FINAL PROGRAM

Live Online

June 21-25

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ITEC2021

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It is with great pleasure that I welcome you to the IEEE Transportation Electrification Conference and Exhibition (ITEC 2021), sponsored by the IEEE Power Electronics Society (PELS), Industry Applications Society (IAS) and Power & Energy Society (PES). ITEC aims to help the industry to electrify transportation systems. The conference focuses on the latest trends in components, subsystems, systems, grid and smart grid interface, smart mobility and energy conversion standards for all types of electrified transportation including electric, hybrid electric, off-road and heavy-duty vehicles, aircraft, ships and rail vehicles.

Due to the lingering effects of COVID-19, the ITEC 2021 Organizing Committee has decided to hold the conference virtually. This presented numerous challenges and opportunities, and the organizing committee has worked hard to build a tremendous conference under these constraints. I express my sincere gratitude for their commitment and countless hours in addressing every aspect of the conference. I would also like to express my gratitude to the PELS, IAS, and PES for their continued support. Last, but not least, I would like to thank RNA Associates who have helped support the conference from its inception and have played a major role in the continued success of the conference.

This year we have invited six world-class keynotes to share their perspective on current state and future trends in transportation electrification. There are 10 short courses and tutorials offered by internationally renowned experts, covering important aspects of component and drivetrain design, new materials, and emerging electric transportation applications in rail and aerospace. I would also like to call your attention to 8 industry panels covering a wide array of topics including trends in aircraft, commercial and off road vehicle electrification, power electronics and battery management challenges, transportation electrification policy, EV motor design trends, and virtual prototyping. The program also includes over 200 presentations of high quality technical papers.

The virtual format allowed the Organizing Committee to spread out the conference proceedings over 5 days to allow more opportunities for formal and informal interactions. In particular, the on-line platform allows for on-demand viewing with the ability to pose questions to the speakers prior to the live presentation. We are hopeful that the attendees will make use of this feature to make the most of their experience.

I hope your experience with virtual ITEC 2021 will be remarkable. I would like to thank all of your for making ITEC a continued success and for supporting the conference through these challenging times. I look forward to seeing all of you in person at ITEC 2022.

Once again, welcome to ITEC 2021!

Srdjan Lukic
ITEC 2021 General Chair

ITEC2021 ORGANIZING COMMITTEE

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Hossein Ghassempouraghamolki, Eaton

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Said Al-Hallaj, All Cell Technologies
Pavel Dutov, LG Chem

Women in Engineering (WIE) Chairs:
Bahareh Anvari, ABB Corporate Research Center
Jennifer Bauman, McMaster University

ITEC2021 ORGANIZING COMMITTEE

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Yiqi Liu, John Deere
Catherine Jones, University of Strathclyde
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Zedong Zheng, Tsinghua University
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Siddharth Ballal, BorgWarner
Di Zhu, Ford
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Vahid R. Disfani, University of Tennessee
Ji Li, University of Birminghan
Tao Yang, University of Nottingham
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Goran Mandic, ABB
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Ahmed Mohamed, City University of New York
Weimin Zhang, Apple
Akshay Rathore, Concordia University
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He Li, Telsa

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Ryan Ahmed, General Motors
Mohamad Berri, Ford Motor Company
Lihua Chen, Ford
David Cottini, Powersys-JMAG
Michael Degner, Ford Motor Company
Suresh Gopalakrishnan, General Motors
Oliver Gross, Stellantis N.V.
Paul Larsen, ANSYS
Konstantinos Laskaris, Tesla Motors
Tracy Moon, Tridus Magnetics and Assemblies
Joe Palazzolo, GKN Driveline
Jon Poponea, Robert Bosch LLC
Kumar Rajasekhara, Marsilli
Jason T. Schug, Ricardo Strategic Consulting
Miaosen Shen, NIO
Nachiket Vader, Rivian Automotive, LLC
Sanjaka Wirasingha, Valeo
Bin Wu, Mercedes-Benz R&D
Hong Yang, Uber Advanced Technologies Group
Weimin Zhang, SF Motors

Aerospace Industry Liaison Chairs:

Yue Cao, Oregon State University
Jiangbiao He, University of Kentucky
Lijun He, GE Global Research
Kamiar Karimi, The Boeing Company
Sayeed Mir, Eaton Aerospace
Waleed Said, Zunum Aero
Bulent Sarlioglu, WEMPEC, University of Wisconsin-Madison

Program At A Glance

Monday

8:00-9:30 AM	10:00-11:30 AM	1:00-2:30 PM	3:00-4:30 PM
PANEL 1	PANEL 2	PANEL 3	PANEL 4
TUTORIAL 1	TUTORIAL 2	TUTORIAL 3	TUTORIAL 4

8:00-11:00 AM	1:00-4:00 PM
SHORT COURSE 1	SHORT COURSE 2

Tuesday

8:00-9:30 AM	10:00-11:30 AM	11:30-1:00 PM	1:00-2:30 PM	3:00-4:30 PM
PANEL 5	PANEL 6	INDUSTRY SESSION 1	PANEL 7	PANEL 8
TUTORIAL 5	TUTORIAL 6		INDUSTRY SESSION 2	INDUSTRY SESSION 3

Wednesday

8:00-11:00 AM	1:00-4:00 PM
SHORT COURSE 3	SHORT COURSE 5
SHORT COURSE 4	

Thursday

8:30AM-12:00 PM	1:00PM-3:00 PM	3:30PM-5:30 PM
PLENARY SESSION 1	TECHNICAL SESSION 1	TECHNICAL SESSION 5
12:00-1:00 PM	TECHNICAL SESSION 2	TECHNICAL SESSION 6
WIE PRESENTATION	TECHNICAL SESSION 3	TECHNICAL SESSION 7
	TECHNICAL SESSION 4	TECHNICAL SESSION 8
	INDUSTRY SESSION 4	

8:30AM-12:00 PM	1:00PM-3:00 PM	3:30PM-5:30 PM
PLENARY SESSION 2	TECHNICAL SESSION 9	TECHNICAL SESSION 13
	TECHNICAL SESSION 10	TECHNICAL SESSION 14
	TECHNICAL SESSION 11	TECHNICAL SESSION 15
	TECHNICAL SESSION 12	TECHNICAL SESSION 16

Friday

8:00 - 10:00 AM	10:30AM-12:30 PM	1:30-3:30 PM	3:30-5:30 PM
TECHNICAL SESSION 17	TECHNICAL SESSION 21	TECHNICAL SESSION 25	TECHNICAL SESSION 29
TECHNICAL SESSION 18	TECHNICAL SESSION 22	TECHNICAL SESSION 26	TECHNICAL SESSION 30
TECHNICAL SESSION 19	TECHNICAL SESSION 23	TECHNICAL SESSION 27	TECHNICAL SESSION 31
TECHNICAL SESSION 20	TECHNICAL SESSION 24	TECHNICAL SESSION 28	TECHNICAL SESSION 32

ITEC2021 Agenda

Note: All Tutorials and Short Courses will be available for preview starting June 14

Monday: June 21

- **8:00 AM Tutorial 1**
  Stray Current in Rail Transit: History, Challenges and Opportunities
- **8:00 AM Panel 1**
  Emerging technologies for aircraft electrification
- **8:00 AM Short Course 1**
  Electric Powertrain: Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles
- **10:00 AM Tutorial 2**
  Calibrating Optimal IPMSM Torque Control with Flux-Weakening Using Model-Based Calibration
- **10:00 AM Panel 2**
  Power Electronics in Electrified Automotive Applications
- **1:00 PM Tutorial 3**
  Power Electronics Packaging for Transportation Applications
- **1:00 PM Short Course 2**
  Challenges and Solutions of WBG based Power Electronics for Vehicle Electrification
- **1:00 PM Panel 3**
  Commercial Vehicle Electrification
- **1:00 PM Tutorial 4**
  EMC Designs and Considerations for Electric Vehicles (EVs)
- **3:00 PM Panel 4**
  Battery Management Challenges in Transportation Electrification

Tuesday: June 22

- **8:00 AM Tutorial 5**
  How to Be Mobile with GaN Power Technology
- **8:00 AM Short Course 3**
  Wireless Power Transfer
- **8:00 AM Short Course 4**
  Aircraft Transportation Electrification Eco-System and Technologies
- **8:00 AM Panel 5**
  Transportaton Electrification: Policy, Infrastructure and Grid Impacts
- **10:00 AM Tutorial 6**
  Battery Chargers, Highly Efficient and Compact Converters, Multi-objective Optimizations
- **10:00 AM Panel 6**
  EV Motor Designs

iTEC2021 Agenda

Note: All Tutorials and Short Courses will be available for preview starting June 14

Tuesday: June 22 - Continued...

- **11:30 AM Industry Session - Mathworks**
  High-Fidelity Motor Modeling for HIL with FPGAs
  Fuel Cell Virtual Vehicle Models for Fuel Economy, Performance, and Thermal Analysis
- **1:00 PM Panel 7**
  Virtual Prototyping and Virtual Design
- **1:00 PM Short Course 5**
  e-NVH of Electric Traction Motors: Focus on Physics of Noise and Vibration Due to Magnetic Forces
- **1:00 PM Industry Session - GMW Associates**
  Coreless Current Sensors for Test Stand and In-Vehicle Current Monitoring
  Current Measurement for Electric Vehicle Charger Test
- **3:00 PM Panel 8**
  Extreme Fast Charging
- **3:00 PM Industry Session - AVL**
  Simulation-based Approach to Battery Development
- **3:45 PM Industry Session - Marsilli**
  - Marsilli Distributed High Density Winding Technology for Electric Motors: Our "Out of the Box" Solution Beyond the Current Technologies

ITEC2021 Agenda

Note: All Tutorials and Short Courses will be available for preview starting June 14

Wednesday : June 23

Plenary Session 1

- **8:30 AM** **Welcome & Awards**
  Welcome Message from ITEC 2021 General Chair
  IEEE and TC4 Awards
- **9:00 AM** **Keynote Speaker 1**
  Martin Bush, John Deere
- **9:30 AM** **Keynote Speaker 2**
  Dimitrios C. Papageorgopoulos, U.S. Department of Energy
- **10:00 AM** **Keynote 1&2 Q&A**
  Live Q&A for Keynotes #1 & #2
- **10:30 AM** **Keynote 3**
  Zilai Zhao, Navistar
- **11:00 AM** **Keynote 4**
  Ken Morris, General Motors
- **11:30 AM** **Keynote 3&4 Q&A**
  Live Q&A for Keynotes #3 & #4
- **12:00 PM** **Women in Engineering Presentation**
  "Continent Hopping"
- **1:00 PM** **Technical Session 1**
  Fast Charging System Test, Design, and Analysis
- **1:00 PM** **Technical Session 2**
  Battery Thermal Performance, Estimation, and Control
- **1:00 PM** **Technical Session 3**
  Electric Machine Noise, Fatigue, and Failure Modeling
- **1:00 PM** **Technical Session 4**
  Electric Aircraft Propulsion System Design and Analysis
- **1:00 PM** **Industry Session - HBK: Measurement of Torque Ripple in Electric Machines**
- **1:45 PM** **Industry Session - Plexim: Model-based design of cascaded speed and current controls for a 6-phase PMSM**
- **3:30 PM** **Technical Session 5**
  Dynamic Wireless Charging and Propulsion
- **3:30 PM** **Technical Session 6**
  Fuel Cell Vehicle Modeling and Energy Management Strategies
- **3:30 PM** **Technical Session 7**
  Electric Machine Design I
- **3:30 PM** **Technical Session 8**
  EV Control Considering Efficiency, Traffic, and Other Factors

ITEC2021 Agenda

Note: All Tutorials and Short Courses will be available for preview starting June 14

Thursday : June 24

Plenary Session 2

- **8:30 AM Awards**
  ITEC 2022 Presentation and TTE Paper Awards & ITEC Best Papers
- **9:00 AM Keynote Speaker 5**
  Dwarka Simili, BorgWarner
- **9:30 AM Keynote Speaker 6**
  Tara Vatcher, Stellantis
- **10:00 AM Keynotes 5&6 Q&A**
  Live Q&A for Keynotes #5 & #6
- **10:30 AM Keynote Speaker 7**
  Armen Baronian, Eaton Aerospace
- **11:00 AM Keynote Speaker 8**
  Florent Nierlich, Safran
- **11:30 AM Keynotes 7&8 Q&A**
  Live Q&A for Keynote #7 & #8
- **1:00 PM Technical Session 9**
  Resonant Converters and Current Source Inverters
- **1:00 PM Technical Session 10**
  Microgrid Control and Design
- **1:00 PM Technical Session 11**
  Electric Machine Design II
- **1:00 PM Technical Session 12**
  Motor Control I
- **3:30 PM Technical Session 13**
  Wireless and Onboard Battery Charger Design and Control
- **3:30 PM Technical Session 14**
  Fuel Cell Vehicle Power Electronics
- **3:30 PM Technical Session 15**
  Rare Earth Free Electric Machines
- **3:30 PM Technical Session 16**
  Motor Control II

ITEC2021 Agenda

Note: All Tutorials and Short Courses will be available for preview starting June 14

Friday : June 25

- **8:00 AM Technical Session 17**
  Wireless and Onboard Battery Charging System Design
- **8:00 AM Technical Session 18**
  Battery Management and State of Charge Estimation
- **8:00 AM Technical Session 19**
  Thermal Management of Power Electronics
- **8:00 AM Technical Session 20**
  Ship and Marine Power Systems
- **10:30 AM Technical Session 21**
  Charging Infrastructure Design Considerations
- **10:30 AM Technical Session 22**
  EV Charging Systems Supplemented with PV, Batteries, and Electrolyzers
- **10:30 AM Technical Session 23**
  Inverter Design and Analysis
- **10:30 AM Technical Session 24**
  Electric Aircraft Power Electronic Topologies and Control
- **1:30 PM Technical Session 25**
  Charging Impact on Power Distribution Systems and Microgrids
- **1:30 PM Technical Session 26**
  Battery Aging, State of Health, and Hybrid Energy Storage
- **1:30 PM Technical Session 27**
  Power Electronics for Vehicle Chargers I
- **1:30 PM Technical Session 28**
  Hybrid Electric Vehicle Energy Management
- **3:30 PM Technical Session 29**
  Coordination of EV Charging
- **3:30 PM Technical Session 30**
  Battery Modeling and Analysis
- **3:30 PM Technical Session 31**
  Power Electronics for Vehicle Chargers II
- **3:30 PM Technical Session 32**
  Bus, Truck, and Rail Electrification

KEYNOTES

BIO

MARTIN BUSH

Engineering Manager, Electrification | John Deere Intelligent Solutions Group

PLENARY SESSION 1: JUNE 23 - 8:30 AM-12:00 PM EDT

As the Engineering Manager of the John Deere Intelligent Solutions Electrification Group, he is responsible for executing the Deere Enterprise Electrification Strategy which involves delivering the key components for electrification sub-systems and integrating them into Deere products to deliver increased value to the customer. In his 25 years with John Deere, he has held various leadership positions related to engine, powertrain, and electrical system design with the past 6 years focused on electrification and electric drive systems. Over his tenure, he also served on the Enterprise Engineering Council and the Electrical Engineering Council for Deere. He holds a Mechanical Engineering degree and an MBA from the University of Illinois in Champaign-Urbana.

DIMITRIOS C. PAPAGEORGOPOULOS

Program Manager for Fuel Cell Technologies | U.S. Department of Energy Hydrogen and Fuel Cell Technologies Office

PLENARY SESSION 1: JUNE 23 - 8:30 AM-12:00 PM EDT

Dimitrios Papageorgopoulos is the Program Manager for Fuel Cell Technologies in the U.S. Department of Energy's (DOE's) Hydrogen and Fuel Cell Technologies Office, where he oversees efforts focused on the development of fuel cells for transportation, stationary and cross-cutting applications. He has more than 20 years of combined experience in research, technology development and management in areas related to surface science, catalysis, and hydrogen and fuel cell technologies. Prior to joining DOE in 2009, Dimitrios was Head of Catalyst Development at CMR Fuel Cells. Previous positions include those at the Energy Research Centre of the Netherlands (ECN), the FOM Institute for Atomic and Molecular Physics (AMOLF) Amsterdam, and at the Ecole Polytechnique Fédérale de Lausanne (EPFL). Dimitrios is a graduate of the Federal Executive Institute's Leadership for a Democratic Society Program. He received his PhD in Natural Sciences (Chemistry), as a Marie Curie fellow, at the University of Cambridge.

BIO

KEYNOTES

ZILAI ZHAO

Director of eMobility Engineering | Navistar, Inc

PLENARY SESSION 1: JUNE 23 - 8:30 AM-12:00 PM EDT

Mr. Zilai Zhao, Director of eMobility Engineering at Navistar Inc., is a 20+ years veteran in automotive electrification. Having held leadership roles in various automotive companies, Mr. Zhao, together with his teams, developed a broad range of eMobility products, from power semiconductors to electric propulsion systems to complete battery electric vehicles. His current focus is to develop EV systems, HV components and energy storages for Class 6 to Class 8 International Trucks and IC School Bus.

KEN MORRIS

Vice President Electric and Autonomous Vehicles | General Motors

PLENARY SESSION 1: JUNE 23 - 8:30 AM-12:00 PM EDT

Ken Morris was named General Motors Vice President of Autonomous and Electric Vehicle Programs in November 2019. In this role, Morris leads the global team of Executive Chief Engineers and Program Managers who oversee GM Autonomous and Electric Vehicle, Electric Drive, Battery, and Fuel Cell programs from inception to launch and beyond. Ken is also responsible for the initiatives associated with the commercialization of EVs and AVs as well as infrastructure improvements.

Previously, Morris was Vice President of Global Product Programs, leading the global team of Executive Chief Engineers and Program Managers who oversee conventional GM Vehicle, Engine, and Transmission programs as well as Performance Accessories. Prior to this role, Ken was the Vice President of Global Product Integrity, leading the organization that implements system integration and oversight across vehicle and propulsion systems to deliver vehicles with consistent safety and compliance performance.

Before joining GM, Morris worked as a test engineer for Borg Warner Automotive Transmission Systems in Muncie, Ind. While there, he helped develop the Borg Warner T56 six-speed manual transmission that went on to be used in many GM vehicles such as the Corvette, Camaro, and CTS-V.

Morris began his General Motors career in 1989 as a brake systems engineer and has held multiple engineering positions over the years. He was the Lead Development Engineer for the original CTS which marked Cadillac's return to rear-wheel-drive vehicles. During this time, he pioneered GM North America's usage of the famed Nürburgring in Germany for vehicle development. Morris has held GM's highest driving certification since 1998 and has accumulated more than 1800 laps on the Nürburgring Nordschleife while leading the dynamic development of GM's vehicles.

BIO

KEN MORRIS BIO CONTINUED...

In January 2002, he was appointed Program Engineering Manager for the 2004 Cadillac CTS-V, where he led the engineering team that analyzed, designed, and developed the vehicle. Morris has stayed engaged with these performance vehicles to this day. His first executive assignment was as Director of Specialty Vehicles in 2005. Morris' role expanded from developing specialty vehicles to leading the team that executes all performance parts and variants, such as the Camaro Z28 and ZL1 as well as the Cadillac V-series.

Before joining GM, Morris worked as a test engineer for Borg Warner Automotive Transmission Systems in Muncie, Ind. While there, he helped develop the Borg Warner T56 six-speed manual transmission that went on to be used in many GM vehicles such as the Corvette, Camaro, and CTS-V.

A native of Indiana, Morris graduated from Purdue University in 1989 with a Bachelor of Science in Mechanical Engineering. He and his wife have two children.

KEYNOTES

DWARKA SIMILI

Global Senior Manager - Controls, Power Drive Systems | BorgWarner

PLENARY SESSION 2: JUNE 24 - 8:30 AM-12:00 PM EDT

He received B.S. and M.Sc. degrees in electrical and electronics engineering from Visvesvaraya Technological University, Bangalore, India and mechanical and aerospace engineering from Illinois Institute of Technology, Chicago, USA in 2003 and 2007, respectively.

His career experience is mainly focused on design and development of electric drive system and controls executing various phases of a production program. Some examples include D7E track type dozer at Caterpillar Inc. (06'-10'), Chevy Spark EV, Cadillac ELR, Gen2 Volt and Chevy Bolt at General Motors (10'-18'). In 2017, he received the Charles "Boss" Kettering Award, the highest GM recognition for technical innovation for contributions in Design and Control of Chevy Bolt.

He is currently leading a global controls team within PDS. His career interests are product development, leadership and innovation.

BIO

KEYNOTES

TARA VATCHER

Global Director for Software Architecture and Engineering | Stellantis

PLENARY SESSION 2: JUNE 24 - 8:30 AM-12:00 PM EDT

Professional:
2020– Present:
• Global Director for Software Architecture and Engineering, Stellantis
2014 – 2019
• Powertrain Software Engineering Director - FCA
• Powertrain Controls Director – FCA
2003 – 2014
• President LHP Engineering Services – LHP Software
• Vice President Embedded SW – LHP Software
• Embedded SW Division Lead – LHP Software
• Technical Specialist SW – LHP Software
• Controls and SW Development Lead – LHP Software
2001 – Software Development Lead – Thomson Consumer Electronics
2000 – Controls and Software Development lead – Cummins Engine Company
1998 – Certification, Software Development Rolls-Royce
1994 – Certification Engineer, Bombardier Aerospace

Education:
• MBA – Indiana University
• Master of Engineering (Certification) – McGill University
• Bachelor of Engineering – Concordia University

Personal
• Married, two boys.

KEYNOTES

BIO

ARMEN BARONIAN

Director - Advanced Technology and Innovation Group | Eaton Aerospace

PLENARY SESSION 2: JUNE 24 - 8:30 AM-12:00 PM EDT

Armen Baronian (SM'05) received the B.Sci. degree in electrical engineering from the University of Belgrade, Belgrade, Yugoslavia, in 1989. In 1989, he joined Nikola Tesla Research Institute, Belgrade, Yugoslavia as a power electronics engineer where he was involved in developing power converters for commercial and military applications. He received Ph.D. degree in electrical and computer engineering from the University of Toronto, Toronto, Canada, in 1998. In 1998, he joined the Department of Electrical and Computer Engineering, University of Toronto as a Senior Research Associate. In 2011, he joined Eaton as an Engineering Manager where he was leading the development of advanced power, control and communication platforms used in Grid-Connected Battery Storage Systems, Wind Converters and Utility Scale Solar Inverters. At the present time, he is a Director of Advanced Technology and Innovation Group, Eaton Aerospace, where he leads research and development of aircraft electrification and IoT/Digitalization. Dr. Baronian has 20+ years of experience in the fields of electronics, power conversion, advanced controls, and management. His previous experiences include consulting work done for companies such as Canamet, Ford, Xerox, Hewlett-Packard, REDA, SRE, TRIO, Myndtec, Oakridge National Labs and Inverpower. Dr. Baronian is an active member of Hydrogen Europe, Vertical Flight Society Forum 77, CSA C232 Committee, SAE E-40 Committee and MW+Multiport EV Charging DOE Committee. Dr. Baronian is a senior member of IEEE and acting Chair, IAS Chapter, Toronto Section, Canada.

FLORENT NIERLICH

Head of Research and Technology Program | Safran Electrical and Power

PLENARY SESSION 2: JUNE 24 - 8:30 AM-12:00 PM EDT

Florent Nierlich received the Engineering Degree in Electrical Engineering from Ecole Nationale Superieure d'Electricite et de Mecanique, Nancy, France, in 1997. After graduation, he joined Lucas Aerospace as electrical engineer to work on primary flight control EHA for Airbus Aircraft. He joined Safran Landing Systems in 2002 (formerly Messier-Bugatti-Dowty) as an R&D engineer. Since then, he contributed to the electrification initiative of Safran Group. He developed a wide expertise in power electronics, control, electric machines and drives for more electric aircraft. Mr. Nierlich holds 21 international patents on electrification of air vehicles including electromechanical brake actuator for aircraft landing system, onboard DC power distribution system, emergency power network for landing-gear hook units, aircraft wheels braking/driving electric system, green taxiing and a system for distributed control of aircraft actuators. His work has been employed in platforms like A380, B787 and A350. In 2015, Mr. Nierlich moved to Safran Electrical & Power to lead research and technology road map mainly focused on new electrical propulsion system. Mr. Nierlich is currently the Head of R&T Program of Safran Electrical & Power, covering electrical generation, distribution and motor drive systems.

WOMEN IN ENGINEERING

ANNETTE MUETZE

Head of Electric Drives and Machines | Graz University of Technology

June 23: 12PM - 1 PM

Continent Hopping

Abstract

Internationalization has become a buzz word in many ways. Academics are expected to make themselves at home internationally. In this talk, I would like to share with you my own years of experience living internationally and how this has impacted my career, my thinking, and my day to day challenges as a professor.

Bio:

Annette Muetze received a Dipl.-Ing. degree in electrical engineering from Darmstadt University of Technology, Germany, and a degree in general engineering from Ecole Centrale de Lyon, France, both in 1999, and her Dr.-Ing. degree from Darmstadt University of Technology in 2004. She has been a Full Professor at Graz University of Technology, Austria, since 2010 where she heads the Electric Drives and Machines Institute and currently serves as vice-dean of the department. Prior to joining Graz University of Technology, she was an Assistant Professor at the University of Wisconsin-Madison, USA, and an Associate Professor at the University of Warwick, Coventry, U.K. Over the years, Dr. Muetze has held several roles within different IEEE committees. She is a Fellow of the IEEE and a recipient of a NSF Career as well as a 6th Nagamori Award.

JOHN HAYES

University College Cork

ABAS GOODARZI

CEO, US Hybrid & US Fuelcell

iTEC2021

NOTE!

All Short Courses and Tutorials are available for preview beginning **June 14th.**

Live Q&A is scheduled during the week of the conference.

John G. Hayes is a senior lecturer at University College Cork, Ireland, and specializes in automotive, industrial and renewable energy systems and related power electronics, machines and electromagnetism. He previously worked in Southern California for ten years at General Motors' Hughes Aircraft subsidiary developing EV propulsion and inductive charging systems for the General Motors EV1, the first modern production EV. John's recent focus has been on the development of integrated and holistic EV teaching materials for the engineering student and the automotive professional. John is the lead author, with co-author Dr. Abas Goodarzi, CEO of US Hybrid in Los Angeles, on a new textbook for university undergraduates and for industry reference. The book is titled Electric Powertrain: Energy Systems, Power Electronics and Drives for Electric, Hybrid and Fuelcell Vehicles. The publisher is John Wiley & Sons and the book was released in January 2018.

G. Abas Goodarzi is founder and President of US Hybrid Corporation and President of Magmotor Technologies. Goodarzi uses his thirty years of EV and HEV experience to direct technology and product development at US Hybrid with a focus on fuel cell engine systems in addition to electric and hybrid powertrain design and manufacturing for medium, heavy duty, and military vehicles. After his experience as Technical Director of General Motor's EV1 program and Senior Scientist at Hughes Aircraft Company, Dr. Goodarzi directed the development of high density and efficiency power converters for organizations including GM, Ford, and Wrightbus, as well as Hydrogenics' fuel cell programs. He has designed various EV, HEV, and FCEV powertrain systems for light, medium, and heavy-duty, on-road, off-road, and special-purpose vehicles. He holds a bachelors from California State University, Sacramento in power systems and a masters and doctorate from the University of Missouri, Columbia in power electronics.

SHORT COURSE

ABSTRACT:

Electric Powertrain: Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles

LIVE Q&A: June 21: 10:30 AM - 11:00 AM

The 2018 Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles is a structured holistic textbook for the teaching of the fundamental theories and applications of energy sources, power electronics, and electric machines and drives to engineering students. This four-part practical guide also acts as an industry reference. In this introductory tutorial, the authors present a two-part seminar covering Power Electronics and Electrical Machines for electric vehicles. The first part of the tutorial provides an overview of the traction machines used in propulsion, with a focus on the induction and IPM ac machines. The second part of the tutorial presents an integrated holistic overview of the power electronics, and discusses the propulsion, charging, accessory, and auxiliary power converters. Isolated and non-isolated dc-dc converters and traction inverters are all discussed, with an additional special focus on battery charging.

LIHUA CHEN

Ford Motor Company

JIN WANG

The Ohio State University

ITEC2021

NOTE!

All Short Courses and Tutorials are available for preview beginning **June 14th.**

Live Q&A is scheduled during the week of the conference.

Lihua Chen received his Ph.D. degree from Michigan State University. He joined Ford Motor Company in 2008 and currently works as a Technical Expert leading the Power Electronic Technology team at Ford Electrified Powertrain Engineering to investigate advanced technologies and solutions for next generation eDrive system and traction inverter design.

He has published over 100 technical papers, holds over 50 US patents. He has given numerous technical presentations and tutorials to IEEE conferences, research institutes, and various companies. Since 2018, he has also been teaching Power Electronics and Electric Machines courses at University of Michigan - Dearborn.

Jin Wang (Fellow IEEE) received his Ph.D. from Michigan State University, East Lansing, in 2005. He worked at Ford for two years before he joined the Ohio State University in 2007, where he currently serves as a Full Professor. His research interests include wide bandgap power devices and their applications, high-voltage and high-power converter/inverters, integration of renewable energy sources, and electrification of transportation. Dr. Wang has over 200 peer-reviewed publications and 9 patents. Dr. Wang received the Nagamori Award in 2020, IEEE Power Electronics Society Richard M. Bass Young Engineer Award in 2011 and the National Science Foundation's CAREER Award in 2011.

ABSTRACT:

Challenges and Solutions of WBG based Power Electronics for Vehicle Electrification

LIVE Q&A: June 21: 3:30 PM - 4:00 PM

This short course is focused on challenges and solutions of Wide BandGap (WBG) power device based systems for electric and hybrid electric vehicles (xEVs) applications including traction inverters, DC/DC converters, onboard and offboard chargers. Many practical aspects and hardware design issues will be specifically addressed. Current status of Silicon Carbide (SiC) and Gallium Nitride (GaN) devices will be introduced with application examples. Specific challenges and opportunities of implementing state-of-the-art SiC and GaN devices in vehicle power electronics systems will be explained in detail. The intent of this educational short course is to introduce WBG based power electronics systems for xEVs from a practical point of view. Many actual product benchmarking results and design examples will be included with technical detail explanations. It is dedicated to help the audience better understanding how current vehicle power electronics are designed to meet automotive application requirements and roadblocks for WBGs in automotive applications. The short course should also be of interest to engineers and researchers who work on power electronics systems for the electrification of other types of transportation.

SHORT COURSE

OMER ONAR

Oak Ridge National Laboratory

iTEC2021

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Omer C. Onar received his Ph.D. degree from Illinois Institute of Technology (IIT) in Electrical Engineering, in July 2010, Chicago, IL. At IIT, he was a doctoral research assistant and a PhD student at the Energy Harvesting and Renewable Energies Laboratory at the Electric Power and Power Electronics Center. He is the recipient of the IEEE-Vehicular Technology Society's 2008 "Transportation Electronics Fellowship" (world-wide single award) and the IEEE-Power Electronics Society's 2009 "Joseph J. Suozzi INTELEC® Fellowship in Power Electronics" (world-wide single award). In July 2010, he received the Alvin M. Weinberg Fellowship at the U.S. Department of Energy's Oak Ridge National Laboratory (ORNL), where he joined the Power Electronics and Electric Machinery Group. At Oak Ridge National Laboratory, he has been working on several projects including advanced power electronics and electric drives, renewable energies, energy storage systems, wireless power transfer systems, and smart grids.

Abstract:

Wireless Extreme Fast Charging (XFC) Systems
LIVE Q&A: June 22: 10:30 AM - 11:00 AM

Electric vehicles (EVs) have the potential to significantly reduce the dependency on imported oil, enhance national energy security, and reduce the greenhouse gas emissions. However, there are two major drawbacks against the widespread commercialization. Limited range and long battery charging times remain to be the critical challenges to mass electrification of our transportation sector. While the vehicles with higher energy battery packs (>100 kWh) can mitigate the range anxiety problem, it would take very long to recharge these vehicles; namely 83, 30, or 15 hours with the conventional 1.2, 3.3, or 6.6 kW chargers, respectively. While DC fast charging can enable charging power levels for >100 kW and reduces the charge times to less than an hour, the connectors, plugs, and cables would be difficult to handle, and conductive charging would be cumbersome with all the heavy and bulkier cables. Therefore, inductive wireless charging systems can be a viable option for the high-power and fast charging systems for EVs. Wireless power transfer is a safe, flexible, and a convenient form of EV battery charging without requiring manual connection of charge cables, it has inherent isolation from the grid to the vehicle, it can run in all-weather conditions, and can also automate the charging process of the EVs without user involvement.

This short course focuses on high-power wireless power transfer developments performed at Oak Ridge National Laboratory. First, we will review the design and development of a 120 kW wireless power transfer system developed. This system can charge a 100 kWh battery pack from 20 to 80% state-of-charge in 30 minutes, which can bring the EV charging process closer to the fuel refueling practice at the gas stations. The short-course will introduce the state-of-the art literature review on high-power wireless charging systems and details the design and development of the power electronics and electromagnetic coupling coils with their finite element analysis (FEA) based models. Design details and parameters of the system will be covered along with the experimental performance analysis of the system including the stage-by-stage power flow and efficiency of the system. Then the focus of the short-course will move to the polyphase electromagnetic couplers that offers the highest power density transmitters and receivers in the world. First the design and development of a 50 kW polyphase system with non-zero inter-phase couplings. Then the short-course will cover the 100 and 300 kW extreme fast wireless charging system developments with polyphase couplers.

SHORT COURSE

RODGER DYSON

NASA

iTEC2021

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Live Q&A is scheduled during the week of the conference.

Rodger Dyson has worked at NASA Glenn Research Center for over 30 years in Power, Propulsion, and Thermal Technologies supporting both aeronautics and space missions. He currently serves as the hybrid gas electric propulsion technical lead, NASA electric aircraft testbed principal investigator, NATO hybrid electric aircraft technology domain lead, founded the Power and Propulsion Systems Alliance hybrid electric technical area team, and leading a new thermal energy conversion initiative to recycle heat on aircraft. He is also a prolific inventor with 8 licensed patents in electric machines and engines, founder of two technology startup companies, and recently served as Chief Technology Officer at Nirvana Energy Systems.

ABSTRACT:

Aircraft Transportation Electrification Eco-System and Technologies

LIVE Q&A: June 22: 10:30 AM - 11:00 AM

Recent advances in ground transportation electrification technology have enabled the acceptance of electric vehicles in the marketplace. And air transportation electrification is expected to experience similar success as the unique technology challenges associated with altitude and mass constraints are addressed. This short three-hour course will provide an overview of the air transportation electrification eco-system; define key technology parameters; review the key required technologies in power, propulsion, thermal, and energy storage; address the technology maturation process that is unique to high voltage Megawatt-scale powertrains; and to recommend future areas of interest for further development and market acceptance.

AGENDA:

1. Background & Motivation
2. Markets
3. Government and Industry Eco-System
4. Key Performance Parameters
5. Propulsion Technologies
6. Power Technologies
7. Thermal Technologies
8. Energy Source/Storage Technologies
9. Flight Demonstration Vehicles
10. Summary and Future Prospects

SHORT COURSE

JEAN LE BESNERAIS

EOMYS ENGINEERING

iTEC2021

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Live Q&A is scheduled during the week of the conference.

J. Le Besnerais made an industrial PhD thesis in Electrical Engineering at the L2EP laboratory of the Ecole Centrale de Lille, North of France, on the reduction of electromagnetic noise and vibrations in traction machines with ALSTOM Transport. After working as an engineer in the railway and wind turbine industries, he created EOMYS ENGINEERING in 2013, a company providing applied research and development services in electrical engineering.

EOMYS has developed a strong expertise in the analysis and reduction of noise and vibrations due to electromagnetic forces in rotating machines. The company has worked on both synchronous and induction machines, from W to MW range, obtaining up to 40 dB reduction after redesign. Based on its consulting experience, EOMYS has developed MANATEE software, the first simulation software for the fast calculation of variable speed noise and vibrations due to magnetic forces, including NVH root cause analysis and mitigation tools.

ABSTRACT:

e-NVH of Electric Traction Motors: Focus on Physics of Noise and Vibration Due to Magnetic Forces

LIVE Q&A: June 22: 4:00 PM - 4:30 PM

Electromagnetically-excited noise and vibrations (e-NVH) can be significant in electrified transportation systems, from electric scooters to eVTOL, including electric bikes, electric vehicles and trains. Tackling noise issues after manufacturing can be particularly expensive and may degrade electric powertrain performances such as efficiency, cooling, and weight. Electric motor designers must therefore take into account e-NVH phenomena at early design stage, besides usual electromagnetic and thermal aspects.

This course first reviews all the potential sources of noise and vibration due to electromagnetic forces, both in rotating machines and passive components (inductors, cables, etc). A focus is then done on electrical machines, explaining how Maxwell forces can generate vibrations of active materials. The quadratic nature of magnetic forces is emphasized, as well as two types of excitation forces, namely slotting (related to e-motor design) and switching (related to power electronics design). The acoustic frequency signature of different applications is studied (e.g. turbochargers, pumps, traction motors) depending on speed range and e-motor topologies (slot pole combination, permanent magnet Vs induction machines). Then, resonance phenomena is explained, demonstrating that it is particularly important to identify main magnetic force wavenumbers and frequencies during early electromagnetic design stage of electrical machines. Therefore, the analytic characterization of magnetic forces in some key EV traction motors is carried, namely Interior Permanent Magnet Synchronous Machines (Tesla model 3) and Squirrel Cage Induction Machines (Audi e-Tron). The generation process of electromagnetic force waves, starting from permeance and magnetomotive force harmonics, is detailed.

The course includes sound files, animations and numerical simulation examples coming from MANATEE® e-NVH simulation software. It is mainly made for electrical engineers involved in the design of electrical systems in transportation sector.

SHORT COURSE

XIAOFENG YANG

Beijing Jiaotong University

iTEC2021

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Xiaofeng Yang (Senior Member, IEEE) received the B.S. and Ph.D. degrees from Beijing Jiaotong University, China, in 2003 and 2011, respectively, all in electrical engineering. From 2003 to 2005, he was power supplier engineer of the seventh Research Institute of China Ministry of Information Industry, Guangdong. From 2012 to 2014, he was a Postdoctoral Fellow at North Carolina State University, Raleigh, NC. Currently, he is Associate Professor of Beijing Jiaotong University. Dr. Yang serves as the Steering Committee Member of IEEE TEC Beijing Chapter, the Deputy Secretary General of the Youth Working Committee of Council of Beijing Power Electronics Society, member of the Youth Working Committee of Council of China Power Supply Society, Associate Editor of Urban Rail Transit, Associate Editor of IEEE ACCESS, Deputy Editor-in-Chief of Electrical Engineering (Chinese Journal). Dr. Yang holds 24 Chinese patents, 1 United States patent, and has published more than 100 technical papers, his current research interests include rail transit power supply, high power energy converter, and rail transit power supply. He received the Outstanding Author Award from Proceedings of the Chines Society of Electrical Engineering in 2018, Outstanding Author Award from Power System Technology in 2016 and 2017. Three papers had been selected as the “Forerunner 5000- Top Articles in Outstanding S&T Journals of China” (F5000).

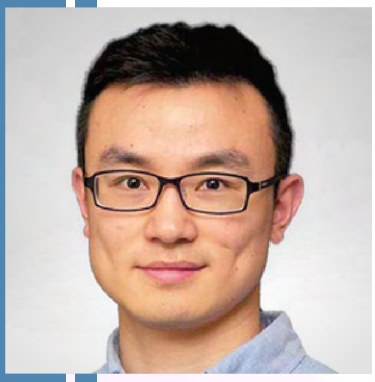
ABSTRACT:

Stray Current in Rail Transit Electrification: History, Challenges and Opportunities

LIVE Q&A: June 21: 9:00 AM - 9:30 AM

As an important part of public transportation, rail transit has been developed rapidly in recent years all over the world. On the one hand, huge amounts of AC high-speed rail transit are generally deployed for long-distance transportation among cities. On the other hand, DC urban rail transit is widely constructed to ease the public traffic inside cities. Different from conventional on-road transportation including electric vehicles and buses, rail transit electrification shows its own characteristics. Safety power supply is essential for such heavy-duty rail transit. For a long time, the inherent stray current issue in rail transit electrification has been ignored by related fields. But many related accidents in recent years have aroused people's concern about this issue.This tutorial will systematically introduce the rail transit electrification with special focus on stray current issue. It will cover the following contents: The history and development of rail transit (high speed rail transit and urban rail transit) electrification. Summarizing the existing challenges in safety power supply of rail transit; Considering the potential harm of stray current issue in rail transit electrification, the generation mechanisms and corresponding existing solutions will be classified and compared. This also inspired continued efforts of the researchers, experts from both academia and industry. Finally, the emerging opportunities will also be concluded for future prospective applications in the rail transit electrification.The study is funded by the key projects of National Natural Science Foundation of China, with a funding amount of more than 3 million RMB.

TUTORIAL



DAKAI HU

Mathworks

iTEC2021

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Dakai Hu is an application engineer at MathWorks supporting customers adopting Model-Based Design for motor and power controls. Prior to joining MathWorks, Dakai worked for Emerson Network Power on the controller design of 400 kVA to 1600 kVA uninterruptible power supplies. Dakai received his Ph.D. in electrical engineering from Ohio State University. While studying at OSU, he published five first-author conference and journal papers, with topics related to motor control and hardware-in-the-loop simulation designs.

ABSTRACT:

Calibrating Optimal IPMSM Torque Control with Field-Weakening Using Model-Based Calibration

LIVE Q&A: June 21: 11:00 AM - 11:30 AM

Calibrating the control of e-motors is a required step in the design of a high-performance electric traction drive. Traditionally, the calibration process involves extensive hardware dynamometer (dyno) testing and data processing, and its accuracy depends largely on the expertise of the calibration engineer. Model-Based Calibration is an industry-proven workflow designed to optimally calibrate complex nonlinear systems using statistical modeling and numeric optimization. Compared to traditional calibration procedures, which usually involve heavy scripting and an unnecessary amount of testing, the Model-Based Calibration workflow is an automated and robust approach that ensures consistent results within minutes.

When applied to IPMSM torque and field-weakening control calibration, Model-Based Calibration involves four steps:

- Design of experiments for characterization.
- Process the IPMSM characterization dataset.
- Fit IPMSM characterization data models.
- Optimize IPMSM controller lookup table data.

This tutorial from MathWorks will walk you through each step in the above workflow, followed by a step-by-step exercise/demo that can be used as basic training for Model-Based Calibration Toolbox.

TUTORIAL

ALAN MANTOOTH & DAVID HUITINK

University of Arkansas

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Alan Mantooth (S'83 - M'90 - SM'97 – F'09) received the B.S.E.E. and M.S.E.E. degrees from the University of Arkansas in 1985 and 1986, and the Ph.D. degree from Georgia Tech in 1990. He then joined Analogy, a startup company in Oregon. In 1998, he joined the faculty of the Department of Electrical Engineering at the University of Arkansas, Fayetteville, where he currently holds the rank of Distinguished Professor. His research interests now include analog and mixed-signal IC design & CAD, semiconductor device modeling, power electronics, power electronic packaging, and cybersecurity. Dr. Mantooth helped establish the National Center for Reliable Electric Power Transmission (NCREPT) at the UA in 2005. Professor Mantooth serves as the Executive Director both the NSF Industry/University Cooperative Research Center on GRid-connected Advanced Power Electronic Systems (GRAPES) and the Cybersecurity Center on Secure, Evolvable Energy Delivery Systems (SEEDS) funded by the U.S. Department of Energy. Dr. Mantooth holds the 21st Century Research Leadership Chair in Engineering. He currently serves as Senior Past-President for the IEEE Power Electronics Society and Editor-in-Chief of the IEEE Open Journal of Power Electronics. Dr. Mantooth is a Fellow of IEEE, a member of Tau Beta Pi and Eta Kappa Nu, and registered professional engineer in Arkansas.

David Huitink joined the faculty in Mechanical Engineering at the University of Arkansas in 2016, prior to which he spent more than 5 years in industry, working in microelectronics technology development and manufacturing at Intel Corporation, where he served as Quality & Reliability Engineering Program Manager for Intel's Custom Foundry Division. There he pioneered the development of advanced methods of predicting reliability of silicon-based flip chip microelectronic packages, as well as developed testing protocols and FEA methods for governing Design for Reliability (DfR) guidance. He managed the foundry customer adoption of 2.5D packaging technology in high performance FPGA processors, along with advancing assembly materials selection for large die and multi-chip packages.

ABSTRACT:

Power Electronics Packaging for Transportation Applications

LIVE Q&A: June 21: 2:00 PM - 2:30 PM

Modern day power electronic systems demand performance criteria such as high power density, high operating frequencies, low losses, etc., that are very difficult to accomplish using conventional silicon power semiconductor devices. After a very brief review of the merits of wide bandgap power semiconductor devices, a description of wide bandgap power electronic modules for transportation applications is provided. Packaging architectures of these power modules will be illustrated and evaluated for application in vehicle systems. A design and layout tool, PowerSynth, developed to take full advantage of the high switching speeds of these devices will be presented along with our extensive models for these wide bandgap power devices. Recent developments in extending to novel package architectures will also be discussed.

As a complementary perspective to package architecture review, considerations of thermal management and reliability in automotive applications will be presented. Implications of system temperatures, operating environments, and power needs will be described in the context of packaging material limitations and needs for next generation systems including double-sided cooling configurations and high temperature die attach materials. Recent research efforts in this realm will be presented, with a perspective toward future opportunities in transportation power electronic packaging.

TUTORIAL

MICHELLE LIU

Tesla

iTEC2021

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Qian (Michelle) Liu, Ph.D. has been in the EMC field for over 18 years; currently she is a staff EMC design engineer at Tesla, focusing on EMC designs for electric vehicles and energy products. Prior to joining Tesla, she worked at Intersil (acquired by Renesas Electronics) as an engineering manager. She also worked as a researcher at General Electric (GE) global research center at Niskayuna, NY. Michelle graduated from Virginia tech, Center for Power Electronic Systems (CPES) with her Ph. D degree. Her research and engineering area include EMC and EMI designs and modeling in sustainable energy applications. She has published more than 20 IEEE papers.

ABSTRACT:

EMC Designs and Considerations for Electric Vehicles (EVs)

LIVE Q&A: June 21: 4:00 PM - 4:30 PM

Over the past twenty years, there haVE been increased EMC challenges in sustainable energy applications, which includes electric vehicles (EVs), Photovoltaic (PV) systems, energy storage systems and other renewable applications. The on-going change in EV EMC environment is one of the few constants, as high-efficiency Silicon-Carbide (SiC) power electronic systems, new onboard electronics, and communications media (both wired and wireless) are added. Consequently, in order to address this complex system-level EMC issue, both standards and design methodologies are evolving to assure the compatibility of vehicles and components in EVs. This presentation of the authors' recent research and engineering effort towards unveiling some complex EMC regulations, design process and practical design challenges in EVs. Some future engineering areas are also discussed regarding EMC design improvements through system-level optimization and integration.

TUTORIAL

JOHN GLASER

Director of Applications, Efficient Power Conversion

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John Glaser received his BSEE from the University of Illinois in Urbana-Champaign and went to Motorola to design RF power amplifiers for mobile and fleet radio systems, after which he earned an MSEE and Ph.D. from the University of Arizona. He spent two years at Hughes Missile Systems working on power electronics for TWT amplifiers, after which he joined General Electric Global Research. From 1998 to 2014, he worked on power electronics for consumer, commercial, medical, industrial, aerospace and wide-bandgap semiconductor applications, for power levels ranging from 1 W to 100 kW and frequencies ranging from 50 Hz to > 100 MHz. In 2014, he joined Efficient Power Conversion (EPC) as Director of Applications, where he develops applications, circuits, and methods to maximize the benefit of GaN and help others do the same. He has published more than 35 papers and has been granted 33 US patents and 12 non-US patents, with several more pending, and is an IEEE Senior Member.

ABSTRACT:

How to Be Mobile with GaN Power Technology

LIVE Q&A: June 22: 9:00 AM - 9:30 AM

This tutorial will cover the use of GaN power device technology for a wide variety of mobility applications, with a focus on applications in the sub-200 V space. There will be a brief review of the present state of the art, followed by a review of design guidelines for using GaN. Since many mobility applications emphasize high power density, thermal management methods for chip-scale power devices will be covered and suggested approaches for low-cost thermal management will be given, including expected performance. Since reliability is of utmost importance in mobility applications, there will be a review of reliability work on chip-scale devices. Since GaN is a newer technology, it is not adequate to rely solely on the metrics developed for Si devices. Thus, the primary focus will be on test-to-fail methodology and root cause failure analysis. A sampling of application use cases will be presented, including 48 V to 12 V bidirectional power conversion at the kW level, 48 V 3-phase electric machine drives, and exterior/interior automotive lidar. The closing will discuss the future of GaN power technology and the benefits of monolithic power ICs made possible with GaN.

Short outline:

1. Brief review of GaN
2. Design guidelines
3. Thermal management of chip-scale packaged GaN power devices
4. GaN reliability and test-to-fail methodology
5. GaN Applications
    a. 48V power for mobility
    b. Benefits of GaN in motor drives
    c. Lidar for interior and exterior applications
6. The Future – Monolithic GaN Power ICs

TUTORIAL

HOLGER FINK

BRUSA Elektronik

iTEC2021

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Dr.-Ing. Holger Fink is, since 2017, CTO of the BRUSA Elektronik AG, which is one of the pioneers in eMobility and a leading engineering supplier for all electronic and mechanical components of automotive e-powertrains, charging systems and DC/DC-converters. From 2000 to 2017 he was working in several Automotive Divisions of the Robert Bosch GmbH. From 2015 to 2017 he was CEO of Lithium Energy and Power, a Joint Venture for automotive Li-Ion battery cells between Robert Bosch, GS Yuasa Corporation and Mitsubishi Cooperation. From 2012 to 2017 he was as Senior Vice President responsible for the R&D of Li-Ion Battery Systems at Robert Bosch Battery Systems. From 2008 to 2012 he was Chief Engineer at SB LiMotive, a Joint Venture for Li-ion battery cells and systems between Samsung SDI and Robert Bosch which was terminated in 2012. He is Electrical Engineer and did his PHD in 2000 at the Institute for Power Electronics and Control Systems of the University of Stuttgart.

ABSTRACT:

High Performance Voltage Doubler – The Fast Charging Booster for the Porsche Taycan

LIVE Q&A: June 22: 11:00 AM - 11:30 AM

Leading OEMs for high-performance cars, such as Porsche or Lucid Motors are doubling the battery voltage from 400-V to around 800-V to benefit from reduced charging times and improved economic efficiency. Another application for 800-V systems are high power drive trains used in commercial vehicles. An interface between the conventional 400-V EV fast charging infrastructure and 800-V battery must be introduced, due to low availability of 800-V charging stations. Therefore, there is a need for a highly efficient and compact power electronic converter that allows this operation.

In this tutorial, firstly the main characteristics of conventional voltage boosters with a list of advantages and disadvantages will be shown. Secondly, the operating principle and multiphase architecture of the voltage doubler with a list of advantages over conventional DC/DC converter will be clarified. Thereafter, the implementation details such as the product architecture for fast charging (150-kW), selection of semiconductors, soft switching mechanisms (ZVS and ZCS) with typical current and voltage waveforms and control system will be explained. The performance and efficiency evaluation with the power loss breakdown and EMC measurements will be shown afterwards. Lastly, an outlook with tendencies for the future designs, necessity of unconventional creative solution, and potential impact of further optimization deploying SiC/GaN wide bandgap semiconductor technology will be discussed.

TUTORIAL

PANEL 1: EMERGING TECHNOLOGIES FOR AIRCRAFT ELECTRIFICATION

June 21: 8:00 AM - 9:30 AM

Moderator: *Cong Li - GE Research*

Panelists:

- Kamiar J. Karimi - *Boeing*
- Sean Clark - *NASA Armstrong Flight Research Center*
- Satish Prabhakaran - *GE Research*
- Sara Roggia - *MagniX*

Abstract:

The aerospace industry is experiencing tremendous changes and evolutions due to aircraft electrification. This panel starts with system level discussions on technology challenges and opportunities for More Electric and Hybrid Electric Airplanes, followed by the introduction of X-57 Maxwell, which is NASA's Distributed Electric Propulsion Research Platform. The subsystem and component-level technology development and challenges are also introduced, with the focus on maturing components and systems for electric propulsion and live examples from concept to reality to make electric aviation real.

PANEL 2: POWER ELECTRONICS IN ELECTRIFIED AUTOMOTIVE APPLICATIONS: HIGH VOLTAGE SYSTEM CHALLENGES AND OPPORTUNITIES

June 21: 10:00 AM - 11:30 AM

Moderator: *Cong Li - GE Research*

Panelists:

- Lihua Chen - *Ford Motor Company*
- Rashmi Prasad - *General Motors*
- Richard Hampo - *Delta Electronics*
- Ming Su - *Rohm Semiconductor*

Abstract:

Vehicle electrification demands higher bus voltage like 800V to further enhance performance and save cost. This panel starts with discussions on HV system structure and architecture variants, followed by an example on an OEM's traction inverter design evolution over time and emerging future technology. The pros and cons of such HV systems from the point of view of a Tier-1 supplier is provided, followed by the latest developments in SiC power device technology, which is one of the key enablers of high density high efficiency high voltage automotive systems.

PANEL 3: COMMERCIAL VEHICLE ELECTRIFICATION

June 21: 1:00 PM - 2:30 PM

Moderator: Yash Singh - *Eaton Corporation*

Panelists:

- Yanming Hou - *Oshkosh Corporation*
- Fan Wu - *Rivian*
- Eric Vilar - *John Deere*
- AKM Arafat - *Cummings*

Abstract:

With the recent rapid electrification of passenger vehicles, one question that the mass media has been wondering is that if the existing engine-powered commercial vehicles will likewise be partially electrified or completely electrified soon? Commercial vehicles generally require larger energy storage and possess different mission profiles and O&M requirements, and the electrification path could be different from the present passenger vehicles. In this panel, engineering experts from commercial vehicle companies including Oshkosh, Rivian, Cummins, and John Deere will talk about the emerging topics and challenges with the commercial vehicle electrifications.

PANEL 4: BATTERY MANAGEMENT CHALLENGES IN TRANSPORTATION ELECTRIFICATION

June 21: 3:00 PM - 4:30 PM

Moderator: Sheldon Williamson - *University of Ontario*

Panelists:

- Sheldon Williamson - *University of Ontario*
- Bob Hess - *BAE Systems*
- Kandler A. Smith - *National Renewable Energy Laboratory*
- Ben Tabatowski-Bush - *Ford Motor Company*
- Balakumar Balasingam - *University of Windsor*

Abstract:

It has become imperative to find future electric energy storage solutions for e-transportation systems. This panel starts with Smart Battery Energy Management and Health Conscious Fast Charging for Future Transportation Electrification, followed by an example on Battery Management Systems for Aircraft Electric Propulsion. The discussion on key technical areas such as Identification, Prediction, and Control of Li-ion Battery Lifetime, and Communication challenges for distributed battery management and second life arrays are also included.

PANEL 5: TRANSPORTATION ELECTRIFICATION: POLICY, INFRASTRUCTURE AND GRID IMPACTS

June 22: 8:00 AM - 9:30 AM

Moderator: Honggang Wang - GE Research

Panelists:

- Matteo Muratori - *National Renewable Energy Laboratory*
- Ziping Wu - *ComEd*

Abstract:

As more and more EV charging infrastructure are being built, the cyber security, grid impact, standards, and policies become increasingly important for evaluating and standardizing the charging infrastructure. In this panel, researchers and engineers will talk about the assessment of EV charging structures, and the related interaction with grid planning and operations across several timescales. We will also discuss how to develop a hardware-in-the-loop testbed to investigate the cyber-physical vulnerability and explore its potential impact on the microgrid. The main motivation is to exploit the synergies between EVs and renewables, and provide a transformative sustainable solution for the integrated energy systems of the future.

PANEL 6: EV MOTOR DESIGNS

June 22: 10:00 AM - 11:30 AM

Moderator: Bruno Lequesne - e-Motors

Panelists:

- Kirk Neet - *BorgWarner*
- Lei Hao - *General Motors R&D*
- James Goss - *Motor Design, LTD*
- Ian Brown - *Illinois Institute of Technology*

Abstract:

As a core power conversion component in EV traction systems, electric machines are facing the challenges to achieve higher energy efficiency, high power and torque density, and higher reliability. In this panel, we will discuss the following emerging topics: (1) Challenges with high-voltage (e.g., 800V) motor stator design; (2) Overviews of permanent magnet (PM) synchronous machines, and reduced-PM or non-PM machines in EV applications; (3) Multi-physics multi-objective design optimization of motor-drive systems.

PANEL 7: VIRTUAL PROTOTYPING AND VIRTUAL DESIGN

June 22: 1:00 PM - 2:30 PM

Moderator: Bryan Lieblick - *Plexim*

Panelists:

- Uday Deshpande - *D&V Electronics*
- Chris Farnell - *University of Arkansas*
- Scott Johnson - *John Deere*

Abstract:
Virtual prototyping and virtual designs are playing an increasingly important role in EV systematic design and analysis, which is generally a complicated multi-physics multi-timescale subject. In this panel, we will discuss the following topics: (1) The necessities and challenges of conducting virtual engineering from a technical and business perspective; (2) Utilizing controller Hardware-In-the-Loop (cHIL) and Hardware-In-the-Loop (HIL) resources to accelerate testing and integration for vehicle applications; (3) Using hardware in the loop simulations enable vehicle level analysis with high fidelity power electronics models.

PANEL 8: EXTREME FAST CHARGING

June 22: 3:00 PM - 4:30 PM

Moderator: Omer Onar - *Oak Ridge National Labs*

Panelists:

- Omer Onar - *Oak Ridge National Labs*
- Rui Zhou - *EnerSys*
- Theodore Bohn - *Argonne National Labs*
- Jim Andriotis - *Cavotec*

Abstract:
Extreme fast charging (XFC) is considered one of the most important research topics in the field of electromobility with the potential to significantly reduce charging times. This panel starts with introduction on different system architectures such as high power inductive charging system development, and direct current fast charging system with tied energy storage system. High power electric vehicle-smart charging standards and implementation of high power charging connections will also be introduced.

INDUSTRY SESSION

iTEC2021

AVL

JUNE 22 - 3:00 PM - 03:45 PM

Founded in 1948, AVL is the world's largest independent company for development, simulation and testing technology of propulsion systems (hybrid, combustion engines, transmission, electric drive, batteries, and software) for passenger cars, trucks and large engines and their integration into the vehicle. With more than 70 years of experience, we develop and provide advanced solutions to the mobility industry. AVL continues to take on complex challenges and lead the way in the development and application of e-mobility, fuel cell, battery, and ADAS/AD technologies. We create tailored solutions in the areas of big data, artificial intelligence, simulation, and embedded systems in an agile and integrated development environment. Learn more at www.avl.com.

Simulation-based Approach to Battery Development

Waldemar Linares, Manager, Simulation Technologies, AVL

Batteries are the key differentiator between the various xEV manufacturers. Adoption of virtual development has become crucial in overcoming the challenges associated with battery-powered systems. Understanding and optimizing performance, efficiency, hazard prevention and lifetime of a battery in a virtual environment is key to increasing the quality of new vehicle development. During this presentation Dr. Waldemar Linares will show how AVL's Virtual Battery Development approach is used to overcome the most challenging tasks such as, cell modelling, fast charging, aging and cooling and thermal runaway event.

INDUSTRY SESSION

iTEC2021

MathWorks®

JUNE 22: 11:30 AM - 1:00 PM

High-Fidelity Motor Modeling for HIL with FPGAs

Joel Van Sickel - Application Engineer, Mathworks

Real-time capabilities are drastically increasing what testing can be done for electric powertrains. Important physical effects such as spatial harmonics and high-speed switching of wide bandgap devices can be achieved in the same model. Additionally, you can run these models in parallel with virtual vehicles. This allows you to connect the device under test (DUT), the motor controller in this example, with a virtual or real ECU for expansive test coverage. You can also use these same techniques to implement virtual dynamometers if ECU integration is unnecessary. See how the approaches presented are hardware agnostic and can often take advantage of existing lab equipment.

Fuel Cell Virtual Vehicle Models for Fuel Economy, Performance, and Thermal Analysis

Yifeng Tang - Application Engineer, Mathworks

Learn about recent advances in modeling fuel cell systems for automotive applications. Explore how to use simulation for fuel-economy study, controller design, thermal analysis, and component selection integrated into a complex, multidomain fuel cell virtual vehicle model that includes:

- A polyelectrolyte membrane (PEM) fuel cell stack with fundamental electrochemical reactions, H2 and air handling systems, and a thermal management system
- An electric powertrain system with a battery, DC/DC converter, and power distribution unit (PDU)
- Supervisory controllers
- Multiple drive-cycle scenarios

INDUSTRY SESSION

iTEC2021

plexim
electrical engineering software

JUNE 23 - 1:45 PM - 02:30 PM

Model-based design of cascaded speed and current controls for a 6-phase PMSM
Presenter: Sisi Zhao
Speaker: Bryan Lieblick

Multi-phase Permanent Magnet Synchronous Machines (PMSM) are used for high performance drive systems like electric vehicles (EV). They offer increased power capability and reliability over their three-phase counterparts. This technical session introduces a workflow for the model based design of the controls for a dual-star PMSM with two inverters attached to different energy sources. The complete system is deployed using a TI embedded target for the controls and a virtual plant model running on the RT Box real-time simulation platform.

Plexim is a global leader in simulation software for power electronic systems. Our software, PLECS, enables customers to speed up product development and innovation by reducing design time and cost.

Our leadership is based on the latest software technologies and simulation algorithms combined with pioneering concepts for modeling. By carefully listening to engineering experts, we offer our new solutions for our customers' needs, today and tomorrow.

Since 2002, our software is the industry standard for power electronics simulation across various industries. Typical applications are renewable energy, automotive, aerospace, industrial and traction drives, and power supplies. Our customers include market leaders such as ABB, Bombardier, Bosch, Danfoss, GE, Philips, Siemens and SMA.

With offices in Zurich and the Boston area, and the support of local representatives worldwide, we are always close to our customers.

INDUSTRY SESSION

iTEC2021

GMW Associates

JUNE 22 - 1:00 PM - 02:30 PM

Clip-on and Clamp-on Current Probes with Analog Signal Output for Test Stand and In-Vehicle Current Monitoring

Presented by (and principal author):
Ian J. Walker – *Senior Applications Engineer, GMW Associates*

GMW Clip-on and Clamp-on "Coreless" Current Probes are available with apertures of 27mm, 77mm and 160mm, full-scale current ranges from +/-250A to +/-16kA, and frequency response from dc to 75kHz. They are small cross-section, light-weight, moisture, ice and vibration resistant with an operating temperature range of -40C to +100C. They have no magnetic core eliminating magnetic hysteresis and ringing artifacts. During a primary current overload the output signal electrically limits with the correct sign and then outputs the correct signal within 10us of the current recovering within the Probe nominal current range. The Probes are undamaged by any current overload for any period of time. The Signal and Power Cable disconnects from the Probe enabling it to be threaded through a small aperture in a firewall or protection barrier to the monitoring Data Logger or Scope.

Current Measurement For Electric Vehicle Charger Test

Presented by: Ben Hartzell – *VP Marketing, GMW Associates*

GMW will provide a brief overview of test instrumentation for current control and metering in vehicle battery and charting systems. We will compare and contrast:

- Fluxgate-based DC/AC current transduceres for high accuracy and resolution measurements;
- Clip-around Rogowski coils with matching analog integrator for ac current measurements from a few Hz to 50Mhz, and can be optimized for accuracy and resolution at a specific frequency;
- Light weight clip-on and clamp-on DC/AC probes suitable for in vehicle tests, both in motion and in climate test chambers;
- 3-component magnetic field probe for measurement and mapping wireless Inductive Power Transfer systems.

INDUSTRY SESSION

iTEC2021

MARSILLI

JUNE 22 - 3:45 PM - 4:30 PM

Marsilli Distributed High Density Winding Technology for electric motors: Our "out of the box" solution beyond the current technologies
Speaker: Kumar Rajasekhara

Mr. Kumar Rajasekhara, President & CEO of Marsilli North America, a wholly-owned subsidiary of Marsilli, will present for the first time to the US market, the Distributed High Density technology, an innovative motor design and manufacturing solution currently under patent review.

The speech underlines the motor producers' requests for a new solution able to overpass the limits of the insertion and the hairpin technologies and how Marsilli faced the challenge.

Add a little bit of body text

A 2-year journey made by Marsilli R&D department, from the first analysis and benchmark of the existing technologies to the realization of the first in-house prototype, to the final validation of the results of a third motor design party.

The results will be presented using multimedia infographic elements to visualize the encompassing level of power density and efficiency reached by this technology matching perfectly with the industry's desire for motors which are smaller, more efficient, and have higher performance at both low and high speeds.

The DHD solution, which is still in the development phase, will hit the market next year and will be the perfect choice for different applications in various industries.

INDUSTRY SESSION

iTEC2021

HBK HOTTINGER BRÜEL & KJÆR

JUNE 23 - 1:00 PM - 1:45 PM

Measurement of Torque Ripple in Electric Machines
Speaker: Mitch Marks

Many engineers have become accustomed to looking at torque as a static value for efficiency purposes, but torque often has a significant frequency component that is important for durability, noise, vibration, and machine control. Torque ripple is often not considered or measured because it is a difficult measurement to make. Torque ripple requires high bandwidth and high accuracy sensors, a capable test rig, and measurement systems capable of acquiring the signals at a sufficient bandwidth and accuracy. While these might sound trivial most sensors and systems are not capable of making these measurements. This session will give a brief introduction to torque ripple and its sources, measurement considerations, analysis, and implication of dynamic torque.

HBK Services and Solutions empower our customers and engineers throughout the world to deploy and maintain test and measurement technologies as well as to optimise the usage of data from measurement insights to deliver actionable decisions.

HBK's Service programmes ensure optimal uptime through connection, engagement and collaboration with our skilled service engineers. By delivering calibration, installation, maintenance and repair from our accredited HBK labs and in field service engineers, HBK empowers the high quality data and knowledge transfer required for effective customer processes and ultimate successes.

HBK's Engineering Services consultants support our customers globally across multiple industries including automotive, aerospace and defence, energy, civil construction, off-highway, consumer products, medical, and more with key focus areas such as sound quality and structural health monitoring.

HBK's Engineering solutions monitor the life cycle of equipment, plant, and vehicle fleets enabling operators to improve the performance of their assets. HBK solutions increase the value of existing assets by maximizing safety, sustainability and by optimizing equipment availability and operational decision making while reducing costs and avoiding inefficiencies.

TECHNICAL SESSIONS

Technical Session 1: Fast Charging System Test, Design, and Analysis

June 23: 1:00 PM - 3:00 PM

Session Chairs: Ben Tabatowski-Bush, Ford Motor Company

- Test Bed Development for Evaluating Extremely Fast Charging Stations
  Ziping Wu1, Omid Alizadeh1, MuhidinLelic1, WahhajIrfan1, RyanGerdes2, (1)ComEd (2)Virginia Polytechnic Institute and State University
- Control of a Direct MV Grid Connected Compact Fast Charger With Input Series and Output Parallel Dual Active Bridge Converters
  Garry Jean-Pierre1 Adel Nasiri1, (1)University of Wisconsin-Milwaukee
- Parasitic Parameter Analysis of High Frequency Transformer for Series Resonant Converter with Experimental Validation
  Temitayo Olayemi Olowu, Hassan Jafari, Italo Peirano, Maryam Mahmoudi, Arif I Sarwat, Florida International University
- Comparative Economic Analysis Between LTO and C-ion Energy Storage System for Electric Vehicles Ultra-Fast Charger Buffering Application
  Nicolas Rene Sockeel, Jim Gafford, Madhav Manjrekar, MikeMazzola, Energy Production and Infrastructure Center at University North Carolina, Charlotte
- Fast Charging Li-Ion Battery Capacity Fade Prognostic Modeling Using Correlated Parameters Decomposition and Recurrent Wavelet Neural Network
  Asadullah Khalid, Arif I.Sarwat, Florida International University (FIU)

Technical Session 2: Battery Thermal Performance, Estimation, and Control

June 23: 1:00 PM - 3:00 PM

Session Chairs: Pavol Bauer, Delft University of Technology & Soeren Striepe, Magna

- Temperature Variations of a Lithium-ion Polymer Battery Cell During Electric Vehicle Driving Cycles
  Yiqun Liu, Y. Gene Liao, Ming-Chia Lai, Wayne State University
- Thermal Effects of Bad-Block-Management in an Intelligent Automotive Lithium-ion Battery Module based on Lumped 3D Electro-Thermal Modeling
  Jan Kleiner, Lorenz Lechermann, Lidiya Komsiyska, GordonElger, ChristianEndisch, Technische Hochschule Ingolstadt
- Experimental Comparison of Two Liquid Cooling Methods for Ultrafast Charging Lithium-Ion Battery Modules
  Ziyu Zhao, Phil Kollmeyer, Ali Emadi, McMaster University, McMaster Automotive Resource Centre (MARC)
- Accurate Surface Temperature Estimation of Lithium-Ion Batteries Using Feedforward and Recurrent Artificial Neural Network Models
  Mina Naguib, Phillip Kollmeyer, CarlosVidal, AliEmadi, McMaster University, McMaster Automotive Resource Centre (MARC)
- Battery Thermal-Conscious Energy Management for Hybrid Electric Bus Based on Fully-Continuous Control with Deep Reinforcement Learning
  Zhongbao Wei, Haokai Ruan, Hongwen He, Beijing Institute of Technology

Technical Session 3: Electric Machine Noise, Fatigue, Thermal, and Failure Modeling

June 23: 1:00 PM - 3:00 PM

Session Chairs: Bruno Lequesne, E-Motors Consulting. LLC & Saeed Habibi, McMaster University

- Acoustic Noise and Vibration of an Interior Permanent Magnet Traction Motor: PWM Effect
  Yawei Wang, Nathan Emery, Berker Bilgin, McMaster University
- Time-Efficient Prediction of Acoustic Noise in Switched Reluctance Motors using an Advanced Field Reconstruction Approach
  Ziyan Zhang, Zichao Jin, SelinYaman, Mahesh Krishnamurthy, Illinois Institute of Technology
- Fatigue Life Calculation and Bridge Stresses Mitigation in the Rotor Core of Delta-Shape Interior Permanent Magnet Motor
  Ashish Kumar Sahu, Ahmed S Abdelrahman, Berker Bilgin, McMaster Automotive Resource Center (MARC), McMaster University
- Comprehensive Parametric Analysis of Inter-turn Short Circuits in Interior Permanent Magnet Synchronous Machines
  Pablo E. Castro Palavicino, Bulent Sarlioglu, University of Wisconsin-Madison
- Effect of Rotor Geometry on Air Cooling of a Ventilated Axial-Flux Permanent Magnet Machine
  Islam Zaher1 Romina Rodriguez1, Ehab Sayed1, Alan Callegaro1, Mikhail Goykhman2, AliEmadi1, (1) McMaster University, (2) Eaton Aerospace

Technical Session 4: Electric Aircraft Propulsion System Design and Analysis

June 23: 1:00 PM - 3:00 PM

Session Chairs: Ayan Mallik, Arizona State University

- An Enhanced and Cost Saving Droop Control Method for Improved Load Sharing for the More Electric Aircraft Application
  Habibu Hussaini, Cheng Wang, TaoYang, Serhiy Bozhko, Power Electronics, Machines and Control Group
- Analysis of a Hybrid Unmanned Aerial Vehicle with a BLDC Propulsion Motor Based on HIL Simulation
  Anjanee Mishra, Taehyung Kim, University of Michigan-Dearborn
- Electric Field Simulation in DC Spacers for Electrified Transportation Assets: From Voltage Transients to Steady State
  Robin Ramin1,2 Gian CarloMontanari1, Peter Zeller2, Michael Steurer1, Peter Cheetham1, (1) Florida State University, (2) University of Applied Sciences Upper Austria
- An Analysis of the Susceptibility of Electric Aircraft to Lightning Strikes
  Chelsea R. Wilson, Santiago C.Grijalva, Georgia Institute of Technology
- Optimal Voltage for More Electric Aircraft Cabling System
  Angel A Recalde1,2 Serhiy V. Bozhko1, Jason A. Atkin1, Sharmila Sumsurooah1 (1) University of Nottingham, (2) Escuela Superior Politecnica del Litoral

TECHNICAL SESSIONS

Technical Session 5: Dynamic Wireless Charging and Propulsion

June 23: 3:30 PM - 5:30 PM

Session Chairs: Tiefu Zhao, University of North Carolina at Charlotte & Md Tawhid Bin Tarek, University of Akron

- Deployment Optimization of Dynamic Wireless Chargers for Electric Vehicles
  Ahmed O El Meligy, Eiman A Elghanam, Mohamed S Hassan, Ahmed H Osman, American University of Sharjah
- Propulsion Assisting Roads for Driving Range Extension of Electric Vehicles
  Vladimir Kuptsov1, Poria Fajri1, MohammadShadmand2, (1) University of Nevada Reno, (2) University of Illinois, Chicago
- The Sensitivity Analysis of Coil Misalignment for a 200kW Dynamic Wireless Power Transfer System with an LCC-S and LCC-P Compensation
  Utkarsh D Kavimandan1, Veda PGaligekere2, OmerOnar2, Burak Ozpineci2, Satish M Mahajan1, (1)Tennessee Technological University, (2)Oak Ridge National Laboratory
- Design and Modeling of Auxiliary Misalignment Detection Coils for Dynamic Wireless Electric Vehicle Charging Systems
  Youssef Louca, Eiman A Elghanam, Mohamed S Hassan, Ahmed H Osman, American University of Sharjah
- Quasi-dynamic Electromagnetic Field Safety Analysis and Mitigation for High-Power Dynamic Wireless Charging of EVs
  Bo Zhang1, Richard B.Carlson1, Veda P. Galigekere2, Omer C. Onar2, Mostak Mohammad2 Charles C. Dickerson1, Lee K.Walker, (1)Idaho National Laboratory, (2) Oak Ridge National Laboratory

Technical Session 6: Fuel Cell Vehicle Modeling and Energy Management Strategies

June 23: 3:30 PM - 5:30 PM

Session Chairs: Liping Guo, Northern Illinois University & Rui Ma, Northwestern Polytechnical University

- Dual Functional Power Management System for an Energy Storage in Light Fuel-Cell Hybrid Electric Vehicles
  Taehyung Kim, University of Michigan-Dearborn
- Multi-Mode Power Allocation Strategy Based on Kalman Filter Algorithm for Fuel Cell Electric Vehicle
  Tianhong Wang1,2 Qi Li1, Weirong Chen1, QianLi2, Alexandre Ravey2, Elena Breaz2,3, Fei Gao2 (1)Southwest Jiaotong University, (2)University of Technology of Belfort-Montbeliard, (3) Technical University of Cluj-Napoca
- Real-time Predictive Energy Management for Fuel Cell Electric Vehicles
  Yang Zhou, Alexandre Ravey, Marie-Cécile Péra, University Bourgogne Franche-Comté, UTBM
- System-level Modeling and Virtual Testing of Fuel Cell Vehicle Mobypost Using Energetic Macroscopic Representation
  Hao Bai1, Chen Liu2, Daniela Chrenko3,4, lexandre Ravey3,4, FeiGao3,4, (1) Northwestern Polytechnical University, (2) Zhengzhou University, (3) FEMTO-ST Institute, Univ. Bourgogne Franche-Comté, UTBM, CNRS, (4) FCLAB, Univ. Bourgogne Franche-Comté, UTBM, CNRS
- Hydrogen Consumption Minimization with Optimal Power Allocation of Multi-stack Fuel Cell System Using Particle Swarm Optimization
  Nureddine Bouisalmane1,2,3 , Tianhong Wang1, Elena Breaz1, Said Doubabi2, Damien Paire1 Jorn Oubraham3, Michael Levy3, Fei Gao1, (1) University Bourgogne Franche-Comté, UTBM, CNRS, (2) Cadi Ayyad University, (3) AAQIUS & AAQIUS S.A., (4) Southwest Jiaotong University

Technical Session 7: Electric Machine Design I

June 23: 3:30 PM - 5:30 PM

Session Chairs: Srihari Gangaraj, Stellantis & Dan Ionel, University of Kentucky

- Landscaping and Review of Traction Motors for Electric Vehicle Applications
  Chandra Sekhar Goli1, Madhav Manjrekar1, Somasundaram Essakiappan1, Prasanth Kumar Sahu2, Nakul Shah2, (1) University of North Carolina at Charlotte, USA, (2) QM Power Inc
- Comparative Analysis of Two Rotor Topologies for a High Power Density Dual Three-Phase IPM Propulsion Motor
  Ahmed S. Abdelrahman, Yawei Wang, Berker Bilgin, McMaster Automotive Resource Centre (MARC) - McMaster University
- Novel Design of Integrated Motor-Compressor Using Flux Reversal Permanent Magnet Machine Topology
  Leyue Zhang, Hao Ding, Ahmed Hembel, BulentSarlioglu, University of Wisconsin-Madison
- Axial Flux Interior Permanent Magnet Motor with a Novel Symmetric Flux Barrier
  Md Tawhid Bin Tarek, Yilmaz Sozer, The University of Akron
- Design of a Compact Stator Winding in an Axial-Flux Permanent Magnet Machine for Aerospace Applications
  Cyrille Goldstein1, Ehab Sayed1, Mohamed Abdelmagid1, Alan Callegaro1, Mikhail Goykhman2, Ali Emadi1, (1) McMaster University (2) Eaton Corporation

Technical Session 8: EV Control Considering Efficiency, Traffic, and Other Factors

June 23: 3:30 PM - 5:30 PM

Session Chairs: Thanh Anh Huynh, National Cheng Kung University & Di Zhu, North Carolina State University

- Optimal Torque Distribution of Dual-Motor All-Wheel Drive Electric Vehicles for Maximizing Motor Energy Efficiency
  Mingi Oh, Iqbal Husain, North Carolina State University
- Optimal Real-Time Velocity Planner Of A Battery Electric Vehicle In V2v Driving
  Matteo Spano1,2 Pier Giuseppe Anselma1,2 , Alessia Musa1,2, Giovanni Belingardi1,2 , Daniela Anna Misul1,2 (1) Politecnico di Torino, (2) Center for Automotive Research and Sustainable Mobility (CARS)
- Attack-Resilient Lateral Stability Control for Autonomous In-Wheel-Motor-Driven Electric Vehicles
  Lulu Guo, Jin Ye, Bowen Yang, The University of Georgia
- Energy Management Strategy for Dual-Motor-Based Electric Vehicle Powertrain Using Nonlinear Model Predictive Controller
  Bowen Yang, Lulu Guo, Jin Ye, Javad Mohammadpour Velni, University of Georgia
- Online State Estimation for Microscopic Traffic Simulations Using Multiple Data Sources
  Kevin Malena1, Christopher Link1, SvenMertin1, Sandra Gausemeier1, Ansgar Trächtler1,2, (1) Paderborn University, Heinz Nixdorf Institute, (2) Fraunhofer IEM

TECHNICAL SESSIONS

Technical Session 9: Resonant Converters and Current Source Inverters

June 24: 1:00 PM - 3:00 PM

Session Chairs: Temitayo Olowu, Florida International University & Martin Baumann, BMW AG

- Performance Evaluation And Loss Modeling Of WBG Devices Based On A Novel Double-Pulse Test Method For Current Source Inverter
  Feida Chen, Sangwhee Lee, Thomas M Jahns, Bulent Sarlioglu, Wisconsin Electric Machines and Power Electronics Consortium(WEMPEC)
- Maximum Efficiency Point Tracking Based Synchronous Rectification for LLC Converter
  Yuqi Wei, Alan Mantooth, University of Arkansas
- Small Signal Modeling and Control of Resonant Switched Capacitor Converter
  Yan Liu1, Xiaofeng Yang1, Chengzhang Yan1, Qian Chen2 Seikil Garashi3, Taku Takaku3, (1) Beijing Jiaotong University, (2) Electric Power Research Institute State Grid, Zhejiang Electric Power Co., Ltd. (3) Fuji Electric Co., Ltd.
- Voltage Controlled Resonant DC/DC Converter for Solid State Transformer Applications
  Temitayo Olayemi Olowu, Hassan Jafari, Arifl Sarwat, Florida International University
- Constant Frequency ZVS PWM Converter
  Erdem Asa, Oak Ridge National Laboratory

Technical Session 10: Microgrid Control and Design

June 24: 1:00 PM - 3:00 PM

Session Chairs: Farzam Malmir, Stellantis & Hengzhao Yang, ShanghaiTech University

- Demonstration of Microgrid Resiliency with V2G Operation
  ASM Jahid Hasan, Jubair Yusuf, Sadrul Ula, Luis Fernando Enriquez-Contreras, MatthewJ.Barth, University of California, Riverside
- Optimal Power Flow Estimation of Microgrid Considering the Grid Services of EV Batteries
  Jingping Nie, Liwei Zhou, Xiaofan Jiang, Matthias Preindl, Columbia University
- Programmable and Reconfigurable Cyber-Physical Networked Microgrids through Software-Defined Networking
  Yan Li1, Liang Du2, (1) The Pennsylvania State University, (2) Temple University
- Coordinated Scheduling of Electric Vehicles within Zero Carbon Emission Hybrid AC/DC Microgrids
  Reza Bayani, Arash Farokhi Soofi, Saeed D. Manshadi, San Diego State University
- Scalable Distributed Reachability Analysis for Cyber-Physical Networked Microgrids with Communication Latency
  Yan Li1, Yichen Zhang2, Dongbo Zhao2, Liang Du3, (1) The Pennsylvania State University, (2) Argonne National Laboratory, (3) Temple University

TECHNICAL SESSIONS

Technical Session 11: Electric Machine Design II

June 24: 1:00 PM - 3:00 PM

Session Chairs: Dhafar Al-Ani, Stellantis & Zhiwei Zhang, The Ohio State University

- Design and Analysis of Stator Cooling Channels for an Axial Flux Permanent Magnet Machine
  Samantha Jones-Jackson1, Romina Rodriguez1, Ehab Sayed1, Cyrille Goldstein1, Christopher Mak1, Alan Callegaro1, Mikhail Goykhman2, Ali Emadi1, (1)McMaster University, (2) Eaton Corporation
- On the Design of Coreless Permanent Magnet Machines for Electric Aircraft Propulsion
  Damien L. Lawhorn, Peng Han, Donovin Lewis, Dan M. Ionel, University of Kentucky
- A Robust Non-Permanent Magnet Five-Phase Synchronous Reluctance Traction Motor
  Zhiwei Zhang, The Ohio State University
- Multiple Objective Co-Optimization of Switched Reluctance Machine Design and Control
  Timothy Burress1,2 (1)Oak Ridge National Laboratory, (2)The University of Tennessee
- High Fidelity Rapid Modeling of Hybrid Rotor PM Machines using Equivalent Machine Model
  Dheeraj Bobba, Bulent Sarlioglu, Wisconsin Electric Machines and Power Electronics Consortium, University of Wisconsin–Madison

Technical Session 12: Motor Control I

June 24: 1:00 PM - 3:00 PM

Session Chairs: Sandun Kuruppu, Saginaw Valley State University & Piyush Desai, Turntide Technologies

- Comparison Of Model Predictive Control Strategies On PMSM Based Electric Power Steering System
  Chang Zhang, Jian Shi, Guangzhou University
- Ifoc-Controlled Pole Phase Modulated Multiphase Induction Drive For Electric Vehicles
  Priyanka C P1, Jalaj Kumar1, Jagadanand G1, Mahesh Krishnamurthy2, (1) NIT Calicut, (2) Illinois Institute of Technology
- Online Non-Parametric Auto-Tuning of Flux Weakening Controller for IPMSM Drives using Modified Relay Feedback Test (MRFT)
  Wesam Taha, Ali Emadi, McMaster Automotive Resource Centre
- A Look-up Table-based Model Predictive Torque Control of Switched Reluctance Motor Drives with Improved Prediction
  Diego F. Valencia1, Rasul Tarvirdilu-Asl1, Cristian Garcia2, Jose Rodriguez3, Ali Emadi1, McMaster Automotive Resource Center (MARC) (1) McMaster Automotive Resource Center (MARC), (2) Universidad de Talca, (3) Universidad Andres Bello
- Fast Anti-Slip Traction Control for Electric Vehicles Based on Direct Torque Control with Load Torque Observer of Traction Motor
  Byoung Gun Park, JaeWoon Lee, Ji Won Kim, Korea Electrotechnology Research Institute

Technical Session 13: Wireless and Onboard Battery Charger Design and Control

June 24: 3:30 PM - 5:30 PM

Session Chairs: Agasthya Ayachit, MBRDNA & Veda Prakash Galigekere, Oak Ridge National Laboratory

- An Accurate Online Parameter Estimation Technique for Inductive Power Transfer Systems
  Hassan Jafari, Temitayo Olowu, Masood Moghaddami, Arif Sarwat, Florida International University (FIU) - Department of Electrical and Computer Engineering
- Optimal Design of Bipolar Power Pad for Dynamic Inductive Electric Vehicle Charging Systems
  Hassan Jafari, Temitayo Olowu, Maryam Mahmoudi, Arif Sarwat, Florida International University, ECE Department
- Design And Optimization Of Cancellation Coil Topologies For A Ferrite-Less Wireless EV Charging Pad
  Aaron D Scher1, Mostak Mohammad2, Omer C Onar2, Burak Ozpineci2, (1) Oregon Institute of Technology, (2) Oak Ridge National Laboratory
- Comparison of Litz Wire and PCB Inductor Designs for Bidirectional Transformerless EV Charger with High Efficiency
  Weizhong Wang1, Liwei Zhou2, Michael Eull2, Matthias Preindl2 (1) Lucid Motors, (2) Columbia University
- Real Time Intelligent Data Processing Algorithm for Cyber Resilient Electric Vehicle Onboard Chargers
  Saikat Dey, Ashwin Chandwani, Ayan Mallik, Arizona State University

Technical Session 14: Fuel Cell Vehicle Power Electronics

June 24: 3:30 PM - 5:30 PM

Session Chairs: Daniela Chrenko, Univ. Bourgogne Franche-Comté, CNRS, Belfort & Elena Breaz, University of Technology of Belfort Montbéliard

- An LLC Converter With Fixed Switching Frequency Operation For Renewable Energy Applications
  Yuqi Wei, Alan Mantooth, University of Arkansas
- Fault-Tolerant Control of Three-Phase Bidirectional Current-Fed Dual Active Bridge DC-DC Converter
  Tat-Thang Le1, Minh-Khai Nguyen2, Sewan Choi1, Caisheng Wang2, (1) Seoul National University of Science and Technology, (2) Wayne State University
- High Gain Non-isolated ZCS Current-fed Full-Bridge Partial Series Resonance Based Voltage Quadrupler for Fuel Cell Vehicles
  Koyelia Khatun1, Akshay Rathore2, (1) Kansas State University, (2) Concordia University
- A Reduced-Scale Power Hardware-in-the-Loop Platform for a Fuel Cell Electric Vehicle
  Chao Jia, Junwei Cui, Wei Qiao, Liyan Qu, University of Nebraska - Lincoln
- A Novel Nonisolated Multi-port Bidirectional DC-DC Converter With High Voltage Gain for Fuel Cell Hybrid System
  Yuhui Ma1, Yigeng Huangfu1, Liangcai Xu1, Hao Bai1, Fei Gao2, (1)Northwestern Polytechnical University, (2)University of Technology of Belfort- Montbeliard

Technical Session 15: Rare Earth Free Electric Machines

June 24: 3:30 PM - 5:30 PM

Session Chairs: Uday Deshpande, D&V Electronics & Diego Valencia, McMaster University

- Design of High Power Density 100 kW Surface Permanent Magnet Machine with No Heavy Rare Earth Material for Traction Application Using Current Source Inverter
  Wenda Feng, Hao Ding, Feida Chen, Sangwhee Lee, Ken Chen, Thomas Jahns, Bulent Sarlioglu, Wisconsin Electric Machine and Power Electronics Consortium
- Six-Phase Non-Rare Earth Spoke Interior Permanent Magnet Traction Motor With Concentrated Windings
  Zhiwei Zhang, The Ohio State University
- Adjoint Sensitivity Analysis of Radial Forces in Switched Reluctance Machines
  Mohamed Abdalmagid, Mohamed H. Bakr, Ehab Sayed, Ali Emadi, McMaster University
- Time-Efficient Behavioral Modeling of Switched Reluctance Machines
  Zichao Jin, Ziyan Zhang, Selin Yaman, Mahesh Krishnamurthy, Illinois Institute of Technology
- Reluctance Mesh-Based Modeling of Switch Reluctance Machines
  Gayan Watthewaduge, Ehab Sayed, Ali Emadi, Berker Bilgin, McMaster University

Technical Session 16: Motor Control II

June 24: 3:30 PM - 5:30 PM

Session Chairs: Bulent Sarlioglu, University of Wisconsin-Madison & Babak Nahid-Mobarakeh, McMaster University

- Low-Speed Sensorless Control of a Surface Mounted Permanent Magnet Motor in an e-Bike Application
  Silvio Rotilli Filho1, Le Sun1, Tim Lambert 2, Muhammad Ikhlas2, Yinye Yang Yang1, Ali Emadi1, (1)McMaster University, (2) Accelerated Systems Inc.
- Challenges in the Development of Ford Mustang Mach-E BEV eMotor Calibration and Controls for NVH & Losses
  Nurani Chandra, Engineering Society of Detroit
- Position Sensor Harmonics Influence on Highly Integrated Field Oriented Controlled PMSM Drive Torque Output
  Sandun Kuruppu, Saginaw Valley State University
- Stability Analysis of PI-Controller-Type Position Estimator for Sensorless PMSM Drives in Flux Weakening Region
  Jiwon Yoo, Seung-Ki Sul, Seoul National University
- A Review of Virtual-Flux Model Predictive Control and Receding Horizon Estimation in Motor Drives
  Michael Eull, Matthias Preindl, Columbia University

Technical Session 17: Wireless and Onboard Battery Charging System Design

June 25: 8:00 AM - 10:00 AM

Session Chairs: Michael Eull, Columbia University & Bo Zhang, Idaho National Laboratory

- A Non-isolated Onboard Charging System for Light Electric Vehicle
  Utsav Sharma, Bhim Singh, Indian Institute of Technology, Delhi
- A BLDC Motor-Driven Light Plug-in Electric Vehicle (LPEV) with Cost-Effective On-Board Single-Stage Battery Charging System
  Anjanee Kumar Mishra, Taehyung Kim, University of Michigan-Dearborn
- Design Considerations of An Inductive Power Transfer System for Rail Applications
  Xiwen Xu, Luocheng Wang, Karl Lin, Shen-En Chen, Tiefu Zhao, University of North Carolina at Charlotte
- Thermal Analysis of 50 kW Three-Phase Wireless Charging System
  Mostak Mohammad, Omer Onar, Jason Pries, Gui-Jia Su, Veda Prakash Galigekere, Jonathan Wilkins, Oak Ridge National Laboratory
- Improved Power Quality On-Board Charging Solution for Light Electric Vehicles
  Bhim Singh, Jitendra Gupta, Indian Institute of Technology, Delhi

Technical Session 18: Battery Management and State of Charge Estimation

June 25: 8:00 AM - 10:00 AM

Session Chairs: Carlos Jose Vidal, McMaster University & Hao Bai, Northwestern Polytechnical University

- A Hybrid Long Short-Term Memory Network for State-of-Charge Estimation of Li-ion Batteries
  Isaiah Oyewole, Abdallah Chehade, Mayuresh Savargaonkar, Youngki Kim, University of Michigan - Dearborn
- Sparse Auto-Encoded LSTM for Long-Term State-of-Charge Estimations of Battery Cells
  Mayuresh Savargaonkar, Abdallah Chehade, Isaiah Oyewole, University of Michigan - Dearborn
- SOC Estimation Error Analysis for Li Ion Batteries
  Di Zhu, Satish Chikkannanavar, JonathanTao, Ford Motor Company
- A Kalman Filter Based Battery State of Charge Estimation MATLAB Function
  Fauzia Khanum, Eduardo Louback, Federico Duperly, Colleen Jenkins, Phillip Kollmeyer, Ali Emadi, McMaster University
- Communication Challenges and Solutions for Distributed Battery Management and Second Life Arrays
  Ben Tabatowski-Bush, Ford Motor Company

Technical Session 19: Thermal Management of Power Electronics

June 25: 8:00 AM - 10:00 AM

Session Chairs: Philip Krein, University of Illinois at Urbana-Champaign and Zhejiang University & Chetan Ugare, AVL Softwares and Functions Gmbh

- Investigation of Cooling Techniques for Integrated Motor Drives - A System-Level Approach
  Renato Amorim Torres1, Hang Dai1, Woongkul Lee2, Thomas Jahns1 BulentSarlioglu1, (1) University of Wisconsin-Madison, (2) Michigan State University
- A Fast And Accurate Thermal-Electrical Coupled Model For Sic Traction Inverter Performance Estimation
  Yuhang Yang1, Mohamed Hefny1, Kenneth Noronha1, Alan Callegaro1, Mikhail Goykhman2, Armen Baronian2, Ali Emadi1, (1) McMaster Automotive Resource Centre (MARC), McMaster University, (2) Eaton Aerospace, LLC
- Weight Reduction Considerations for Thermal Management of Aerospace Power Electronics
  Paul Shibata1, John Ramoul1, Romina Rodriguez1, Alan Dorneles Callegaro1, Piranavan Suntharalingam2 James Cotton1, Ali Emadi1, (1)McMaster University, (2) Eaton Research Labs
- Cold Plate Tool Development for Aerospace Applications
  Romina Rodriguez1, Mario F Cruz2, Ali Emadi1, (1)McMaster University, (2) Eaton
- Emulation of High-Dynamic Automotive Loads Using Parallel MOSFETs in Linear Mode Operation
  Leo Tassilo Peters1 Christoph Weissinger2 MartinBaumann1,2, Julian Taube1, Hans-Georg Herzog1, (1) Technical University of Munich, (2) BMW Group

Technical Session 20: Ship and Marine Power Systems

June 25: 8:00 AM - 10:00 AM

Session Chairs: Cassiano Rech, Federal University of Santa Maria

- Integrated Design And Control Approach For Marine Power Systems; First Step In System Design Optimization
  Dalia Casanova Mombiela, Norwegian University of Science and Technology
- Control Strategy of Electric Propulsion System to Improve Ship Dynamics
  Sanggi Ko1, Jonghun Yun1, Seung-Ki Sul1, Shin-Won Kang2, Sang-Hyun Kim2 , (1) Seoul National University, (2)Korea Shipbuilding & Offshore Engineering Co., Ltd.
- Modeling In-and-Out-of-Water Impact on All-Electric Ship Power System Considering Propeller Submergence in Waves
  Saman Nasiri1, Saeed Peyghami2, Mostafa Parniani1, FredeBlaabjerg2, (1) Sharif University of Technology, (2) Aalborg Universitet
- Reliability Analysis for Shore-to-Ship Fast Charging Systems
  Siamak Karimi1, Mehdi Zadeh1, Jon AreSuul2,3, Christoph Thieme1, (1) Department of marine technology, Norwegian University of Science and Technology (NTNU), (2) Department of engineering cybernetics, Norwegian University of Science and Technology (NTNU), (3) SINTEF Energy Research
- Co-Simulation of a Marine Hybrid Power System for Real-Time Virtual Testing
  Pramod Ghimire1,2, Mehdi Zadeh1, Eilif Pedersen1, (1) Norwegian University of Science and Technology, (2) Kongsberg Digital

Technical Session 21: Charging Infrastructure Design Considerations

June 25: 10:30 AM - 12:30 PM

Session Chairs: Steve McHenry, SRF Consulting Inc & Mohammad Saad Alam, Center of Advanced Research in Electrified Transportation, AMU, India

- A Novel Multi-Tier Real-Time Pricing Policy For Electric Vehicle Charging Stations
  Ashwini Uthirakumar, San Francisco State University
- PEVs Idle Time Prediction at Public Charging Stations Using Machine-Learning Methods
  Ahmad Almaghrebi1, Fares Aljuheshi1, Kevin James1, Nasser Aljuhaishi2, MahmoudAlahmad1, (1) University of Nebraska-Lincoln, (2) Kuwait University
- Analysis of PEV User Charging Behavior at Household Charging Stations, Omaha Case Study
  Ahmad Almaghrebi1,2, Xiaoyue Cheng2, KevinJames1, MahmoudAlahmad1, (1) University of Nebraska-Lincoln, (2)University of Nebraska at Omaha
- Correlation Study Between Features Of A Geographic Location And Electric Vehicle Uptake
  Subhaditya Shom, Mahmoud Alahmad, Kevin James, University of Nebraska-Lincoln
- Cybersecurity for Electric Vehicle Fast-Charging Infrastructure
  Anuj Dilip Sanghvi, Anthony Markel, National Renewable Energy Laboratory

Technical Session 22: EV Charging Systems Supplemented with PV, Batteries, and Electrolyzers

June 25: 10:30 AM - 12:30 PM

Session Chairs: Saeed Peyghami, Aalborg University & Tianyu Hu, University of Science and Technology Beijing

- Control of PV Array, WECS Based EV Charging Station with Seamless Grid Interface
  Anjeet Kumar Verma, Bhim Singh, Indian Institute Of Technology, Delhi
- Combined Use of EV Batteries and PV Systems for Improving Building Resilience to Blackouts
  Huangjie Gong, Dan M. Ionel, SPARK Lab, Department of Electrical and Computer Engineering
- Optimal Battery Energy Storage System Sizing for Demand Charge Management in EV Fast Charging Stations
  George Koolman, Marco Stecca, Pavol Bauer, Electrical Sustainable Energy Department, Delft University of Technology
- Aggregated Impact of EV Charger Type and EV Penetration level in Improving PV Integration in Distribution Grids
  Saumitra Wagh1, Yunhe Yu1, Aditya Shekhar1, Gautham Ram Chandra Mouli1, Pavol Bauer1, Delft University of Technology
- Power-to-Gas Systems for Active Load Management at EV Charging Sites with High DER Penetration
  Rishabh Jain1, Kazunori Nagasawa1, National Renewable Energy Laboratory

Technical Session 23: Inverter Design and Analysis

June 25: 10:30 AM - 12:30 PM

Session Chairs: Peter Azer, McMaster University

- Analysis of EMI Source in Balanced Inverter
  Pengkun Tian, Thomas M. Jahns, Bulent Sarlioglu, Wisconsin Electric Machines and Power Electronics Consortium (WEMPEC), University of Wisconsin-Madison
- Comparative Analysis of 2-Level and 3-Level Voltage Source Inverters in Electric Traction Applications
  Yicheng Wang1,2, Amirreza Poorfakhraei1,2, Mehdi Narimani1,2, Ali Emadi1,2, (1)McMaster University, (2) McMaster Automotive Resource Centre (MARC)
- Plastics in high reliability Power Inverter Applications
  Chetan Ugare, Christoph Bauer, AVL Software and Functions GmbH
- Efficiency Evaluation of 2L and 3L SiC-Based Traction Inverter Topologies for Electric Vehicles with 800V Battery
  Wesam Taha, Babak Nahid-Mobarakeh, JenniferBauman, McMaster University
- Crash Safety Of A Power Electronic Unit Of An Electrified Vehicle
  Desiree Kofler1, Alessio Sevarin1, Christian Ellersdorfer1, Alexander Thaler2, Wolfgang Sinz1, (1) Vehicle Safety Institute at Graz University of Technology, (2) Virtual Vehicle Research GmbH

Technical Session 24: Electric Aircraft Power Electronic Topologies and Control

June 25: 10:30 AM - 12:30 PM

Session Chairs:

- Comparative Investigation of SiC Current Source Converter and Matrix Converter Topologies for Aircraft Medium-Voltage Turboelectric Propulsion
  Benjamin Luckett, JiangBiao He, University of Kentucky
- A New Cost-Effective Consolidated Converter for Small Hybrid Electric Aircraft
  Anjanee Kumar Mishra, Taehyung Kim, University of Michigan-Dearborn
- A Compact 50kW High Power Density, Hybrid 3-Level Paralleled T-type Inverter for More Electric Aircraft Applications
  Likhita Ravuri, Hao Tu, Arindam Chatterji, Hui Yu, Srdjan Lukic, FREEDM Systems Center
- An Improved Feedforward Controller for Minimizing the DC-link Capacitance in a Brushless Synchronous Generator based Aircraft DC Power System
  Goutham Selvaraj, Krishna Raj Ramachandran Potti, Kaushik Rajashekara, University of Houston
- Optimised Current Loop Design for a High Speed Nine-Phase Permanent Magnet Synchronous Machine in More Electric Aircraft: A Case Study
  Mi Tang1, Bo Wang1, Zhen Huang1, Xiaoyu Lang1, Ganeish Velmurugan1, Tao Yang1, Chris Gerada1, Pericle Zanchetta1,2, (1) University of Nottingham, (2) University of Pavia

Technical Session 25: Charging Impact on Power Distribution Systems and Microgrids

June 25: 1:30 PM - 3:30 PM

Session Chairs: Bhim Singh, IIT Delhi & George Koolman, Royal Haskoning DHV

- Integration of Electric Vehicle Loading and Charging Infrastructure in Distribution Network
  Vivienne Hui Fan, Ke Meng, Zhaoyang Dong, School of Electrical Engineering and Telecommunications, University of New South Wales
- Power Hardware-in-the-Loop Demonstrator for Electric Vehicle Charging in Distribution Grids
  Lode De Herdt, Aditya Shekhar, Yunhe Yu, Gautham Ram Chandra Mouli, Pavol Bauer, Jianning Dong, Delft University of Technology
- Strategies to Maintain Voltage on Long, Lightly Loaded Residential Feeders with Widespread Residential Level 2 Plug-in Electric Vehicle Charging
  Don Scoffield1, John Smart1, Timothy Pennington1, C. Birk Jones2, Matthew Lave2, Anudeep Medam1, Bhaskar Mitra1, (1)Idaho National Laboratory, (2) Sandia National Laboratories
- Analyzing Power Quality Implications of High Level Charging Rates of Electric Vehicle within Distribution Networks
  Arash Farokhi Soofi1, Reza Bayani1, Saeed D. Manshadi2, (1) University of California, San Diego (2)San Diego State University
- Identifying Hopf Bifurcations of Networked Microgrids Induced by the Integration of EV Charging Stations
  Xinyuan Jiang1, Yan Li1, Liang Du2, DaningHuang1, (1) The Pennsylvania State University (2) Temple University

Technical Session 26: Battery Aging, State of Health, and Hybrid Energy Storage

June 25: 1:30 PM - 3:30 PM

Session Chairs: Md Rasheduzzaman, Southeast Missouri State University & Nicolas Sockeel, UNC Charlotte

- Assessing Impact of Heavily Aged Batteries on Hybrid Electric Vehicle Fuel Economy and Drivability
  Pier Giuseppe Anselma1,2, Phillip Kollmeyer3, StefanoFeraco1,2, Angelo Bonfitto1,2, Giovanni Belingardi1,2, Ali Emadi3, Nicola Amati1,2, Andrea Tonoli1,2, (1) Department of Mechanical and Aerospace Engineering (DIMEAS), Politecnico di Torino, (2)Center for Automotive Research and Sustainable Mobility (CARS), Politecnico di Torino, (3) McMaster Automotive Resource Centre (MARC), McMaster University
- Performance Enhancement of a Hybrid Battery-Supercapacitor EV Energy Storage System
  Hazem M Sharf, Eiman A Elghanam, Mohamed S Hassan, Ahmed H Osman, Ahmed O El Meligy, American University of Sharjah
- Practical State of Health Estimation of Lithium-ion Battery with High Robustness to Charging Partialness
  Haokai Ruan, Hongwen He, Zhongbao Wei, Beijing Institute of Technology
- The Effectiveness of Charge Limiting and Partial Charge Limiting
  Evan Chen, University of California, Davis
- EIS Measurements from Accelerated and Realistic Aging Tests
  Marvin Messing1,2, Tina Shoa1, Saeid Habibi2, (1)Cadex Electronics, (2) McMaster University

TECHNICAL SESSIONS

Technical Session 27: Power Electronics for Vehicle Chargers I

June 25: 1:30 PM - 3:30 PM

Session Chairs: Shenli Zhou, Rivian

- A Novel Three Phase Oak Ridge DC / AC Converter for Wireless Grid Tied Applications
  Omer Onar, Erdem Asa, Oak Ridge National Laboratory
- High Efficiency Bidirectional LLC Converter for Solar-Charged Electric Vehicles
  Pengfei Zheng, Jennifer Bauman, Mcmaster University
- AC-AC Matrix Converter Using Lookup-Based PWM for Inductive Power Transfer Systems
  Hassan Jafari, Temitayo Olowu, Maryam Mahmoudi, Arif Sarwat, Florida International University (FIU) - Department of Electrical and Computer Engineering
- Design and Evaluation of SiC Active Soft-Switching Cell for 1-ph/3-ph Universal Voltage Input PFC for On-Board Charger Applications
  Tomas Sadilek1,2, Yungtaek Jang1, Peter Barbosa1, Iqbal Husain2, (1) Milan M. Jovanovic Power Electronics Lab, (2) FREEDM Systems Center, NCSU
- Modular Design of Receiver Side Power Electronics for 200 kW High Power Dynamic Wireless Charging System
  Lingxiao Xue, Veda Prakash Galigekere, Emre Gurpinar, Gui-jia Su, Omer C. Onar, Oak Ridge National Laboratory
- A Unique Modulation Technique for Reduced Common Mode Voltage in IMC
  Vulavakayala Siva, IIT (BHU) Varanasi

Technical Session 28: Hybrid Electric Vehicle Energy Management

June 25: 1:30 PM - 3:30 PM

Session Chairs: Yang Zhou, Northwestern Polytechnical University

- Double Q-learning Algorithm-based Energy Management Strategy of Fuel Cell/Battery Hybrid System
  Xiang Meng, Qi Li, Guorui Zhang, Xiaofeng Wang, Weirong Chen, Southwest Jiaotong University
- Gearshift Schedule of P2 Hybrid Powertrain During Regenerative Braking Process
  Sihao Wu1, Peng Dong1, Jiadong Sheng1, Xiaodong Li2, KaifengWang3, ShuhanWang1, XiangyangXu1, (1) Beihang University, (2) Guizhou Kaixing Hydraulic Transmission Machinery Co. LTD. (3) Shaanxi Fast Gear Co., Ltd.
- A New Regen-based Energy Management Strategy for Online Control of Hybrid Powertrains
  Lucas Bruck, Ali Emadi, McMaster University
- Fully Decentralized Energy Management Strategy Based on Model Predictive Control in a Modular Fuel Cell Vehicle
  Arash Khalatbarisoltani1, Loic Boulon1, XiaosongHu2, (1) Université du Québec à Trois-Rivières, (2) Chongqing University
- Effects Of Battery Pack Capacity On Fuel Economy Of Hybrid Electric Vehicles
  Yiqun Liu, Y. Gene Liao, Ming-Chia Lai, College of Engineering, Wayne State University

Technical Session 29: Coordination of EV Charging

June 25: 3:30 PM - 5:30 PM

Session Chairs: Aditya Shekhar, Delft University of Technology

- Thermal Stress Oriented Dispatch Strategy for Paralleled Grid-Connected Converters in Electric Vehicle Charging Stations
  Luocheng Wang1, Linquan Bai2, Tiefu Zhao1, (1) University of North Carolina at Charlotte, (2) University of North Carolina at Charlotte
- EV Specific Time-of-use Rate Analysis for Workplace Charging
  Sadik Kucuksari1, Nuh Erdogan2, (1) University of Northern Iowa, (2) University College Cork
- A Spatial-Temporal EV Charging Demand Model Considering Generic Second-Order Traffic Flows
  Megan Ross, Benjamin Seibold, LiangDu, Temple University
- Probabilistic Electric Vehicle Charging Demand Forecast Based on Deep Learning and Machine Theory of Mind
  Tianyu Hu1 Kailong Liu2, Huimin Ma1, (1)School of Computer and Communication Engineering, (2) WMG
- Real-time Aggregation of Large-scale EVs Considering Fast Charging
  Sina Kiani1 Keyhan Sheshyekani1, HananeDagdougui2, (1) Department of Electrical Engineering, Polytechnique Montréal (2)Department of Mathematics and Industrial Engineering, Polytechnique Montréal

Technical Session 30: Battery Modeling and Analysis

June 25: 3:30 PM - 5:30 PM

Session Chairs: Zack Yang, Stellantis & Abdallah Chehade, University of Michigan-Dearborn

- Battery Voltage Prediction Using Neural Networks
  Di Zhu1, Jeffrey Joseph Campbell2, Gyouho Cho3, (1) North Carolina State University, (2) University of Texas, (3) University of Michigan
- A Voltage Fault Detection Method Enabled by A Recurrent Neural Network for Lithium-ion Batteries
  Olaoluwa Joseph Ojo1, Xianke Lin1, Haoxiang Lang1, Xiaosong Hu2, (1) Ontario Tech University, (2) Chongqing State Key Laboratory of Mechanical Transmissions, Department of Automotive Engineering,University
- Peukert's Law for Lithium-ion Capacitors With Constant Power Loads
  Hengzhao Yang, Shanghai Tech University
- Modeling of Traction Batteries for Rail Applications Using Artificial Neural Networks
  René Bauer, Sebastian Reimann, Peter Gratzfeld, Institute of Vehicle System Technology, Rail System Technology, Karlsruhe Institute of Technology (KIT)
- Cost Analysis of Different Battery Pack Architectures
  Ye Cheng1, Matilde D'Arpino1, PorporaFrancesco1,2, GiorgioRizzoni1, (1) Center for Automotive Research, The Ohio State University, (2) University of Cassino and Southern Lazio

Technical Session 31: Power Electronics for Vehicle Chargers II

June 25: 3:30 PM - 5:30 PM

Session Chairs: Minh-Khai Nguyen, Wayne State University

- Fault-Tolerant Method Based On Reconstructed Modulation For H-Bridge Converter In Power Electronic Traction Transformer
  Nan Zhao, Zedong Zheng, Yongdong Li, Tsinghua University
- Deadzone Compensated Double Integral Sliding Mode Control for Distributed Converters
  Martin Baumann1,2, Yue Sun1,2, Bert Haj Ali1,2, Christoph Weissinger1, Hans-GeorgHerzog2, (1) BMW Group, (2)Technical University of Munich
- Small Signal Analysis and Control of Single-Phase Bridgeless Cuk-based PFC Converter for On-Board EV Charger
  Akshay Rathore, Sukanya Dutta, Concordia University
- Single-Phase Five-Level Quasi-Switched Boost T-Type Inverter
  Vinh-Thanh Tran1, Minh-Khai Nguyen2, Duc-Tri Do1 Caisheng Wang2, (1) Ho Chi Minh City University of Technology and Education (2) Wayne State University
- Zero Sequence Voltage Control Enabling Transformerless Electric Vehicle Chargers
  Michael Eull1, Weizhong Wang2, Liwei Zhou1, Matthias Preindl1, (1)Columbia University, (2) Lucid Motors

Technical Session 32: Bus, Truck, and Rail Electrification

June 25: 3:30 PM - 5:30 PM

Session Chairs: Santosh Singh, Indian Institute of Technology (BHU) Varanasi & Zhongbao Wei, Beijing Institute of Technology

- Energy Consumption Uncertainty Model For Battery-Electric Buses in Transit
  Hatem Abdelaty, Moataz Mohamed, McMaster University
- Efficiency Map based Modelling of Electric Drive for Heavy Duty Electric Vehicles and Sensitivity Analysis
  Nived Abhay1, Jianning Dong1, Pavol Bauer1, Simon Nouws2, (1) Delft University of Technology, (2) DAF Trucks NV
- Energy Analysis of City and Intercity Electric Buses and their Battery Size Requirements
  Hussein Basma1, Charbel Mansour1,2, Marc Haddad2, Maroun Nemer1, Pascal Stabat1, (1) PSL Research University - Mines ParisTech, Center for Energy Efficiency of Systems (CES), (2) Lebanese American University, Industrial and Mechanical Engineering Department
- Assessing the Charging Load of Battery Electric Bus Fleet for Different Types of Charging Infrastructure
  Hussein Basma1, Charbel Mansour1,2, Maroun Nemer1, Marc Haddad2, Pascal Stabat1, (1) PSL Research University - Mines ParisTech, Center for Energy Efficiency of Systems (CES), (2)Lebanese American University, Industrial and Mechanical Engineering Department
- High Voltage DC Traction Power Supply For Urban Rail Transit
  Miao Wang, Xiaofeng Yang, Shixiang Li, Menghan Ni, Trillion Q Zheng, Beijing Jiaotong University

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12. Codes, Standards, Policies, and Regulations for Transportation Electrification

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