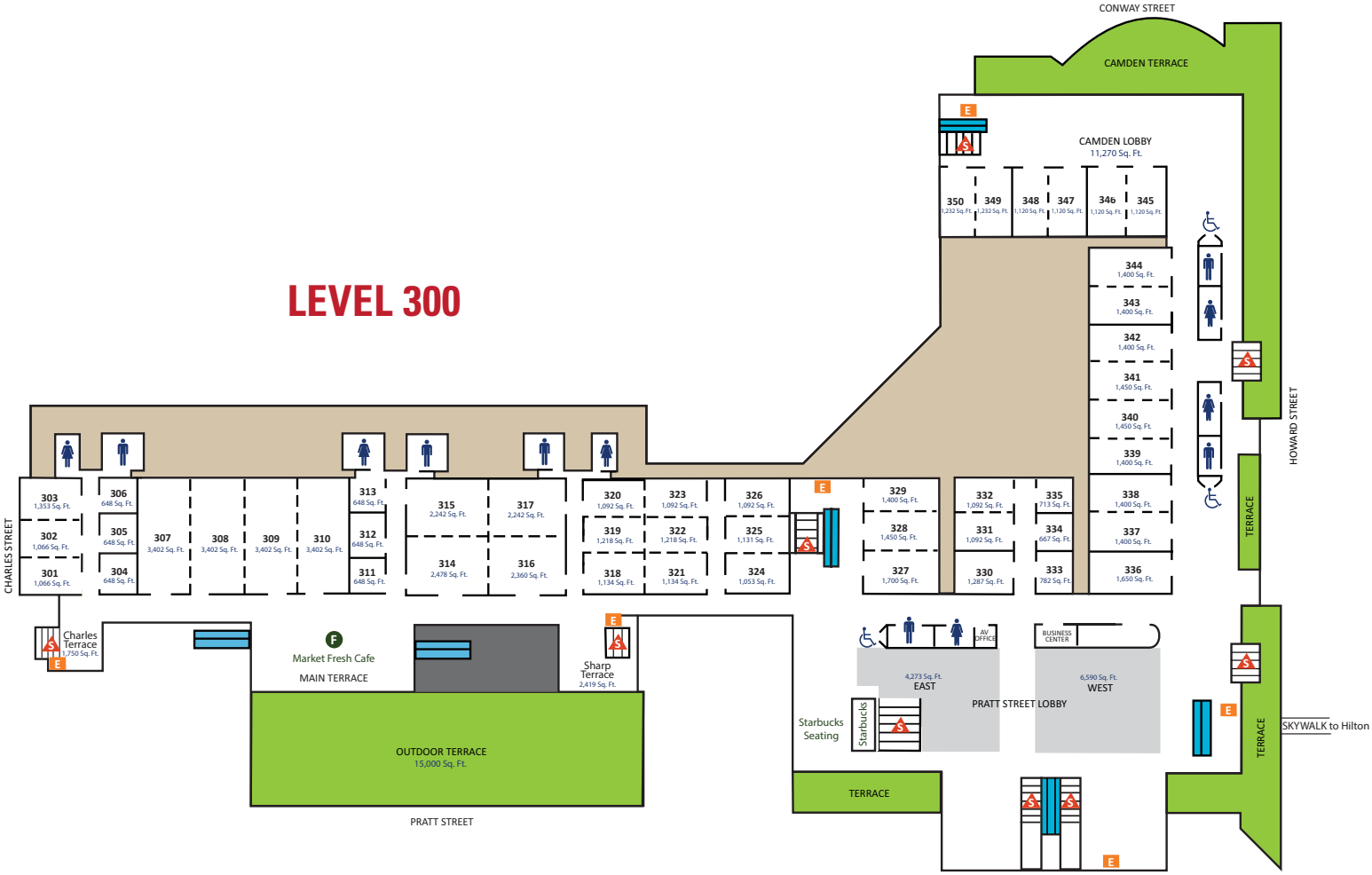
P5505 | Load Estimation of A Series-Series Tuned Wireless Power Transfer System [19818]
Sangmin Lee, Jaehong Lee, Eunchong Noh, Tae-Ik Gil and Seung-Hwan Lee, *University of Seoul, Korea (South)*

P5506 | The High Order Harmonic Distortion Phenomenon in the Strongly Coupled IPT System and Its Reduction Method [19108]
Hua Zhang, Yao Wang, Chong Zhu, Ying Mei, Teng Xu and Fei Lu, *Drexel University, United States; Shanghai Jiao Tong University, China; Zhejiang University, China; LG Electronics, Shanghai, China*

NOTES

CONVENTION CENTER FLOOR PLAN

LEVEL 300



LEVEL 400

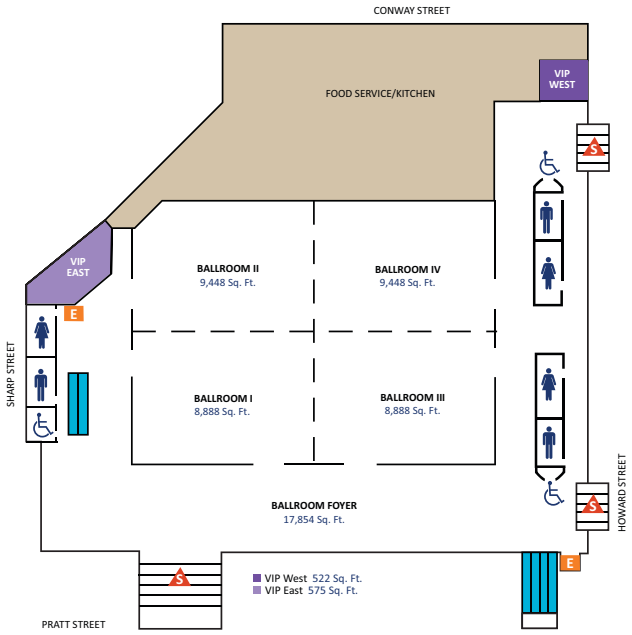
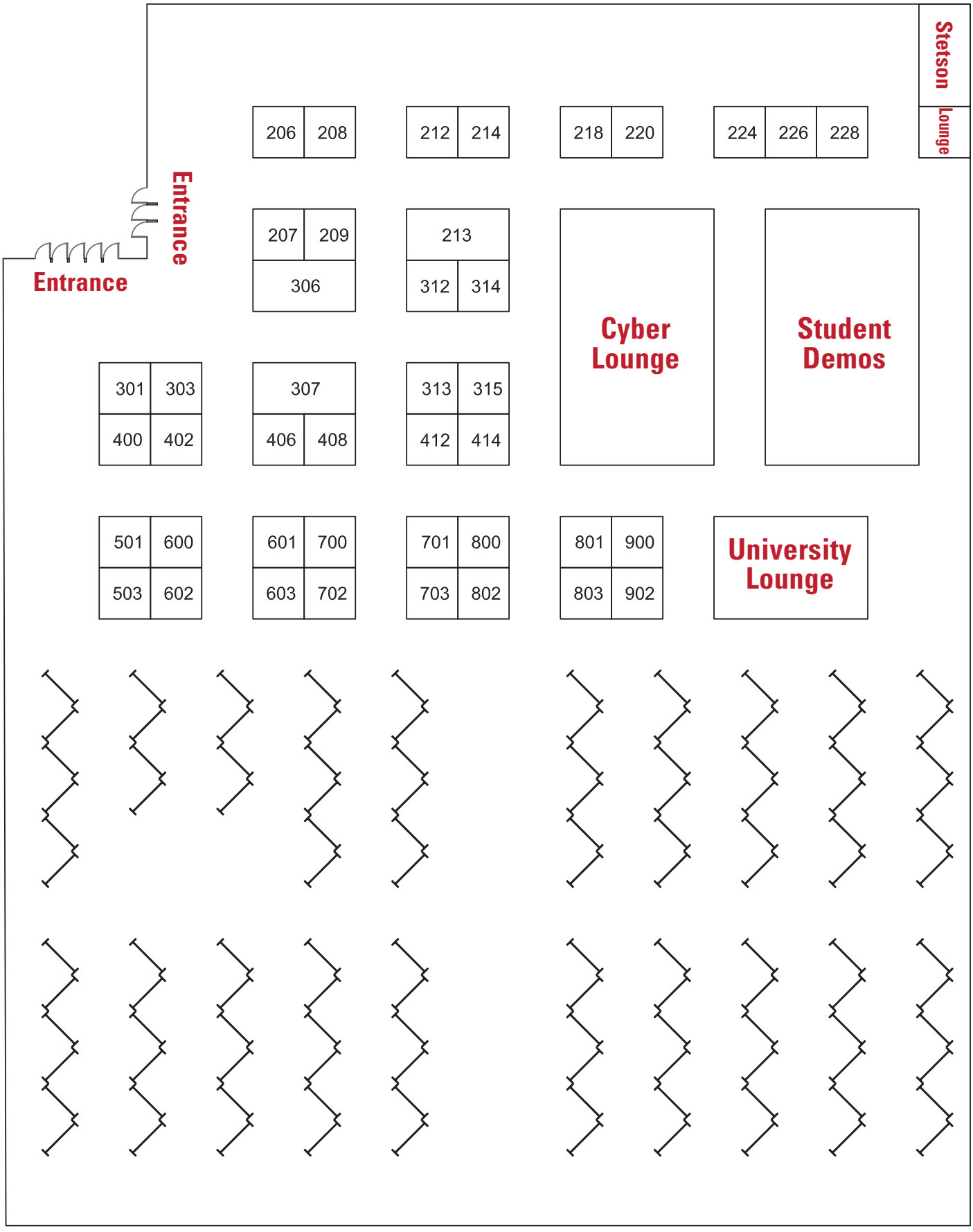


EXHIBIT HALL FLOOR PLAN



PRODUCTS AND SERVICES SESSIONS

These half-hour, industry-driven sessions, provide an in-depth look off the show floor from our exhibitors, showcasing their innovative products and services.

Monday, September 30 | Exhibit Hall 5:00PM – 5:30PM

Accelerate Motor Testing and Development Up To 100X

HBM Test and Measurement

www.hbm.com

Presenter: Krista Tweed, *Applications Engineer*
Email: *Krista.Tweed@HBM.com*

Characterizing electric motors and drives, especially for electric and hybrid vehicles is a very important topic in many engineering labs worldwide. Every lab has unique interests to test and validate products using multiple pieces of measurement equipment from different suppliers. While these systems work, they often have high levels of complexity and operate much slower than an optimized system. This presentation proposes a solution specifically designed for motor and drive testing. The solution consolidates many systems into one, allowing for rapid efficiency motor mapping and custom advanced real-time analysis significantly boosting productivity, capability and research and development results.

Monday, September 30 | Exhibit Hall 5:40PM – 6:10PM

Selecting Your Power Resistor for Best Reliability and Cost

5S Components Inc. P

www.danotherm.com

Presenter: Wim van Dijk, *Sales Engineer Danotherm Electric A/S in Denmark*
Email: *dijk@danotherm.dk*

In power electronics there are many applications were resistors are used. In inverters, for charging and discharging capacitor banks, in filters, as snubbers, in drive systems as brake resistor and in wind turbines as energy dump resistors.

With a dynamic power load we need to observe the resistor as a dynamic component. Energy that is generated in the resistor must be expelled to the outside. The ability to do this lies within the properties of the resistor itself.

From physics we can build a thermal model. Once the thermal model is established, it is easy to do a simulation and find the internal temperatures and check if the resistor is up to the job.

Tuesday, October 1 | Exhibit Hall 11:00AM – 11:30AM

Ultra-Clean Tier 4 Final Diesel PowerBlocks – Reliability through Modularity

Power Secure

www.powersecure.com

Presenter: Kyle Butler, *VP Horizontal Markets*

Email: *kbutler@powersecure.com*

When it comes to microgrids, reliability is key. PowerSecure's modular PowerBlock generation design utilizes modularity to not only increase system reliability, but limit the impact of any component failure. The foundation of the PowerBlock is an ultra-clean, Tier 4 Final diesel engine that is robust and time-tested, and meets federal EPA and most local jurisdiction requirements for air permitting. Diesel is no longer a "dirty" word, and new advances in emissions controls utilized in the PowerBlock are changing the microgrid and backup generation landscapes.

Tuesday, October 1 | Exhibit Hall 11:40AM –12:10PM

Seamless Multiphysics Optimization of Motors

Altair

www.altair.com

Presenter: Dr. Vincent Leconte, *Director of Business Development – EM Solutions*
Email: *vleconte@altair.com*

In the electrification of mobility applications, the design of motors presents many challenges. The designer faces multiple constraints on weight, compactness, cost, efficiency and temperature rise. The efficiency of the motor impacts directly the autonomy of the vehicle. In a race to sustainability, designers need innovative methodologies and fast tools to meet the many requirements of electric mobility. The efficiency must be optimized over the full operation cycles of motors, considering the harmonic rich currents supplied to the motors. Today, such optimization can be achieved using new dedicated and fast analysis tools. Discover the optimization workflow an a full example.

STUDENT DEMONSTRATIONS

Monday, September 30 **4:30PM – 7:00PM**
Tuesday, October 1 **10:30AM – 5:00PM**

Location: Exhibit Hall FG

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.

Development of a 100 kW SiC Switched Tank Converter for Automotive Applications

Demonstrator: Ze Ni, *North Dakota State University*

Quarter-Turn Transformer Design and Optimization for High Power Density 1-MHz LLC Resonant Converter

Demonstrators: Chen Chen, Kai-De Chen, *National Taiwan University of Science and Technology*

A Flying-Inductor Hybrid DC-DC Converter for 1S & 2S Battery Charging Applications

Demonstrator: Casey Hardy, *University of Colorado Boulder*

An Ultra-Efficient Highly-Compact Differential Power Processing (DPP) System for Future HDD Storage Servers

Demonstrator: Ping Wang, *Princeton University*

High-efficient GaN-driven Micro Active Impedance Enhancer for On-grid Multiple-paralleled Inverter System

Demonstrator: Yuqi Peng, *Hangzhou Dianzi University*

A Robotic Spine with Distributed Actuators and Integrated Power Electronics

Demonstrators: Bonhyun Ku, Sunyu Wang, *University of Illinois at Urbana-Champaign*

A 250 kW All Silicon Carbide High Density Traction Inverter for Heavy Equipment Applications

Demonstrator: Yuheng Wu, *University of Arkansas*

3D Printing Assisted Lightweight Low Inductance Power Module Design with Ceramic Baseplates

Demonstrators: Xintong Lyu, Haoyang You, Xingyue Tian, *Ohio State University*

Reliable Ultra Fast Three-step Short Circuit Protection for E-mode GaN HEMTs

Demonstrators: Xintong Lyu, Yousef Abdullah, Ke Wang, *Ohio State University*

Multi-port Power Converter Topology for dc-nano Grid Applications

Demonstrator: Pasan Gunawardena, *University of Moratuwa*

A Low Torque Ripple Mutually Coupled Switched Reluctance Motor Drive

Demonstrator: Siddharth Mehta, *North Carolina State University*

A 'Perch-and-Stare' Drone Using Electrostatic Adhesion

Demonstrator: Sanghyeon Park, *Stanford University*

100 MHz Segmentation and Singleton Inductive Wireless Power Transfer

Demonstrator: Xin Zan, *University of Michigan, Ann Arbor*

Electromagnetic Model-Based Foreign Object Detection for Wireless Power Transfer

Demonstrator: Sung Yul Chu, *University of Michigan, Ann Arbor*

High Temperature GaN Based Integrated Motor Drive With Natural Cooling

Demonstrator: Yousef Abdullah, *Ohio State University*

Three-Port Full-Bridge Converter for Energy Storage Applications

Demonstrator: Sebastián Neira, *Pontificia Universidad Católica de Chile*

High-Efficiency High-Power-Density GaN-Based Single-Phase Online Uninterruptible Power Supply

Demonstrator: Danish Shahzad, *Cornell University*

A High-Power-Density Electrolytic-Free Offline LED Driver Utilizing a Merged Energy Buffer Architecture

Demonstrator: Mausamjeet Khatua, *Cornell University*

A Grid-Tied Inverter with an Extremely Low Inductance Using GaN-HEMT Devices under MHz Switching and Discontinues Current Mode Operation for Compact Power Conversion

Demonstrator: Jiantao Zhang *University of Tsukuba*

A Regulated 48V-to-1V/100A 90.9%-Efficient Hybrid Converter for POL Applications in Data Centers and Telecommunication Systems

Demonstrators: Ratul Das, Casey Hardy, *University of Colorado Boulder*

Dynamic Voltage Scaling for the Light Detection and Ranging (LiDAR) System

Demonstrator: Xiaofan Cui, *University of Michigan, Ann Arbor*

A Novel Simulation-Design Tool For Study and Optimal Design of Resonant Converters Based On Time-Domain Analysis

Demonstrator: Amit Kumar, *Queen's University*

EXHIBITOR LISTING

Alphabetical Listing by Exhibitor Name

University Lounge

Concordia University
Dartmouth College's Power Management Integration Center
EPIC, UNC Charlotte
FREEDM, North Carolina State University
University of Maryland – College Park
Semiconductor Power Electronics Center, University of Texas at Austin
Center for Power Electronics Systems (CPES) - Virginia Tech

Numerical Listing by Booth Number

ECCE 2020

IEEE ENERGY CONVERSION CONGRESS & EXPO DETROIT, MICHIGAN | OCTOBER 11-15

IMPORTANT DATES

January 15, 2020
Digest submission

May 1, 2020
Author notification

June 30, 2020
Final papers with IEEE copyright forms

Call for Papers

IEEE

IAS IEEE INDUSTRY APPLICATIONS SOCIETY Linking Research to Practice

pels IEEE POWER ELECTRONICS SOCIETY Powering a Sustainable Future

General Chair
Yunwei (Ryan) Li
University of Alberta, Canada

ECCE 2020 Technical Program Co-Chairs
Emmanuel Agamloh
Baylor University, USA

Henry Chung
City University of Hong Kong, Hong Kong SAR, China

Navid Zargari
Rockwell Automation, Canada

Martin Ordonez
University of British Columbia, Canada

The Twelfth Annual IEEE Energy Conversion Congress and Exposition (ECCE 2020) will be held in Detroit, Michigan, USA from October 11 to October 15, 2020. ECCE is a pivotal international event on energy conversion. ECCE 2020 will feature both industry-driven and application-oriented technical sessions, as well as expositions. 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, which includes, but is 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

Component, Converter and Subsystem Technologies

- Power electronic devices (Si and wide band-gap) and applications
- Power conversion topologies, modulation and control
- Modeling and control of components, converters and systems
- Rotating/linear electro-mechanical devices, drive systems and topologies
- Passive components and materials
- Power electronic packaging, integration and advanced manufacturing
- Reliability, advanced fault protection systems, diagnostics, prognostics and equipment health management
- EMI and EMC
- Thermal management and advanced cooling technologies

Digests Submission: Prospective authors are requested to submit a digest no longer than five (5) pages, single column, single-spaced, summarizing the proposed paper. The digest should include key equations, figures, tables and references as appropriate, but no author names or affiliations. **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 confidentiality and fair review. Please refer to the conference website for a detailed list of technical topics and the digest submission method.

www.ieee-ecce.org/2020

IEEE ENERGY CONVERSION CONGRESS & EXPO DETROIT, MICHIGAN | OCTOBER 11-15

IMPORTANT DATES

February 17, 2020
Submission of completed Tutorial Proposal Form

March 27, 2020
Notification of acceptance

June 30, 2020
Full Tutorial materials due

Call for Tutorials

IEEE

IAS IEEE INDUSTRY APPLICATIONS SOCIETY Linking Research to Practice

pels IEEE POWER ELECTRONICS SOCIETY Powering a Sustainable Future

General Chair
Yunwei (Ryan) Li
University of Alberta, Canada

Tutorial Co-Chairs
Xinbo Ruan
Nanjing University of Aeronautics and Astronautics, China

Ali Khajehoddin
University of Alberta, Canada

The Twelfth Annual IEEE Energy Conversion Congress and Exposition (ECCE 2020) will be held in Detroit, Michigan, USA from October 11 to October 15, 2020. The conference will bring together practicing engineers, researchers and other professionals for interactive discussions on the latest advances in areas related to energy conversion. ECCE has grown to become the foremost technical conference and exposition for people looking for energy conversion solutions that are timely, practical, customer focused, market sensitive, and cost effective. Engineers from throughout the energy conversion industry's broad spectrum come to ECCE specifically to take advantage of the concentrated brain trust assembled annually in one very special location to do business in a convivial and innovative atmosphere, a perfect blend of state of the art technical prowess and commercial opportunities under one roof.

The ECCE organizing committee invites proposals for half-day tutorials to be presented at ECCE 2020. The organizing committee is particularly interested in tutorials that are of value to the practicing engineer, with an emphasis on solutions to practical problems. Tutorials are solicited on any subject pertaining to the scope of the conference that includes, but is not limited to, the major topics listed below.

Energy Conversion Systems and 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

Component, Converter and Subsystem Technologies

- Power electronic devices (Si and wide band-gap) and applications
- Power conversion topologies, modulation, and control
- Modeling and control of components, converters and systems
- Rotating/linear electro-mechanical devices and drives systems
- Passive components, magnetics and materials
- Power electronic packaging, integration, and advanced manufacturing
- Power supply on chip and power supply in package
- Reliability, diagnostics, prognostics, and health management
- EMI and EMC
- Thermal management, advanced cooling technologies

Tutorials accepted for presentation will receive one conference registration together with an honorarium for $1000. Note that publication of a technical paper at the conference will still require a full paid registration.

Tutorial Proposal Submission Guidelines: Tutorial proposals should be submitted as a digest summarizing the content of the tutorial. Please follow the attached tutorial proposal form as the tutorial submission guideline. Please check ECCE 2020 website for proposal submission details.

www.ieee-ecce.org/2020

Detroit, Michigan, USA – October 11 – October 15 , 2020

IEEE ENERGY CONVERSION CONGRESS & EXPO 2020 DETROIT, MICHIGAN | OCTOBER 11-15

Tutorial Proposal Form

1. Title of Tutorial

2. Abstract

(No more than 500 words. If the tutorial is accepted, this abstract will be published on the conference website, program, and proceedings)

3. Outline of Tutorial

(Outline would only define the topics and the subtopics that would be covered. No detailed descriptions should be included in the proposal)

4. Lead Instructor

(Name, affiliation, and contact information)

Name **Affiliation**

Email **Phone**

5. Other Instructor(s) if applicable

(Name, affiliation, and contact information)

Name **Affiliation**

Email **Phone**

6. Instructor Bios: ~150 Words

(Please provide a brief biography for each instructor, describing the qualifications for presenting the proposed tutorial, including the work and publications that are most relevant to the proposal)

IEEE ENERGY CONVERSION CONGRESS & EXPO DETROIT, MICHIGAN | OCTOBER 11-15

IMPORTANT DATES

March 31, 2020
Proposal submissions deadline

May 1, 2020
Notification of session acceptance

Call for Special Sessions

General Chair
Yunwei (Ryan) Li
University of Alberta, Canada

Special Session Co-Chairs
Bulent Sarlioglu
University of Wisconsin-Madison, USA

Xiongfei Wang
Aalborg University, Denmark

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The ECCE organizing committee invites organizers interested to organize S**pecial Sessions**. Such sessions consist of oral presentations only, without written papers, and are strongly oriented towards the latest industrial interests and new technology trends. The special sessions are gear towards encouraging the latest cross-pollination between the theoretical and the applied in order to encourage collaboration opportunities between industry and academia. Presentations may be of a more commercial nature than those related to the papers in the standard technical session, and the organization of the sessions are more malleable and could be in the form of panel discussions, debates, technical challenges, and contests. Audience participation and open source brainstorming session on topics of interest are not only welcomed but encouraged. Papers presented in special sessions are not subject to peer review and will not be made available in the conference proceedings. Presenters are encouraged to distribute their presentations through the conference mobile app.

Presentations are solicited on any subject pertaining to the scope of the conference described in its Call for Papers. As examples, the following aspects of growing interest and innovation are particularly encouraged for ECCE 2020, but serve only as suggestions for the special session organizers:

- Standard development for power electronics systems /products
- Electrification of transportation systems including Hybrid Electric Vehicles(HEV)/EV, aircrafts, drones, and ships
- Technologies and systems for large, cycle-efficient and cycle-intensive energy storage.
- Power electronic based grid infrastructure: technologies, trend, and grid integration
- Power Supply on Chip (PwrSoC) and related technology
- High Efficiency, flicker free LED light fixtures
- DC transmission, distribution and micro-grids: trend, requirement, and technologies
- Innovative materials for improved components and/or systems in electrical and electromechanical energy conversion
- Components and systems for electrical applications in the oil & gas and mining sectors.
- Reliability, diagnostics and prognostics of components and modular systems.
- Thermal management, advanced cooling technologies
- Advanced technologies for electric machines and power electronics such as materials, 3-D printing, magnets, magnetic devices, capacitors, switching devices

Proposal Submission Guidelines: Special Session organizers are requested to submit a maximum five-page proposal summarizing the proposed Special Session with 4 or 8 presentations. The proposal should contain the session title, session organizer, title of each presentation, presenter for each presentation (with a short biography) and a summary of each presentation. Please check ECCE 2020 website for proposal submission details.

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