

ITEC2019

2019 IEEE Transportation Electrification Conference and Expo



ITEC is aimed at helping industry in the transition from conventional vehicles to advanced electrified vehicles

Final Program

**Suburban Collection Showplace
Novi, Michigan, USA
June 19-21, 2019**



ITEC Sponsors



Dear ITEC 2019 Participants,

It is with great pleasure that I welcome conference participants from industry, academia, government agencies, and the public to the 2019 IEEE Transportation Electrification Conference and Expo (ITEC'19), to be held this time at Suburban Collection Showplace in Michigan, from June 19 to June 21, 2019. This year is the 8th year of the conference. ITEC is aimed at helping the industry in the transition from conventional vehicles to advanced electrified vehicles. The conference is focused on components, systems, standards, and grid interface technologies, related to efficient power conversion for all types of electrified transportation, including electric vehicles, hybrid electric vehicles, and plug-in hybrid electric vehicles (EVs, HEVs, and PHEVs) as well as heavy-duty, rail, off-road vehicles, airplanes and ships.



Our conference includes a diverse set of activities: keynote speakers, short courses, tutorials, panels, oral and poster presentations. It is an excellent venue to share ideas, disseminate knowledge, network, and become part of this exciting field. We will have an exhibition area where many companies, societies, and other entities will showcase their products and services in the area of transportation electrification.

This year, we have 12 keynote speakers from industry, government, and academia. Subjects range from electrification of aircrafts and vehicles, to integration of future transportation and smart grids, to wireless power charging, and to Department of Energy's initiative on research and design in vehicle technologies. We have leading experts discussing wide-band-gap technology trends, supply-chain integration, manufacturing innovations, and commercialization in the Town Hall Session. We have six short courses and five tutorials in the areas of energy storage, power electronics, electric machines, connected vehicles, electric roads and electrified powertrain. Moreover, there will be two industry special sessions and seven panels where numerous experts from industry and academia will share their expertise and answer questions from participants. ITEC 2019 is the inaugural year for a Women in Engineering event to promote female engineers and scientists in this exciting field.

The organizing committee and I look forward to welcoming you at ITEC'19 on June 19-21 at Suburban Collection Showplace in Michigan.

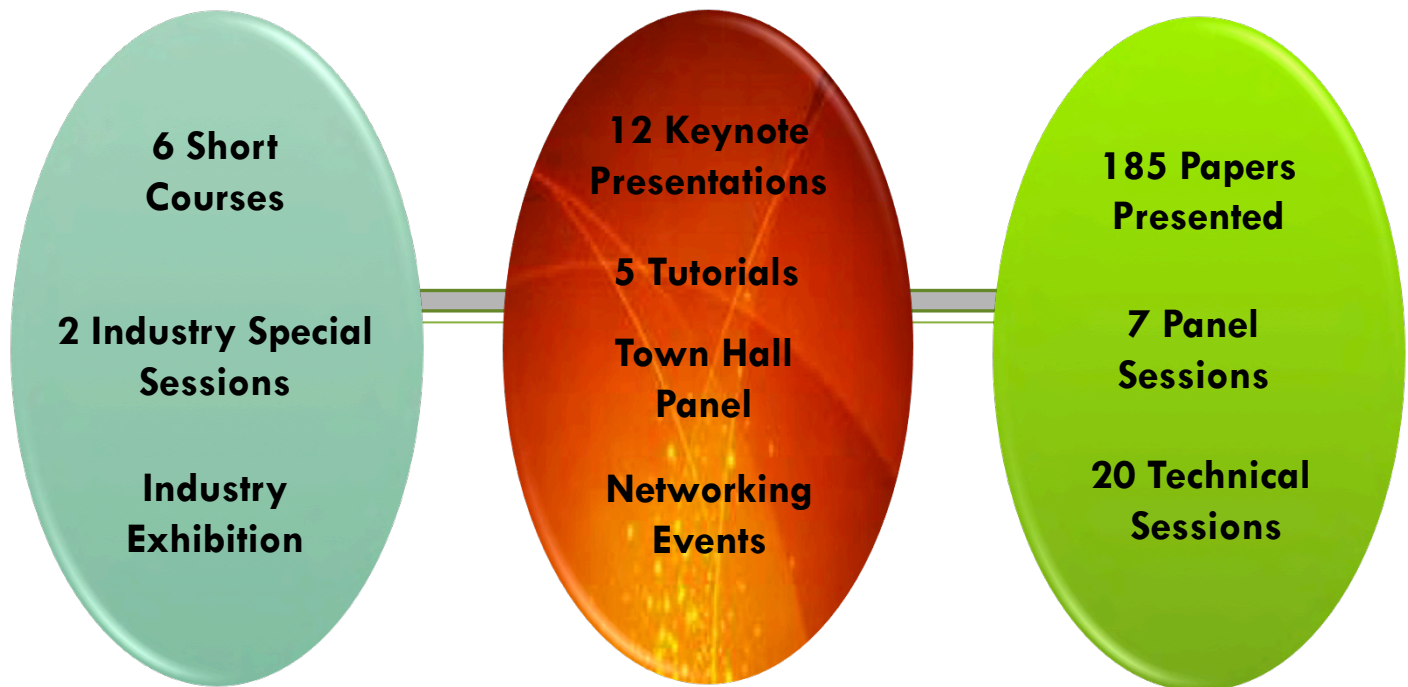
We hope that you enjoy the conference and have a great experience.

Best regards,
Dr. Jin Ye
General Chair, ITEC'19



You will experience....

ITEC is focused on components, systems, standards, and grid interface technologies, related to efficient power conversion for all types of electrified transportation for electric, hybrid electric, and plug-in hybrid electric vehicles (EVs, HEVs, and PHEVs) as well as heavy-duty, rail, off-road vehicles, airplanes and ships.



Keynote Speakers

It's About The Knowledge Shared...

Hao Huang

IEEE Fellow, Technical Chief
GE Aviation

Carl Kutsche

Chief Technologist
Idaho National Laboratory

Igor Stamenkovic

Global Technology Director
Eaton Corporation

Richard Hellinga

Manager
Borgwarner Technical Center

V. Anand Sankaran

IEEE Fellow, Director of Electrified
Powertrain Engineering
Ford Motor Company

Joachim Kupe

Head of Engineering and
Project Management - NA
Mildhybrid Edrives Segment
Hybrid and Electric Vehicles
Continental Automotive Systems

Steven Boyd

Program Manager
Vehicle Technologies Office
US Department of Energy

John M. Miller

Life IEEE Fellow
Technical Advisor
Momentum Dynamics Corp

Morris Kessler

Chief Technology Officer
WiTricity

Nitin Patel

Head of ePT Technology and Design
Fiat Chrysler Automobiles

Eric Hultgren

Principal Engineer
General Dynamics Electric Boat

Annette Muetze

IEEE Fellow
Professor
Graz University of Technology



GE Aviation



FIAT CHRYSLER AUTOMOBILES



It's About Collaboration...

All conference registrants are welcome to attend the panel discussions, which are in parallel with short courses and tutorials, at no additional charge.

Panels are 80 minutes in duration and are scheduled in the afternoons of Wednesday (June 19, 2019) and Thursday (June 20, 2019).

At each panel, the panel moderator/organizer and panelists will each give a short 5-10 minute presentation/speech and then the floor will be opened to the audience for open panel discussions and Q&A.

Panel 1

High Voltage Traction Systems for Performance Electric Vehicles

Panel 2

Off-Road Vehicle Electrification

Panel 3

Battery Management Systems: State of the Art and Future

Panel 4

Electric Vehicle Grid Integration and Services

Panel 5

WBG Devices in Automotive Applications

Panel 6

Aviation Electric Propulsion Systems

Panel 7

Advancements and Developments in Electric Vehicle Charging Systems



Short Courses & Tutorials

Short Course 1

Model-Based Design for Electric Powertrain Systems

Short Course 2

Functional Safety for Electrified Powertrains

Short Course 3

Electric Road Systems

Short Course 4

Thermal Materials, Components, and Systems: Key Solutions for Vehicle Electrification

Short Course 5

Electrified Powertrain, an Overview for Plug-in Hybrids and Electric Vehicle

Short Course 6

Applying Wide-bandgap Devices in EV Battery Chargers

Tutorial 1

Modeling and Optimization of Trip Based Energy Consumption and Charging Management for Connected Automated Electric Vehicles

Tutorial 2

A Practical Perspective on WBG Power Device for Vehicle Electrification

Tutorial 3

History/ Advancement of Sensorless Control in Automotives

Tutorial 4

Magnetic Gears for EV Applications

Tutorial 5

Fundamentals and Review of Battery State Estimation

Continuing Education

Educational Short-Courses and Tutorials at ITEC'19 are offered by internationally renowned experts from industry and academia. The content and the quality of the courses have passed IEEE's strict criteria for educational excellence and they are entitled to award IEEE Continuing Education Units (CEUs), recognized as the standard of excellence for continuing education programs in IEEE's fields of interest.

In the United States, many states require professional engineers to obtain Professional Development Hours (PDHs) for maintaining licensure. Through IEEE's continuing education offerings, professional engineers can earn PDH certificates that can be used as evidence of participation in these courses to help meet their requirements activity (1 CEU=10 PDHs).

In order to receive the CEUs available at the course, attendees must sign the roster sheets given at the beginning of the course as well as complete a review and hand them in at the registration desk.

ITEC '19 Organizing Committee

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ITEC '19 Organizing Committee

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Off-Road Vehicle Industry Liaison Chairs

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Long Wu, *John Deere*

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Jiangbiao He, *GE Global Research*
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*

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Parikshith Channegowda, *UTRC*
Qingsong Wang, *University of British Columbia*
Jalpa Shah, *Eaton Corporation*
Hengzhao Yang, *California State University*
Poria Fajri, *University of Nevada, Reno*
Azrin Mohd Zulkefli, *Eaton Corporation*
Hossein Ghassempour Aghamolki, *Eaton Corporation*
Zhiwei Zhang, *Ohio State University*

Automotive Industry Liaison Chairs

Dhafar Al-Ani, *FCA LLC*
Ryan Ahmed, *General Motors*
Mohamad Berri, *Ford Motor Company*
Lihua Chen, *Ford Motor Company*
David Cottini, *Powersys-JMAG*
Michael Degner, *Ford Motor Company*
Suresh Gopalakrishnan, *General Motors*
Oliver Gross, *FCA LLC*
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 SA., USA*
Bin Wu, *Mercedes-Benz R&D*
Hong Yang, *Sensata Technologies*
Weimin Zhang, *SF motors*

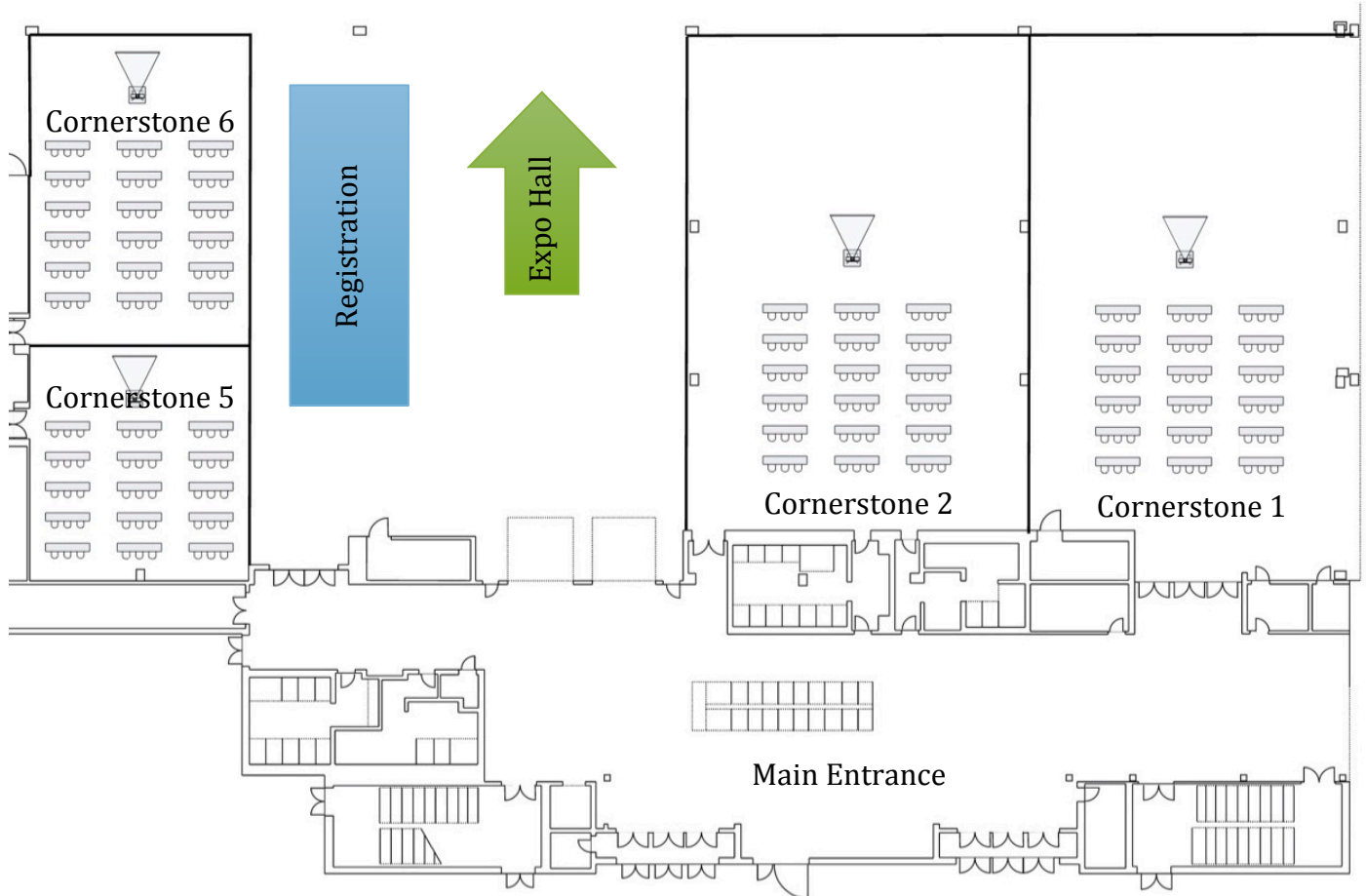
Battery Industry Liaison Chairs

Lucia Gauchia, *Michigan Tech University*
Said Al-Hallaj, *All Cell Technologies*
Pavel Dutov, *LG Chem*

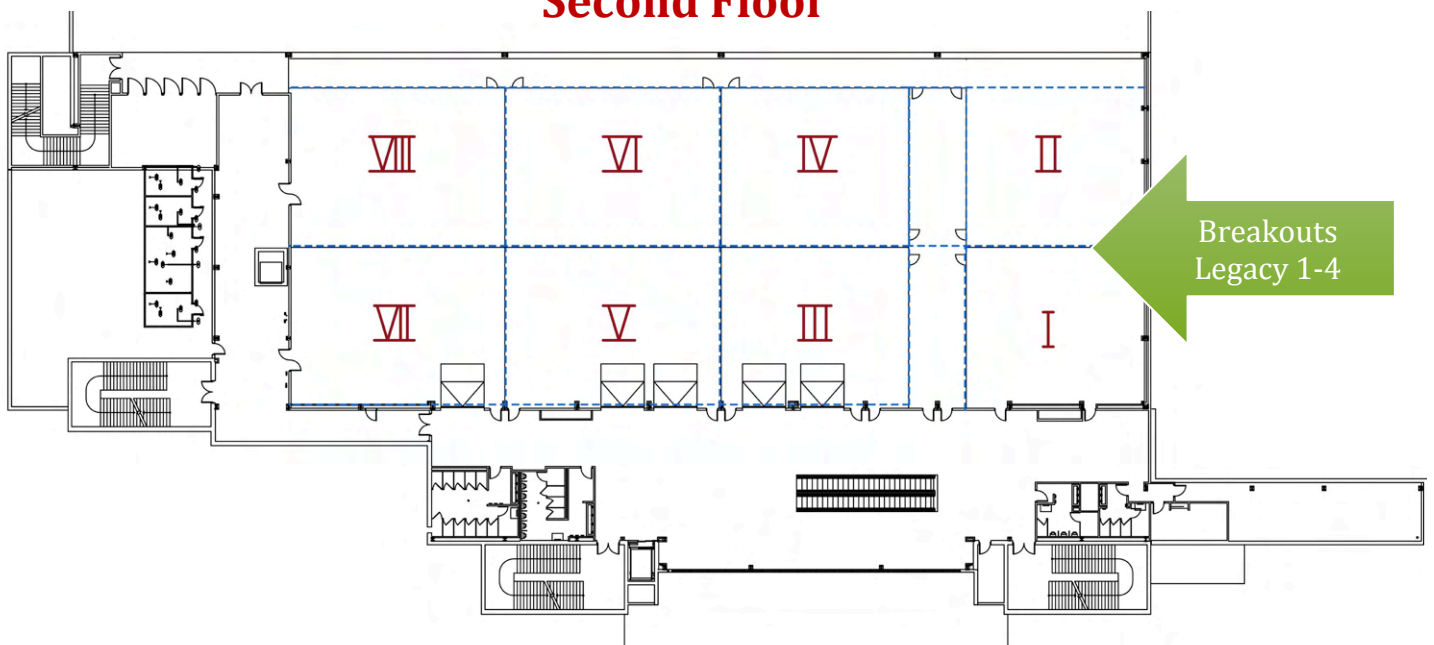
Suburban Showplace Center Map



First Floor



Second Floor



IT'EC'19 Program-at-a-Glance

	7:30AM-8:15AM	Conference Registration Open				
Wednesday June 19, 2019	8:10AM-10:00AM	Plenary Session 1				
	10:00AM-10:30AM	Coffee Break Outside Legacy Ballroom				
	10:30AM-12:00PM	Plenary Session 1	Poster Session 1 Exhibit Hall Buffet Lunch	Town Hall Panel Tutorial 1 Short Course 1		
	12:00PM-2:00PM				2:00PM-3:20PM	3:20PM-4:20PM
	4:20PM-5:40PM	Short Course 1 Tutorial 2 Tutorial 3 Tutorial 4 Panel 1 Panel 2 Panel 3		Short Course 2 Short Course 3 Short Course 4 Panel 6 Panel 7 Industry Session		4:00PM-5:40PM Technical Sessions 16-20
	5:40PM-7:00PM	Networking Dinner in Exhibit Hall		PELS Day Celebration Dinner		
Thursday June 20, 2019						
Friday June 21, 2019	8:30AM-10:10AM	Plenary Session 2	Plenary Session 1	Short Course 2 Short Course 3 Short Course 4 Panel 4 Panel 5 Tutorial 5	2:00PM-3:40PM Technical Sessions 11-15	Coffee Break Outside Legacy
	10:30AM-12:10PM	Plenary Session 2	Poster Session 2 Exhibit Hall Buffet Lunch	Short Course 2 Short Course 3 Short Course 4 Panel 4 Panel 5 Tutorial 5		

Wednesday June 19, 2019

Keynote Presentations

Plenary Session 1

Wednesday, June 19, 2019

8:10AM – 12:00PM

Venue: Legacy Ballroom

Plenary Session Chairs:

Babak Nahid-Mobarakeh,

University of Lorraine

Long Wu,

John Deere Electronic Solutions

Welcome and Introduction

8:10AM-8:15AM

Jin Ye, University of Georgia

General Chair, 2019 IEEE Transportation Electrification Conference

Welcome Presentation

8:15AM-8:20AM

Mohammad Islam, Chair of IAS Transportation Systems Committee, Halla Mechatronics

2019 IEEE Transportation Technologies Award

8:20AM-8:30AM

Award Presenter: Alireza Khaligh, University of Maryland

Presented To: Hao Huang, for his contributions to aircraft electrification.



Keynote Presentation 1: A Bright Era for Electrical in Aerospace

8:30AM – 9:00AM

Speaker: Hao Huang

Technology Chief

GE Aviation – Electrical Power

Short Biography:

Dr. Hao Huang is the Technology Chief of GE Aviation—Electrical Power, as well as an IEEE Fellow and SAE Fellow. He is responsible for generating the technical directions, innovation strategies, and multi-generation product roadmaps for the GE aircraft electrical power division. He has been constantly leading and contributing innovations and inventions of aircraft electrical power technologies.



Keynote Presentation 2: Implications in Merging Smart Energy Grids with Smart Electric Vehicle Fleets

9:00AM – 9:30AM

Speaker: Carl Kutsche

Chief Technologist Critical Infrastructure Security and

Resilience, National & Homeland Security

Idaho National Laboratory

Short Biography:

Dr. Carl Kutsche, Chief Technologist for the Critical Infrastructure Security and Resilience Directorate, organizes capabilities solving communications, cyber security, energy grid, and critical infrastructure challenges across the Nation. He is also the technical lead for INL's National and Homeland Security Research and Development Program. Prior to joining INL, Dr. Kutsche served 25 years active duty with the US Air Force leading communications, intelligence, and counter-terrorism programs. Dr. Kutsche received his Doctorate in Electrical and Optical Engineering from the University of Central Florida, focusing on High Speed Communications and Electro-Optic Systems.



Keynote Presentation 3: The More Electric 'X' - Connecting the Future of Transportation with a More Intelligent Grid

9:30AM – 10:00AM

Speaker: *Igor Stamenkovic*
Global Technology Director
Eaton

Short Biography:

Dr. Igor Stamenkovic is a technology executive with entrepreneurial background and 16 years' experience in delivering growth based on innovation and business strategies. He joined Eaton in 2013 as the Manager for Microgrids with an objective to create and execute a business strategy around early stage microgrid technologies. Ever since 2015, Igor has acted as Director – Global Technology. In this role at Eaton, Igor runs global organization that conducts research and innovates new products and businesses based on early stage technologies across power systems, power electronics, and more electric transportation. Prior to working at Eaton, Igor had been working as an entrepreneur and technical executive with Venture Capital backed technology companies. He holds a BS and MS in Electrical Engineering from University of Belgrade, Serbia, and Ph.D. degree in Electrical & Computer Engineering from Illinois Institute of Technology, Chicago, IL. Igor lives in Evergreen, CO with his wife and children. He loves spending time with his family hiking, golfing and skiing.

Coffee Break 10:00AM – 10:30AM



Keynote Presentation 4: Integrating the Electrified Powertrain: Opportunities and Challenges

10:30AM – 11:00AM

Speaker: *Richard Hellinga*
Manager
BorgWarner Waterloo Technical Center

Short Biography:

Richard Hellinga manages the BorgWarner Waterloo Technical Center, (previously Sevcon Inc) where BorgWarner develops power electronic controls. He is a graduate of the University of Waterloo with an MASc in Electrical Engineering. He has more than 25 years experience of leading and directing engineering focused on electric motor control and vehicles.



Wednesday June 19, 2019

Keynote Presentations



Keynote Presentation 5: Vehicle Electrification - 2020 and Beyond

11:00AM - 11:30AM

Speaker: *V. Anand Sankaran*

*IEEE Fellow, Director of Electrified Powertrain Engineering
Ford Motor Company*

Short Biography:

Dr. V. Anand Sankaran, Director, Electrified Powertrain Engineering, Ford Motor Company, is a recognized leader in electrification technologies, namely, energy storage system, hybrid transmission and e-drive systems, power electronics and devices. He received his B.S. in Electrical Engineering from P.S.G. College of Technology, India, followed by M.S. and Ph.D. degrees in Electrical Engineering from Univ. of South Carolina, Columbia. He has an MBA from Univ. of Michigan, Ann Arbor. He began his career at Ford Research and Innovation Center in 1991 and received the Henry Ford Technology Award in 1999 for his electrification work. Over his 27 years at Ford Motor Company, he has served in various capacities and successfully launched nine electrified production vehicles including the "Escape Hybrid - the most fuel efficient SUV on the planet" and "Fusion Hybrid- the most fuel efficient mid-size sedan in North America". Anand's contributions include 22 publications in internationally recognized Conferences and Transactions, 31 US patents in the area of automotive power electronics and hybrid vehicle technologies. Anand is a Fellow of the Institute of Electrical and Electronics Engineer (IEEE). He served in various capacities in the IEEE Industry Applications Society, was the Chairperson for the IEEE Workshop on Power Electronics in Transportation (1992-1998) and Publications Chairman for the 2011 IEEE Energy Conversion Conference and Expo. Automotive News named him as one of the top 100 most influential leaders in electrification in 2011.



Keynote Presentation 6: Harnessing the Full Potential of 48 Volt Technologies to Power the Future

11:30AM - 12:00PM

Speaker: *Joachim Kupe*

*Head of Engineering and Project Management - NA
Mildhybrid Edrives Segment, Hybrid and Electric Vehicles
Continental Automotive Systems*

Short Biography:

Dr. Joachim Kupe is an Innovation and Development Leader with experience in managing global culturally diverse cross-functional teams, innovating new components and systems, and leveraging technological and engineering expertise to position organizations for success. Under his leadership as Chief Engineer - Advanced Powertrain Technology at Delphi, he developed advanced powertrain components and subsystems, including electric machines. As a Director-Advanced Systems Engineering at Cummins Inc., he led the Systems Engineering and Integration of vehicle electrification architectures as well as key components development. And most recently, as Head of Systems Engineering and Head of Engineering - Mild Hybrid eDrives and Battery Systems -NA at Continental Automotive Systems, he has contributed to the development and the launch of the 48V BSG with FCA. He holds a Doctorate Degree in Electrical Engineering from the RWTH Technical University Aachen, Germany.

Poster Session 1

Wednesday, June 19, 2019

12:00 PM – 2:00 PM

Exhibit Hall

Session Chairs: Caisheng Wang, Wayne State University &
Zhiwei Zhang, Ohio State University

Paper Order #	Title/Author
1	A Supercapacitor-Based Converter Topology for Grid-Side Power Management in Dynamic Wireless Charging Systems <i>Ahmed Azad, Zeljko Pantic - Utah State University</i>
2	Virtual Inertia Control of Inductive Electric Charging System Using a Power Transfer Controller <i>Masood Moghaddami, Hassan Jafari, Arif Sarwat - Florida International University (FIU) - Department of Electrical and Computer Engineering</i>
3	Evaluation of Cell Balancing Circuits for Supercapacitor-based Energy Storage Systems <i>Hengzhao Yang - California State University</i>
4	Offline Parameter Identification and SOC Estimation for New and Aged Electric Vehicles Batteries <i>Ryan Ahmed, Sara Rahimifard, Saeid Habibi - Department of Mechanical Engineering, McMaster University</i>
5	A Compact and Low-Distortion Inductive Charging System for Automatic Guided Vehicles Based on LCC Compensation and Integrated Magnetic Coupler <i>Hua Zhang¹, Chong Zhu², Fei Lu¹ – (1) Drexel University, (2) Shanghai Jiaotong University</i>
6	A Multi-Output Convolved Gaussian Process Model for Capacity Estimation of Electric Vehicle Li-ion Battery Cells <i>Abdallah Chehade¹, Ala Hussein^{2,3} – (1) Department of Industrial and Manufacturing Systems Engineering, University of Michigan – Dearborn, (2) Department of Electrical and Computer Engineering, University of Central Florida, (3) Department of Electrical Power Engineering, Yarmouk Univeristy</i>
7	An Intelligent Power and Energy Management System for Fuel Cell/Battery Hybrid Electric Vehicle using Reinforcement Learning <i>Namireddy Praveen Reddy, David Pasdeloup, Mehdi Zadeh, Roger Skjetne - Norwegian University of Science and Technology</i>
8	Design of a Spoke-Type Ferrite Magnet Generator for a Hybrid Electric Vehicle Application <i>Sandra Castano¹, Ehab Sayed¹, James Jiang¹, Jianbin Liang¹, Berker Bilgin¹, Anand Sathyan², Hossein Dadkhah², Dhafar Al Ani², Nitin Patel², Ali Emadi¹ – (1) McMaster Institute for Automotive Research and Technology (MacAUTO), McMaster University, (2) FCA US LLC</i>
9	Determination of D and Q Axes Inductances for Steady State Model Analysis of Permanent Magnet Machines with Non-Ideal Machine Parameters <i>Binita Nanda, Praveen Kumar - IIT Guwahati</i>
10	Current Harmonics Injection Table To Minimize Torque Ripples For Electric Powertrain Interior Permanent Magnet Motor Over Maximum Torque-Speed Curve <i>Philippe Wendling¹, Tan Pham² – (1)Altair, Troy, MI, USA, (2) Altair Engineering, Irvine, CA, USA</i>
11	Studies on Super-thin Electrical Steel in Traction Motors with Various Gauge <i>Ruilin PEI¹, Lingyu GAO², Lubin ZENG¹ – (1) Suzhou Inn-Mag New Energy Ltd., (2) Universié de Technologie de Troyes</i>

Poster Session 1

Wednesday, June 19, 2019

12:00 PM – 2:00 PM

Exhibit Hall

Session Chairs: Caisheng Wang, Wayne State University &
Zhiwei Zhang, Ohio State University

Paper Order #	Title/Author
12	Optimum Design of Interior Permanent Magnet Synchronous Motor Using Taguchi Method Jiawei Xu ¹ , Lubin Zeng ¹ , Ruilin Pei ¹ , Lingyu Gao ² , (1) Suzhou Inn-Mag New Energy Ltd., (2) Université de Technologie de Troyes
13	Enabling Technologies for Compact Integrated Electric Drives for Automotive Traction Applications Shajjad Chowdhury, Emre Gurpinar, Gui-Jia Su, Tsarafidy Raminosoa, Timothy Burrell, Burak Ozpineci - Power Electronics and Electric Machinery Group, Oak Ridge National Laboratory
14	Multi-fidelity Near-Optimal On-Line Control of a Parallel Hybrid Electric Vehicle Powertrain Pier Giuseppe Anselma ^{1,2} , Atriya Biswas ³ , Joel Roeleveld ³ , Giovanni Belingardi ^{1,2} , Ali Emadi ³ - (1) Department of Mechanical and Aerospace Engineering (DIMEAS), (2) Center for Automotive Research and Sustainable Mobility (CARS), (3) McMaster Institute for Automotive Research and Technology (MacAUTO), McMaster University
15	A Q-Learning Based Charging Scheduling Scheme for Electric Vehicles Qiyun Dang, Di Wu, Benoit Boulet - McGill University
16	Design, Installation, and Testing of a Paratransit Bus with Electrified Accessories Charles Penney ¹ , Mike Lewis ¹ , Matt Boothe ² , Stuart Thompson ³ - (1) The University of Texas at Austin Center for Electromechanics, (2) Center for Transportation and the Environment, (3) TransWorld Associates LLC
17	Practical Assessment of Saliency-Tracking Feasibility for Safety-Relevant IPM Drives in Automotive Applications Kilian Rehork ¹ , Benjamin Grothmann ² , Dieter Gerling ¹ , Daniel Grotz ³ - (1) Universität der Bundeswehr München, (2) AUDI AG, (3) HTWG Konstanz
18	Instability of Grid Connected Converter under Weak AC Grid Conditions Xinyue Zhang ¹ , Chen Liu ² , Rui Ma ² , Hao Bai ² , Franck Gechter ² , Fei Gao ² - (1) Henan Mechanical and Electrical Vocational College, (2) Université de Technologie Belfort-Montbéliard
19	A Novel Multi-Mode Adaptive Energy Consumption Minimization Strategy Approach for P1-P2 Hybrid Electric Vehicle Architectures Mike Haußmann, Carlos Vidal, Daniel Barroso, Lucas Brueck, Ali Emadi - McMaster Automotive Resource Centre (MARC), McMaster University
20	Implementation of an FPGA-based Real-Time Emulator for the Rapid Validation of Power Electronics System in Fuel Cell Electric Vehicle Hao Bai, Chen Liu, Rui Ma, Damien Paire, Elena Breaz, Fei Gao - FEMTO-ST Institute, Univ. Bourgogne Franche-Comté, UTBM, CNRS
21	Analytical Approach for Calculating Magnetic Field Distribution in Surface Mount PM Motor Including Stator Slot Effect Mohamad Salameh ¹ , Selin Yaman ¹ , Yong Jiang ¹ , Shuwang Li ² , Mahesh Krishnamurthy ¹ - (1) Illinois Institute of Technology - Dept. of Electrical & Computer Engineering, (2) Illinois Institute of Technology - Dept. of Applied Mathematics
22	Current Sensorless Model Free Control Applied on PMSM Drive System Saeid Aghaei Hashjin ^{1,2} , El-hadj Miliani ³ , Karim Ait Abderrahim ² , Babak Nahid-Mobarakeh ¹ - 1 Université de Lorraine, (2) ESME Sudria, (3) IFP School

Wednesday, June 19, 2019

Poster Session 1

Wednesday, June 19, 2019

12:00 PM – 2:00 PM

Exhibit Hall

Session Chairs: Caisheng Wang, Wayne State University &
Zhiwei Zhang, Ohio State University

Paper Order #	Title/Author
23	Transfer Functions of Wireless Power Transfer Systems with Series and Series-Parallel Compensation Schemes <i>Agasthya Ayachit¹, Mohamad Abdul-Hak¹, Marian Kazimierczuk² – (1) Mercedes-Benz Research and Development North America (2) Wright State University</i>
24	An Integrated Modular Converter for Switched Reluctance Motor Drives in Range-Extended Electric Vehicles <i>Zekun Xia, Jennifer Bauman - Department of Electrical and Computer Engineering, McMaster University</i>
25	Energy Efficient Predictive Rotor Flux Control of Induction Machines in Autonomous Driving Electric Vehicles <i>Arne Brix, Volkmar Müller, Wilfried Hofmann - Institute of Electrical Power Engineering, Technische Universität Dresden</i>
26	Efficiency Analysis of Induction Motor Control Strategies Using A System-Level EV Model <i>Rasul Tarvirdilu-Asl, Jennifer Bauman - Electrical and Computer Engineering Department, McMaster University</i>
27	Efficiency Improvement of PMSM Drive System Using Discontinuous Current Control Method at Low Torque Region <i>Gyu Cheol Lim¹, Hyeon-gyu Choi², Jonghun Choi², Jung-Ik Ha² - (1) Agency for Defense Development, (2) Seoul National University</i>
28	A Three-Port LLC Resonant Converter for a Photovoltaic-Battery Hybrid System <i>Garry Jean-Pierre, Necmi Altin, Adel Nasiri - University of Wisconsin-Milwaukee</i>
29	Design of Wireless Power Transfer System with Load-Independent Voltage/Current Output Based on the CLC Compensation Network <i>Yao Wang, Weiguo Liu, Yigeng Huangfu - Shaanxi Key Laboratory of Small & Special Electrical Machine and Drive Technology</i>
30	Efficiency Improvement of a High Power “Power Distribution Unit” at Low Power Demands Using Ultra-Capacitor <i>Lokesh Soni, Shivaram Venkateswaran, Saif Absar - Ather Energy Private Ltd</i>
31	A Modulation Method to Eliminate Common-mode Voltage of Dual Three-Phase Motor <i>Fangke Lu, Haifeng Lu, Yongdon Li, Jianyun Chai, - Tsinghua University</i>
32	Improved Signal-Injection Sensorless Control Robust to Inverter Nonlinearity Effects by Prediction of Voltage Disturbance <i>Yoon-Ro Lee, Yong-Cheol Kwon, Seung-Ki Sul - Seoul National University</i>
33	Integration of Pulsed Electric Bus Fleet Charging Profiles Through Coordinated Control of Hybrid Microgrids <i>Kaitlyn Sitch, Dongsun Sun, Liang Du - Department of Electrical and Computer Engineering, Temple University</i>

Wednesday, June 19, 2019

Poster Session 1

Wednesday, June 19, 2019

12:00 PM – 2:00 PM

Exhibit Hall

Session Chairs: Caisheng Wang, Wayne State University &
Zhiwei Zhang, Ohio State University

Paper Order #	Title/Author
34	An Implementation of Renewable Energy Based Grid Interactive Charging Station <i>Anjeet Verma, Bhim Singh – Indian Institute of Technology</i>
35	I-DPAPS Based Control Algorithm for an Islanded Microgrid with Dynamic and EV Loads <i>Seema Kewat, Bhim Singh – Indian Institute of Technology</i>
36	Arizona Long-Term Electric Vehicles Highway Charging Energy Demand: An Advanced Geospatial Analysis <i>Emilio Rodriguez Izquierdo, Antonio Marin Ecija - IEEE Member</i>
37	Two-Stage Energy Management of Smart Homes in Presence of Intermittencies <i>Sima Aznavi ¹, Poria Fajri ¹, Arash Asrari ², Javad Khazaei ³ – (1) Electrical and Biomedical Engineering Department, University of Nevada-Reno, (2) Electrical & Computer Engineering Department, Southern Illinois University, (3) School of Science, Engineering, and Technology, Penn State Harrisburg</i>
38	Junction Temperature Estimation Based on Updating RC Network for Different Liquid Cooling Conditions <i>Fei Gao, Jennifer Bauman, Berker Bilgin - McMaster University</i>
39	Thermal Modeling of DC/AC Inverter for Electrified Powertrain Systems <i>Fan He, Meng Li, Wei Tao, Bruce Geist - FCA US LLC</i>

Wednesday, June 19, 2019

Town Hall Panel



Wide Bandgap Technology Trends, Manufacturing Innovations, and Commercialization

2:00PM – 3:40PM

Venue: Legacy Ballroom

Panel Organizer and Moderator:

Brij Singh - John Deere Electronics Solutions, Inc.

Panelists:

Allen Hefner - US Department of Energy

Victor Veliadis - PowerAmerica in NC State University

Bhim Singh – Indian Institute of Technology

Lauren Boteler – US Army Research Laboratory

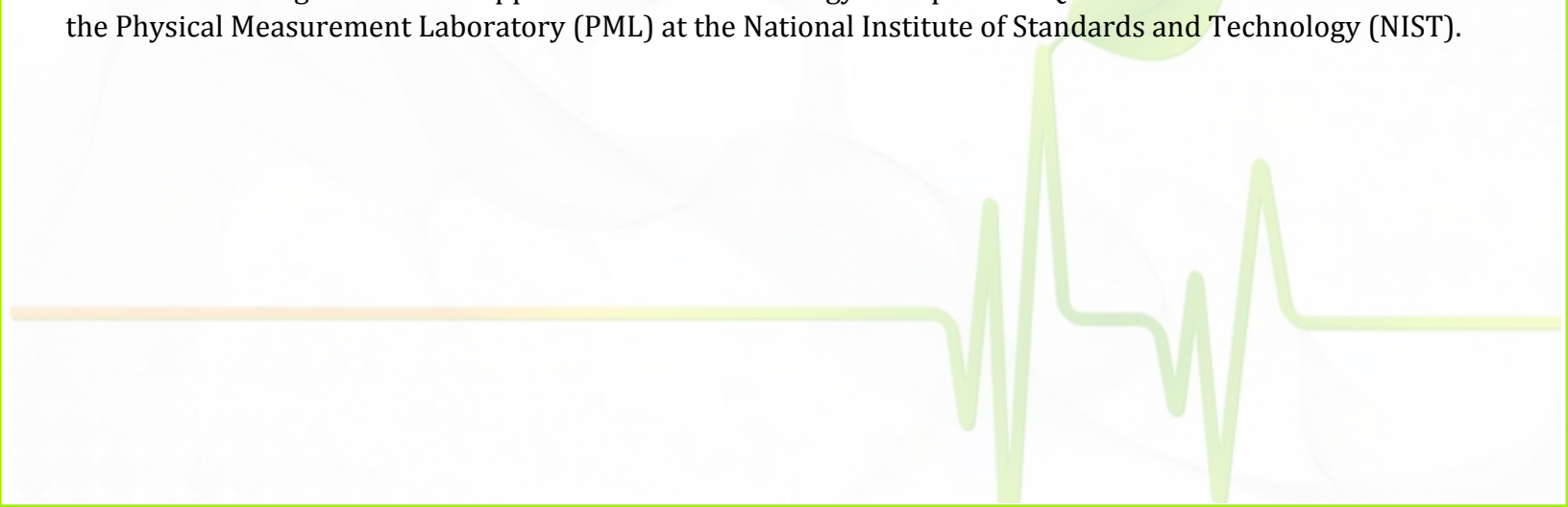
Panel Description:

Wide bandgap (WBG) power electronics have gained significant momentum in past four years. Some vehicle manufacturers have launched cars with the SiC inverter-based electric-power-train. The mass adoption of WBG power converters requires manufacturing innovations targeted to address supply-chain issues starting from wafer through packaging to end users. Manufacturing innovations targeted for commercialization in niche applications could be aided by availability of power devices with acceptable lead-time, WBG inverter designers with multi-disciplinary expertise and problem-solving experts with systems level knowledge. This panel will discuss how industry and government agencies could partner to mitigate risks involved with the WBG power converter technology. Application examples with success stories from industries will be covered.

Panelists' Short Biographies:

Victor Veliadis is Deputy Executive Director and CTO of PowerAmerica, which is a U.S Department of Energy wide bandgap power electronics public-private Manufacturing Institute. Dr. Veliadis manages a budget in excess of \$30 million per year that he strategically allocates to over 35 industrial, University, and National-Laboratory projects, to enable US leadership in WBG power electronics manufacturing, work force development, job creation, and energy savings.

Alan Hefner is presently a Technology Manager in the US Department of Energy in Advanced Manufacturing Office. Dr. Hefner is managing several DOE research programs including PowerAmerica. Dr. Hefner has over two decades experience in WBG devices, technology and applications. In his current role, he is tasked to promote WBG power electronics product manufacturing in US. Before working at DoE, Alan Hefner has been an electronics engineer in the Applied Electrical Metrology Group in the Quantum Measurement Division of the Physical Measurement Laboratory (PML) at the National Institute of Standards and Technology (NIST).



Wednesday, June 19, 2019

Town Hall Panel



Wide Bandgap Technology Trends, Manufacturing Innovations, and Commercialization

2:00PM – 3:40PM

Venue: Legacy Ballroom

Panelists' Short Biographies (Continued):

Bhim Singh is IEEE Fellow and he is a professor at Indian Institute of Technology Delhi, India since 1997. His areas of research interests are power electronics, electric machines and drives, HVDC, FACTS, power quality, renewable energy and DSP based control of power converter and drive. Prof. Singh is a Fellow of the Indian National Academy of Engineering (FNAE), The Indian National Science Academy (FNA), The National Academy of Science, India (FNASc), The Indian Academy of Sciences, India (FASc), The World Academy of Sciences (FTWAS), Institute of Electrical and Electronics Engineers (FIEEE), the Institute of Engineering and Technology (FIET), Institution of Engineers (India) (FIE), and Institution of Electronics and Telecommunication Engineers (FIETE) and a Life Member of the Indian Society for Technical Education (ISTE), System Society of India (SSI), and National Institution of Quality and Reliability (NIQR). He has been the General Chair of the 2006 IEEE International Conference on Power Electronics, Drives and Energy Systems (PEDES'2006).

Lauren Boteler leads the thermal and packaging research programs as part of the Advanced Power Electronics group at the U.S. Army Research Laboratory (ARL). She received her PhD degree in mechanical engineering from the University of Maryland. Her work at ARL, beginning in 2005, has included electronics packaging and thermal management solutions for a wide range of Army applications. Her research programs focus on design tool development and package integrated thermal solutions including 3D chip stacking, power electronics, laser diodes, double side cooling, and phase change materials. More recently, she has initiated a research program in Advanced Power Electronics Packaging and Thermal Management which defines the four main challenges of power electronics packaging: co-engineering/co-design, transient thermal mitigation, additive manufacturing, and high-voltage packaging. She is an adjunct professor at Johns Hopkins University and was awarded the 2018 ASME EPPD Woman Engineer of the Year award for her contributions to the electronics packaging community.



Wednesday, June 19, 2019

Afternoon Breakout Sessions



Tutorial 1: Modeling and Optimization of Trip Based Energy Consumption and Charging Management for Connected Automated Electric Vehicles

Wednesday, June 19th, 2019

2:00PM - 3:20PM

Venue: Cornerstone 5

Speaker:

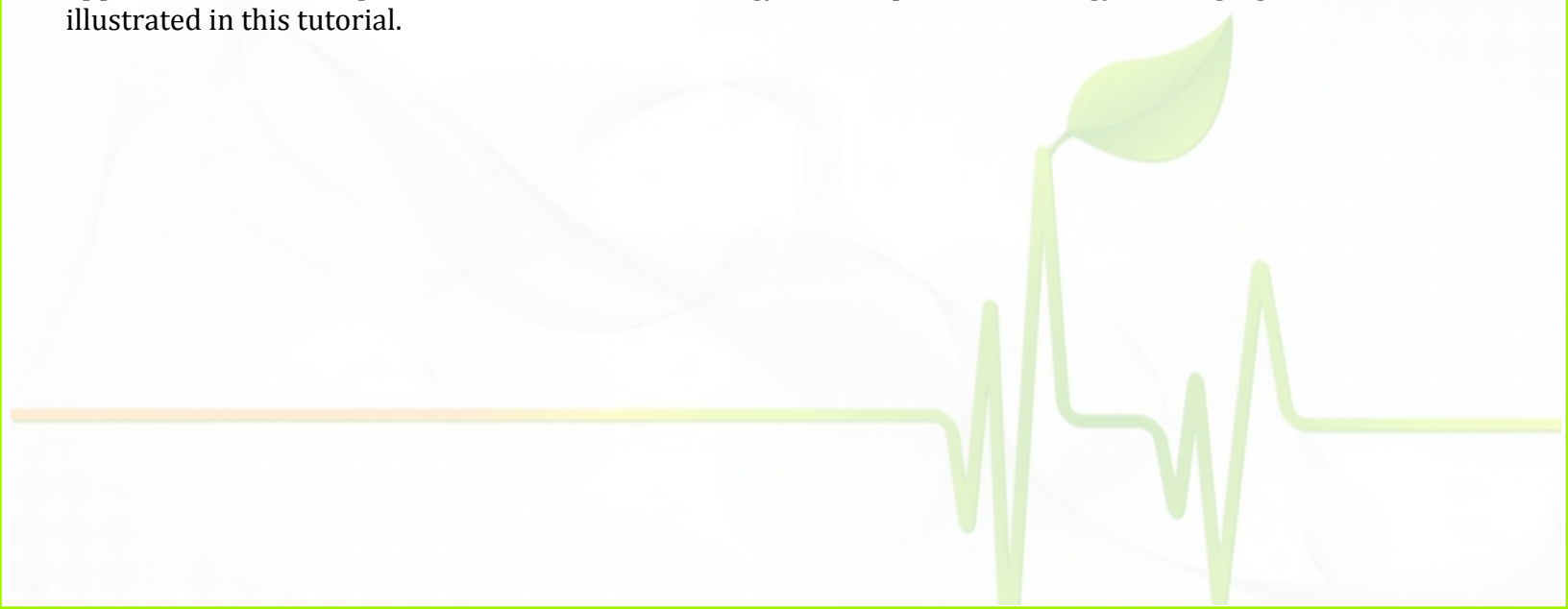
Zonggen Yi - Idaho National Laboratory

Short Biography:

Zonggen Yi is a research scientist with Idaho National Laboratory's Energy Storage and Advanced Vehicles department. He received his Ph.D. in electrical engineering from University of Notre Dame in USA. He earned his bachelor's, in automation, and master's, in control science and engineering, from Tongji University, Shanghai, China. His research is mainly related to the intelligent and electrified transportation systems and also their interactions with future smart grid. His current research includes the energy cost and recharging management for connected and automated electric vehicles, control and optimization of smart charging for electric vehicle fleet integrated to power grid, shared autonomous electric vehicle fleet management, etc. He has strong research interest in designing high efficient data driven methodologies for distributed control and optimization of future electrified autonomous systems.

Summary:

Trip aware energy consumption and charging management for electric vehicles is a key component to ensure sustainability of electrified transportation. The upcoming vehicle communication and autonomous driving technologies will provide opportunities to achieve more intelligent management strategies. This tutorial will introduce the state-of-the-art technologies that are being designed for optimizing the trip level energy cost and recharging operations of connected automated electric vehicles (CAEVs). The information needs, modeling, control and optimization techniques for optimal trip level energy management will be introduced. Opportunities and benefits from vehicle communication and automation will be discussed. In general, three main sub-topics will be presented in detail: first, advanced EV energy consumption modeling and prediction technologies; second, energy efficient driving technologies, e.g. eco-driving and eco-routing, etc.; third, optimally automatic charging decision making for CAEVs. Following these details, the research challenges, opportunities for co-optimization between the energy consumption and energy recharging of CAEVs will be illustrated in this tutorial.



Wednesday, June 19, 2019

Afternoon Breakout Sessions



Short Course 1: Model-Based Design for Electric Powertrain Systems

Wednesday, June 19th, 2019

2:00PM – 5:40PM (3:20PM-4:20PM Coffee Break in Exhibit Hall)

Venue: Cornerstone 6

Instructors:

Dr. Dakai Hu – Mathworks

Dr. Javier Gazzarri - MathWorks

Short Biography:

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 the 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.

Javier Gazzarri is a Principal Application Engineer at MathWorks in Novi, Michigan, specializing in simulation tools as part of Model Based Design. His work focuses on battery modeling, from cell-level to system-level, parameter estimation for model correlation, battery management system design, thermal management, aging diagnosis, and state-of-charge estimation algorithms. Before joining MathWorks, Javier worked on fuel cell modeling at the National Research Council of Canada in Vancouver, British Columbia. He received a Mechanical Engineering Bachelor's degree from the University of Buenos Aires (Argentina), a MASc degree (Inverse Problems), and a PhD degree (Solid Oxide Fuel Cells) both from the University of British Columbia (Canada).

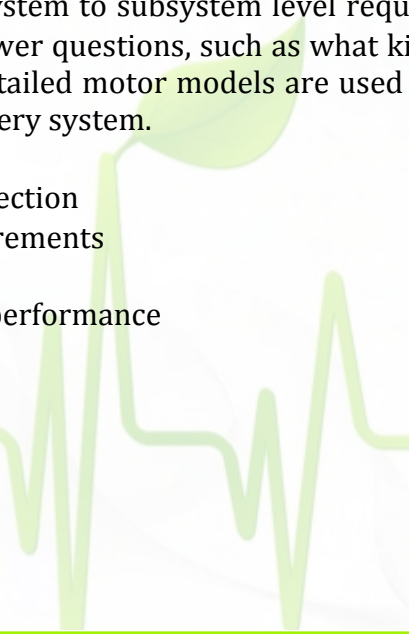
Summary:

In this session, MathWorks engineers will describe how modeling and simulation are being applied by engineering teams at different points along the development V-cycle. In the early design stages, system level simulation helps them to explore design options. A wide variety of battery only and hybrid electric powertrain topologies are considered. Design studies are used to assess the fuel economy and performance of candidates to select the optimal powertrain configuration.

As development moves down the V-cycle, the focus shifts from system to subsystem level requirements. At this stage, more detailed simulation models are brought in to answer questions, such as what kind of battery will be required to meet the demand of the system. Similarly, detailed motor models are used to determine the optimal motor control strategy for a given powertrain and battery system.

Over the course of this tutorial, MathWorks will demonstrate:

- How to use system level vehicle simulation for powertrain selection
- How to use battery modeling tools to meet system level requirements
- How to use simulation to develop optimal motor controls
- How to integrate these designs and validate the system level performance



Wednesday, June 19, 2019

Afternoon Breakout Sessions



Tutorial 2: A Practical Perspective on WBG Power Devices for Vehicle Electrification

Wednesday, June 19th, 2019

4:20PM – 5:40PM

Venue: Cornerstone 1

Speakers:

Lihua Chen – Ford Motor Company

Jin Wang - Ohio State University

Short Biography:

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 Ford next generation eDrive system and traction inverter design and optimization. He has published over 100 technical papers, holds many patents, and has gave numerous technical presentations to IEEE conferences, research institutes, and various companies.

Jin Wang received his Ph.D. from Michigan State University, East Lansing, in 2005. From Sept., 2005 to Aug. 2007, he worked at the Ford Motor Company as a Core Power Electronics Engineer. He joined the Ohio State University in 2007 as an Assistant Professor and was promoted to Associate professor in 2013 and full professor in 2017. 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 150 peer-reviewed journal and conference publications and 6 patents. Dr. Wang received the IEEE Power Electronics Society Richard M. Bass Young Engineer Award in 2011 and the National Science Foundation's CAREER Award in 2011. Dr. Wang initiated and served as the General Chair for the 1st IEEE Workshop on Wide Bandgap Power Devices and Applications in 2013.

Summary:

This tutorial is focused on challenges and opportunities for wide bandgap (WBG) power electronics devices in electric and hybrid electric vehicles (xEVs) based applications. Existing power electronics systems onboard xEVs will be introduced. The design and optimization of traction drive system will be used as an example. Current status of Silicon Carbide (SiC) and Gallium Nitride (GaN) devices will be summarized with 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. It is dedicated to help the audience better understanding how vehicle power electronics are currently designed to meet automotive application requirements and roadblocks for WBGs in automotive applications. The short course should also be of interest to engineers who work on power electronics systems for electrification of other types of transportations.



Wednesday, June 19, 2019

Afternoon Breakout Sessions



Tutorial 3: History/ Advancement of Sensorless Control in Automotives

Wednesday, June 19th, 2019

4:20PM – 5:40PM

Venue: Cornerstone 2

Speaker:

Raja Ramakrishnan – Halla Mechatronics

Short Biography:

Ramakrishnan Raja (M'11) received B.Sc. degree from Amrita Institute of technology, India in 2003 and Master's Degree in electrical engineering from New Jersey Institute of Technology, in 2005. He received his Ph.D. degree in automotive system engineering from University of Michigan-Dearborn, MI. From 2004-2013 he has been working for Delphi steering and Nexteer automotive as Senior Electrical Engineer. Currently he is working at Halla mechatronics as Chief Scientist-Controls. He is responsible for motor drive control for various automotive applications. His research interest includes electrical machines and variable speed drives including sensorless motor control drives.

Summary:

This presentation goes over the History of various sensorless control techniques and shows how these sensorless techniques are being introduced in automotive industry. The material will cover new redundant architectures used in safety critical components such as steering and brakes and show how sensorless techniques will benefit these new architectures.



Wednesday, June 19, 2019

Afternoon Breakout Sessions



Tutorial 4: Magnetic Gears for EV Applications

Wednesday, June 19th, 2019

4:20PM – 5:40PM

Venue: Cornerstone 6

Speaker:

Matthew Johnson - US Army Lab

Short Biography:

Matthew Johnson earned his B.S. in electrical engineering from Texas A&M University, College Station, Texas in 2011. In 2017, he received a Ph.D. in electrical engineering after completing his dissertation on the “Design and Analysis of Axial and Radial Flux Magnetic Gears and Magnetically Geared Machines” in the Advanced Electric Machines and Power Electronics Laboratory at Texas A&M University under Professor Hamid Toliyat. He has received several fellowships and awards, including a Prize Paper Award from the IEEE Industry Applications Society Electric Machines Technical Committee for one of his papers on magnetically geared machines. Dr. Johnson worked in the medium voltage drives research and development group at Toshiba International Corporation from 2016 to 2018, and he currently works for the U.S. Army Research Laboratory in the Energy and Power Division of the Sensors and Electron Devices Directorate. Dr. Johnson has published 15 conference and journal papers on magnetic gears and magnetically geared machines and submitted a patent application on a novel magnetically geared machine. He has also worked on the design and construction of 7 magnetic gear or magnetically geared machine prototypes.

Summary:

Magnetic gears provide a non-contact alternative to mechanical gears for mechanical power transmission. Although magnetic gears perform the same fundamental task as their mechanical counterparts, they achieve the gearing effect through the interaction of magnetic fields instead of mechanical contact between moving parts. This non-contact power transmission offers numerous potential advantages, such as reduced maintenance, higher reliability, inherent overload protection, reduced acoustic noise, and physical isolation between shafts. Furthermore, various magnetically geared machines integrate a magnetic gear and an electric machine into the same package to provide a compact alternative to direct drive machines.

This tutorial will discuss the different motivations for magnetic gears and various transportation applications where magnetic gears and magnetically geared machines have been proposed as a possible solution. The tutorial will also introduce several types of magnetic gears and magnetically geared machines with a specific focus on the coaxial magnetic gear, the most popular family of topologies in modern magnetic gear literature. The different topologies’ operating principles will be presented along with a comparison of their relative advantages and disadvantages, as well as an overview of basic design trends and tradeoffs. Finally, several magnetic gear and magnetically geared machine prototypes and their associated experimental performances will be reviewed.



Wednesday, June 19, 2019

Afternoon Breakout Sessions



Panel 1 : High Voltage Traction Systems for Performance Electric Vehicles

Wednesday, June 19th, 2019

4:20PM - 5:40PM

Venue: Legacy 1

Panel Organizers:

Anand Sathyan - LG Electronics, U.S.A

Beijing Wang - Fiat Chrysler Automobiles (FCA)

Berker Bilgin - McMaster University

Panel Moderator:

Hossein Dadkhah -LG Electronics, U.S.A

Panelists:

Andre Christmann - Infineon

Oliver Gross - Fiat Chrysler Automobiles (FCA)

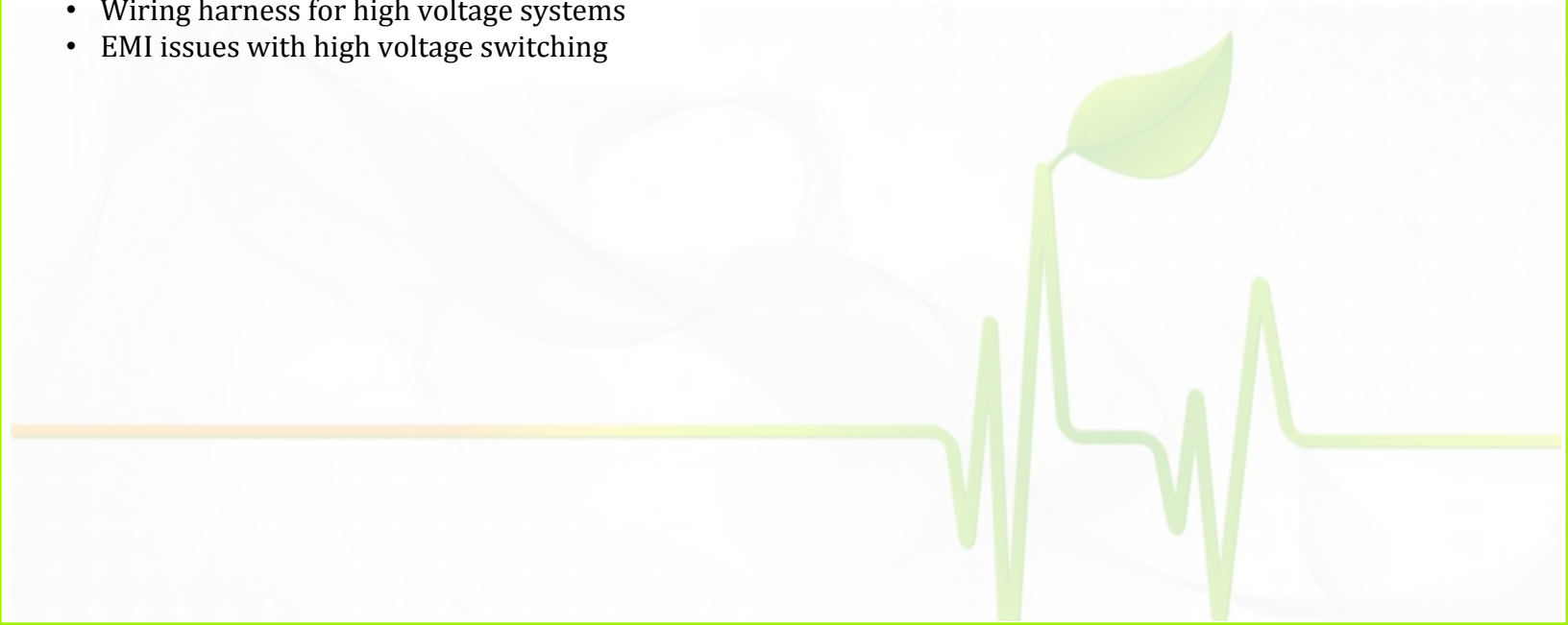
Charles Zhu - Delta Electronics (Americas) Ltd.

Panel Summary:

Performance vehicles are shifting towards total electrification, due to availability of instantaneous torque that a conventional combustion engine cannot deliver. High Power Electrified System requires very high currents that result in bulky cables and HV connectors. To overcome this issue, higher DC battery voltage can be used, where more number of cells would be configured in series. As the voltage increases, the amount of required current decreases, making it possible to use thinner-gauge wires and smaller motors and other components. In turn, it would reduce size and cost.

This panel is to invite subject matter experts and discuss interesting topics in the following areas.

- Need for high voltage systems for high performance vehicles
- Pros and cons of 800V systems and different architectures
- Developments in energy storage technologies
- Motor design, magnet wires and insulations for 800V systems
- SiC / IGBT devices capable of handling high voltage and high current switching
- Wiring harness for high voltage systems
- EMI issues with high voltage switching



Wednesday, June 19, 2019

Afternoon Breakout Sessions



Panel 2: Off-Road/Heavy Duty Electrification

Wednesday, June 19th, 2019

4:20PM – 5:40PM

Venue: Legacy 2

Panel Organizer and Moderator:

Jalpa Shah - Eaton

Panelists:

- Rachel Wang- Eaton
- Lewei Qian - Eaton
- Bratvold Brian - John Deere
- Yanming Hou - Oshkosh Corporation

Panel Summary:

There is a strong demand of alternate technologies on account of environmental concerns followed by stringent government regulations in the mobile vehicle industry. Significant innovations in various vehicles mechanisms from varied market segments has led to different degrees of electrifications. Respective advancements in each domain can be leveraged across mobile platforms although there are limitations that are not implicit. In this panel discussion, panelists will share their perspective on the electrification challenges and opportunities between different sectors of the off-road / heavy duty industry highlighting the gaps and synergies between electrification technologies and applications.



Wednesday, June 19, 2019

Afternoon Breakout Sessions



Panel 3 : Battery Management Systems: State of the Art and Future

Wednesday, June 19th, 2019

4:20PM – 5:40PM

Venue: Legacy 3

Panel Moderator:

Pawel Malysz – FCA USA LLC

Panelists:

- Marcello Canova - Ohio State University
- Kirk Stetzel - LG Chem Michigan Inc
- Lucia Gauchia - Michigan Technological University
- Vishal Mahajan - Samsung

Panel Summary:

Energy storage systems and large batteries require sophisticated control and management technologies for their optimal operation. This panel will discuss and overview current research trends, challenges, and technologies for battery management systems for both electrified transportation and stationary storage. Key aspects of a battery management system include cell modeling, advanced battery state estimation, power availability, thermal management, cell balancing, and safety design features. Experts from both academia and industry will present current research, available products, and provide insight to future directions of energy storage systems. This includes discussions involving anticipated technologies such as increased vehicle connectivity, fast charge, solid-state batteries and electrochemical based battery state estimation algorithms.



Wednesday, June 19, 2019

Afternoon Breakout Sessions



Joint PELS/IAS Technical Committee Meeting

Wednesday, June 19th, 2019

7:00PM – 8:15PM

Venue: Cornerstone 2

Agenda:

ITEC 2019 Presentation

7:00PM – 7:10PM

ITEC'19 General Chair: Dr. Jin Ye, University of Georgia

IEEE Transactions on Transportation Electrification Presentation

7:10PM – 7:20PM

Editor-in-Chief: Dr. Ali Emadi, McMaster University

IEEE Power Electronics Society (PELS) Technical Committee on Vehicle and Transportation Systems (TC4)

7:20PM-7:30PM

Committee Chair: Dr. Alireza Khaligh, University of Maryland – College Park

IEEE Industry Applications Society (IAS) Transportation Systems Committee

7:30PM-7:40PM

Committee Chair: Dr. Mohammad Islam, Halla Mechatronics

IEEE Transportation Electrification Community

7:40PM-7:50PM

TEC Chair: Bruno Lequesne – E-motors Consulting, LLC

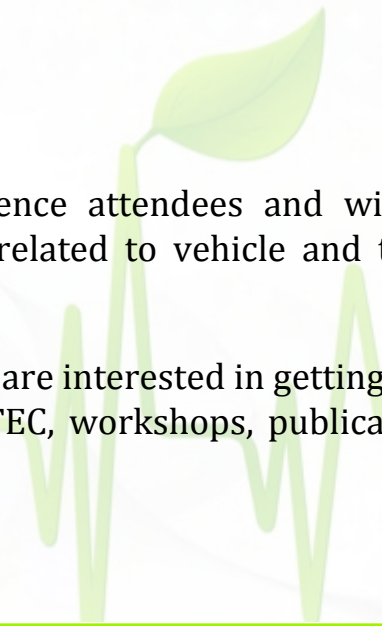
ITEC 2020 Presentation

7:50-8:00PM

ITEC'20 General Chair: Dr. Babak Nahid-Mobarakeh

Technical Committee Meeting is open to all conference attendees and will discuss the activities of the PELS and IAS technical committees related to vehicle and transportation systems and ITEC.

Please participate in this joint PELS&IAS meeting if you are interested in getting involved with the IEEE-PELS and/or IEEE-IAS activities including ITEC, workshops, publications, awards, etc.



Plenary Session 2

Thursday, June 20, 2019

8:30AM - 12:00PM

Venue: Legacy Ballroom

Plenary Session Chairs:

Srdjan Lukic – North Carolina State University

Bahar Anvari- ABB

8:20AM-8:25AM

Welcome Presentation

TEC Chair: Bruno Lequesne, E-motors Consulting, LLC

8:25AM-8:30AM

2019 IEEE PELS Vehicle and Transportation Systems Achievement Award

Recipient: Kaushik Rajashekara, University of Houston



Keynote Presentation 1: DOE Vehicle Technologies Office R&D in Beyond Lithium-Ion, Extreme Fast Charging, and High Power Density Drive Systems

8:30AM - 9:00AM

Speaker: *Steven Boyd,*
Program Manager
Vehicle Technologies Office
US Department of Energy

Short Biography:

Steven Boyd has worked in the Vehicle Technologies Office at the US Department of Energy since 2006. In his current position as Program Manager for Batteries and Electrification R&D, Steven manages projects across transportation electrification including energy storage, electric drive systems, and vehicle charging. Steven received his Bachelor of Science and Master of Science degrees in Mechanical Engineering from Virginia Tech, and participated in DOE's Advanced Technology Vehicle Competitions.



Keynote Presentation 2: It's Time to Unlock the Full Potential of Wireless Charging

9:00AM - 9:30AM

Speaker: *John M. Miller*
Technical Advisor
Momentum Dynamics Corp

Short Biography:

John M. Miller is owner and founder of J-N-J Miller Design Services PLLC, which was established in 2002 to provide professional consulting to industry. Dr. Miller has 43 years of experience in electrical engineering across various industries that include automotive, aerospace, white goods, and electrical practice. He joined Momentum Dynamics Technical Advisory Board in 2014 working on wireless power transfer for heavy-duty vehicles. His previous work experience includes Distinguished R&D Scientist at Oak Ridge National Laboratory (ORNL) where he held positions as Director of the Power Electronics and Electric Power Systems Research Center and Program Manager of the DOE Vehicular Technologies subprogram APEEM. Previously, Dr. Miller held various senior management and engineering positions at Maxwell Technologies, Ford Motor Company, and Texas Instruments. He has published several books related to wireless charging, ultracapacitor applications (translated to Chinese 2015), propulsion systems for hybrid vehicles (translated to Chinese 2016), automotive power electronics, and vehicular electric power systems.

Thursday, June 19, 2019

Keynote Presentations



Keynote Presentation 3: Wireless Charging Enables the Future of Mobility

9:30AM - 10:00AM

Speaker: *Morris Kesler*
Chief Technology Officer
WiTricity

Short Biography:

Dr. Morris Kesler is the Chief Technology Officer at WiTricity where he is responsible for the research and development activities in the company. He joined WiTricity in 2007 and has served as Chief Engineer and vice president of research and development. Prior to joining WiTricity, he was a founder of Wide Net Technologies, Inc., which developed unique optical communication and sensing systems for both government and industry. His work at Wide Net Technologies involved secure high-speed communications systems for fiber and free space applications, and the development of novel nano-photonic devices for communications and sensing. From 2000 to 2003, Dr. Kesler held the position of Consulting Engineer at PhotonEx Corporation, where he was responsible for transmission engineering and testing and played a key role in the development of the PhotonEx 40 Gb/s optical transport system. Dr. Kesler spent ten years with the Georgia Tech Research Institute where he led research programs in electromagnetic scattering, antenna arrays, novel antenna structures and photonic band-gap structures. He held the position of Principal Research Engineer when he left. He holds over 100 patents and has published over 40 technical journal and conference papers. He holds a B.S., M.S., and Ph.D. from the Massachusetts Institute of Technology in Electrical Engineering and Computer Science.

Coffee Break: 10:00AM-10:30AM



Keynote Presentation 4: Electrification Technologies and Architectures

10:30AM - 11:00AM

Speaker: *Nitin Patel*
Head of ePT Technology and Design
FCA US LLC

Short Biography:

Nitin R. Patel received his B.Sc. degree from the University of Poona, India in 1991, M.S. degree in Electrical Engineering from the University of Tennessee, Knoxville in 1996, and M.S. degree in Mechanical Engineering from the University of Wisconsin, Madison in 2004.

In 1997, he joined General Motors where he held various technical and leadership positions in Electrification division. Now at FCA, as a Head of ePowertrain Technology and Design, he is responsible for ePT Systems and product development for FCA's global electrified vehicle applications. His research interests are in developing high performance ePowertrain systems, architectures, electric motors, electrification electronics, energy storage systems and controls for BEV, PHEV, HEV, and mHEV applications. He has authored several technical publications in IEEE conferences and journals. He holds over 50 US patents. He was also awarded two General Motors Vice President's awards and one Boss Kettering award.

Thursday June 19, 2019

Keynote Presentations



Keynote Presentation 5: Design Challenges of Concentric Magnetic Gear Motors

11:00AM - 11:30AM

Speaker: *Eric Hultgren*
Principal Engineer
General Dynamics Electric Boat

Short Biography:

Eric Hultgren is a multi-disciplined engineer with over 20 years of electric machine and system design experience at General Dynamics Electric Boat. During his time at Electric Boat, he has worked on several electric drive and electric actuation projects for various United States government organizations, academic institutions and commercial customers. As part of these projects, he has performed mechanical, electrical, magnetic, thermal and fluid analysis, in addition to supporting manufacture, assembly, test and performance validation efforts. His efforts have also included development of pressure compensation and cooling systems, as well as non-metallic (composite) components for use in electric machine systems.



Keynote Presentation 6: New Auxiliary Drives for Automotive Applications

11:30AM - 12:00PM

Speaker: *Annette Muetze*
Professor
Graz University of Technology

Short Biography:

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 the NSF Career Award.



Poster Session 2

Thursday June 20th, 2019

12:00 PM – 2:00 PM

Exhibit Hall

Session Chairs: Jiyao Wang, Ford Motor Company &
Fei Gao, University of Technology of Belfort-Montbéliard (UTBM)

Paper Order #	Title/Author
1	Design and Control of 3-Phase Integrated Bidirectional Charger for Dual-Inverter Drivetrain Electric Vehicles Sitan Wang, Peter Lehn - University of Toronto
2	High Misalignment Tolerant Wireless Charger Designs for EV Applications Ali Ramezani, Mehdi Narimani - Department of Electrical and Computer Engineering, McMaster University
3	Battery State of Charge Management by Voltage Feedback Modification Niloofer Ghanbari, Subhashish Bhattacharya - North Carolina State University
4	Investigating the Sources of Uncertainty in Capacity Estimation of Li-ion Batteries Melika Salehabadi ¹ , Mehrdad Zandigohar ¹ , Poria Fajri ² , Nima Lotfi ¹ – (1) Mechanical and Mechatronics Engineering Department, (2) Electrical and Biomedical Engineering Department
5	DAB-based WPT Charger with Integrated Battery Management System for Fast Charging of Mobility Devices Ahmed Azad, Chakridhar Teeneti, Regan Zane, Zeljko Pantic - Utah State University
6	Improving Model Fitting to EIS Measurements at Low Temperatures Using Time Domain Constant Phase Elements Abdel Rahman Tawakol ¹ , Rioch Dlyma ² , Phillip Kollmeyer ¹ , Andreas Hackl ³ , Saeid Habibi ¹ – (1) McMaster Automotive Resource Centre (MARC), McMaster University, (2) D&V Electronics Ltd., (3) Institute of Automotive Engineering, Graz University of Technology
7	Analysis of Dead-Time in a Single Phase Wireless Power Transfer System Utkarsh Kavimandan, Veda Galigekere, Burak Ozpineci, Omer Onar - Oak Ridge National Laboratory
8	Leveraging Thermal Imaging for Autonomous Driving Ben Miethig, Chang(Ash) Liu, Saeid Habibi, Martin v. Mohrenschildt - McMaster University
9	Inductively Coupled, Full Duplex Data Link for use in Static and Dynamic Resonant Induction Wireless Charging Francis McMahon, Anthony Calabro, Benjamin Cohen, Andrew Daga, John Miller, John Wolgemuth - Momentum Dynamics Corporation
10	System Design of Dynamic Wireless Power Transfer for Automated Highways Andrew Foote, Omer Onar, Suman Debnath, Veda Galigekere, Burak Ozpineci - Oak Ridge National Laboratory
11	Hybrid-Excited Multi-Tooth Flux Switching Brushless Machines for EV Propulsion Zhiwei Zhang ¹ , Jianfei Chen ² , Xicai Liu ³ - (1) Department of Electrical and Computer Engineering, The Ohio State University, (2) Department of Electrical and Computer Engineering, Wayne State University, (3) School of Electrical and Electronics Engineering, Huazhong University of Science and Technology

Poster Session 2

Thursday June 20th, 2019

12:00 PM – 2:00 PM

Exhibit Hall

Session Chairs: Jiyao Wang, Ford Motor Company &
Fei Gao, University of Technology of Belfort-Montbéliard (UTBM)

Paper Order #	Title/Author
12	Evaluation Method of Noise and Vibration used in Permanent Magnet Synchronous Motor in Electric Vehicle Lingyu Gao ¹ , Hangbing Zheng ² , Lubin Zeng ² , Ruilin Pei ² - (1) Université de Technologie de Troyes, (2) Suzhou Inn-Mag New Energy Ltd.
13	A New Converter Topology for SRM to Improve High Speed Performance Oguzhan Kilic, Ali Topcu, Md. Ehsanul Haque, Yilmaz Sozer - University of Akron
14	Comparative Study of Dual-Stator 6/4 FSPM and SPM Machine for High-Speed Applications Mingda Liu, William Sixel, Bulent Sarlioglu - University of Wisconsin-Madison
15	Effects of Winding and Slot-Pole Configurations on Sizing of Permanent Magnet Synchronous Machines Dheeraj Bobba, Seun Guy Min, Bulent Sarlioglu - Wisconsin Electric Machines and Power Electronics Consortium, University of Wisconsin-Madison
16	The Drive Towards Open Pole Stator Winding for Electric Machines and Actuators Kumar Rajasekharg - Marsilli North America, Inc
17	Analysis of User Charging Behavior at Public Charging Stations Ahmad Almaghrebi, Subhaditya Shom, Fares Aljuheshi, Kevin James, Mahmoud Alahmad - University of Nebraska-Lincoln
18	Energy Management of a Dual-engine System for Hybrid Heavy-duty Vehicles Jiayi Hu ¹ , Ziyong Song ² , Jianqiu Li ¹ , Zunyan Hu ¹ , Liangfei Xu ¹ , Minggao Ouyang ¹ – (1) State Key Laboratory of Automotive Safety and Energy, Tsinghua University, (2) Department of Electrical Engineering and Computer Science, University of Michigan
19	A Multi-Motor Architecture for Electric Vehicles Omar Nezamuddin, Rishikesh Bagwe, Euzeli dos Santos Jr - Indiana University Purdue University
20	Dynamic Modeling and Stability Analysis of Onboard DC Power System for Hybrid Electric Ships Daeseong Park, Mehdi Zadeh - Norwegian University of Science and Technology
21	Adaptive Neuro-Fuzzy Inference System (ANFIS) for Optimization of Solar Based Vehicle-to-Home (V2H) Fuzzy Inference System (FIS) Controller Mahdi Shafaati Shemami ¹ , Mohammad Saad Alam ¹ , M. S. Jamil Asghar ¹ , Samir M. Shariff ² - (1) Department of Electrical Engineering, ZHCET, Aligarh Muslim University, (2) College of Engineering, Taibah University
22	Modeling and Simulation of a Reversible Substation for Recuperation of Regenerative Braking Energy in Rail Transit Systems Mahdiyeh khodaparastan - Cuny-City College

Poster Session 2

Thursday June 20th, 2019

12:00 PM – 2:00 PM

Exhibit Hall

Session Chairs: Jiyao Wang, Ford Motor Company &
Fei Gao, University of Technology of Belfort-Montbéliard (UTBM)

Paper Order #	Title/Author
23	Systematic Comparison of Current Control Techniques for Switched Reluctance Motors Siddharth Mehta ¹ , Prerit Pramod ² , Iqbal Husain ¹ – (1) Department of ECE, North Carolina State University, (2) Nexteer Automotive
24	Power Quality Improvement for PMSG Based Isolated Small Hydro System Feeding Three-phase 4 Wire Unbalanced Nonlinear Loads Vineet Chandran, Shadab Murshid, Bhim Singh - Indian Institute of Technology
25	LiFePO₄ Battery Modeling and Drive Cycle Loss Evaluation in Cascaded H-Bridge Inverters for Vehicles Oskar Theliander ¹ , Anton Kersten ¹ , Manuel Kuder ² , Emma Grunditz ¹ , Torbjörn Thiringer ¹ – (1) University Chalmers (2) University of the German Federal Armed Forces
26	Analysis of Auxiliary Power Unit and Charging for an 800V Electric Vehicle Iman Aghabali ^{1,2} , Jennifer Bauman ^{1,2} , Ali Emadi ^{1,2} – (1) McMaster Automotive Resource Centre (MARC), (2) McMaster University
27	A New Digital Current Control Algorithm for Boost Converter Tianyu Chen - University of Texas at Dallas
28	Analysis of Multiple-EV Wireless Power Transfer System Using a Single Transmitter Coil Agasthya Ayachit ¹ , Mohamad Abdul-Hak ¹ , Marian Kazimierczuk ² – (1) Mercedes-Benz Research and Development North America, (2) Wright State University
29	A High Frequency Isolated Push-Pull Resonant Gate Driver for SiC MOSFET with Asymmetrical Voltage Qunfang Wu ¹ , Mengqi Wang ¹ , Weiyang Zhou ¹ , Guanliang Liu ¹ , Qin Wang ² – (1) ECE Department, University of Michigan-Dearborn, (2) College of Automation Engineering, Nanjing University of Aeronautics and Astronautics
30	CM & Line-DM Noise Separation for Three-Level NPC Inverter with Connected Neutral Point for Vehicle Traction Applications Anton Kersten ¹ , Karl Oberdieck ² , Jerome Gossmann ² , Andreas Bubert ² , Rolf Loewenherz ² , Markus Neubert ² , Emma Grunditz ¹ , Torbjörn Thiringer ¹ , Rik W. De Doncker ² – (1) Chalmers University of Technology, (2) RWTH Aachen
31	Extending Operational Range for Low-Cost Motor Drive Systems by Mitigating Narrow Pulse Effect Joon-Hee Lee, Yong-Cheol Kwon, Seung-Ki Sul - Department of Electrical and Computer Engineering, Seoul National University
32	A T-Type and Flying-Capacitor Based Hybrid Five-Level Rectifier Jianfei Chen ¹ , Caisheng Wang ¹ , Zhiwei Zhang ² , Yulin Zhong ³ , Chen Duan ¹ , Kewei Ding ¹ – (1) Wayne State University, (2) Ohio State University, (3) University of Michigan
33	Inverter Voltage Drop Characterisation Considering Junction Temperature Effects Guanghan Zhao ¹ , Shamsuddeen Nalakath ¹ , Yingguang Sun ² , Jason Wiseman ² , Ali Emadi ¹ – (1) McMaster University, (2) BorgWarner Waterloo, Inc

Poster Session 2

Thursday June 20th, 2019

12:00 PM – 2:00 PM

Exhibit Hall

Session Chairs: Jiyao Wang, Ford Motor Company &
Fei Gao, University of Technology of Belfort-Montbéliard (UTBM)

Paper Order #	Title/Author
34	Modeling and Control of a Multiport Converter based EV Charging Station with PV and Battery Yibin Zhang, Jiangbiao He, Dan Ionel - SPARK Lab, ECE department, University of Kentucky
35	Impact of Background Voltage Harmonic Mitigation Techniques on Coupled Frequencies in VSC-Based EV Fast Charging Md Ahsanul Hoque Rafi ¹ , Yin Sun ² , Jennifer Bauman ¹ – (1) Department of ECE, McMaster University, (2) DNV GL
36	Probabilistic Electric Vehicle Load Management in Distribution Grids Behnam Khaki, Yu-Wei Chung, Chicheng Chu, Rajit Gadh - Smart Grid Energy Research Center (SMERC), Mechanical Engineering Department, University of California
37	Impact of Vehicle-to-Grid on the European Electricity System – the Electric Vehicle Battery as a Storage Option Maria Taljegard - Division of Energy Technology, Chalmers University of Technology
38	V2G for Reliable Microgrid Operations: Voltage/Frequency Regulation with Virtual Inertia Emulation Saleh Dinkhah, Cesar Negri, Miao He, Stephen Bayne - Texas Tech University
39	Optimizing Size of Lithium-Ion Battery Combined with PV Generation Jinqiang Liu, Zhaoyu Wang, Chao Hu - Iowa State University
40	Online Parameter Estimation of PMSM in EV Powertrain Including Thermal Measurements Arnout Zwartbol, Jianning Dong, Pavol Bauer, Henk Polinder - Delft University of Technology
41	Performance Estimation of a Traction Machine with Direct Cooled Hairpin Winding Avo Reinap, Mats Andersson, Francisco Márquez-Fernández, Philip Abrahamsson, Mats Alaküla - Lund University
42	Using Multi-Agent Transport Simulations to Assess the Impact of EV Charging Infrastructure Deployment Francisco Márquez-Fernández ^{1,2} , Gabriel Domingues-Olavarria ^{1,2} , Joschka Bischoff ³ , Mats Alaküla ^{1,2} – (1) Lund University, (2) Swedish Electromobility Centre, (3) Technical University in Berlin
43	Thermal Assessment of an ERS for Static Charging of Electric Vehicles Philip Abrahamsson, Francisco Márquez-Fernández, Mats Alaküla - Lund University
44	A Novel Approach for Maximizing Regenerative Braking Energy Extraction of Electric Vehicles Using Motor Performance Lookup Table Shoeib Heydari ¹ , Poria Fajri ¹ , Reza Sabzehgar ² , Mohammad Rasouli ³ – (1) University of Nevada Reno, (2) San Diego State University, (3) Penn State Behrend

Thursday, June 20, 2019



Afternoon Breakout Sessions

Short Course 2: Functional Safety for Electrified Powertrains

Wednesday, June 20th, 2019

2:00PM – 5:40PM (3:20PM-4:20PM Coffee Break in Exhibit Hall)

Venue: Legacy 1

Instructor:

Jody Nelson - kVA

Short Biography:

Jody Nelson received the B.S. and M.S. degrees in electrical engineering from the University of Wisconsin, Madison, with an emphasis on power electronics and was a member of WEMPEC. From 2002 until 2009 he worked for Daimler AG. At Daimler he worked in both the EMC Research and Development departments working on production hybrid and electric vehicles. He later moved to the electric motor control department where he focused on software development, diagnostics, high voltage safety, torque security and control board development for electric powertrains. In 2010 he co-founded kVA, a U.S. based company dedicated to improving functional safety in the automotive and industrial segments through consulting, assessments and training on ISO 26262 and IEC 61508.

Summary:

This short course discusses functional safety development concepts, stemming from the ISO 26262 standard, with respect to electrified powertrains. Without preventive measures, the risk of safety critical system malfunction becomes unacceptably too high. The functional safety standard ISO 26262, recently updated in its Second Edition, provides crucial safety-related requirements for all on-road vehicles. The First Edition was limited to passenger cars. Now with the introduction of the Second Edition, all trucks, buses and motorcycles are now included. Electric powertrains introduce additional hazards in comparison to traditional, internal combustion engine powered powertrains. The course will cover these hazards including increased braking torque, high voltage exposure and thermal concerns. The course will describe how automotive OEMs conduct the required hazard analysis and risk assessment (HARA) at the vehicle level. The HARA is the key analysis used to identify potential risks and develop the highest level safety requirements to mitigate these identified risks. Attendees of the course will become more familiar with the rugged processes required to develop functionally safe on-road vehicles.



Thursday, June 20, 2019

Afternoon Breakout Sessions



Short Course 3: Electric Road Systems

Thursday, June 20th, 2019

2:00PM – 5:40PM (3:20PM-4:20PM Coffee Break in Exhibit Hall)

Venue: Legacy 2

Instructor:

Francisco Marquez-Fernandez - Lund University, Sweden

Short Biography:

Francisco J. Márquez-Fernández was born in Huelva (Spain) in 1982. In 2006 he graduated as a M.Sc. on Industrial Engineering with a major in Industrial Electronics from the University of Seville (Spain). He received his Ph.D. in Electrical Engineering in 2014 Lund University in Sweden. Between December 2014 and June 2016 he was a Post-doctoral Research Assistant with the Energy and Power Group at the University of Oxford, UK. Currently he is appointed as a Researcher at the Div. of Industrial Electrical Engineering and Automation, Lund University, and the Swedish Electromobility Centre. His research interests are mostly related to transport electrification, spanning from the design of new topologies of electrical machines and power electronic drives to charging and energy management strategies for electric vehicles and their interaction with the power grid.

Summary:

Electric Vehicles (EVs) are nowadays readily available in the market, and for the most part, their performance is comparable to that of their ICE-powered counterpart, if not better. Moreover, alongside the development of technology, EVs are also slowly becoming economically competitive. However, there is still one big issue that prevents mass adoption of EVs: providing acceptable range with reasonable charging times.

Looking at the market evolution, the battery capacity installed onboard the vehicles has increased substantially over the last few years. This not only makes the vehicles more expensive, but also implies carrying an unnecessary weight onboard all the time for a piece of equipment that is seldom needed. Additionally, in those occasions in which the large battery capacity is actually needed, the time required to recharge the battery is generally much longer than what it takes to refill a conventional fuel tank, making it impractical. These problems are even more severe when electrifying heavy-duty commercial vehicles.

A possible solution to this challenge is to supply energy to the vehicles as they drive over certain sections of the road, so called dynamic charging or Electric Road Systems (ERS). Part of this energy will be used to propel the vehicle while the rest could be stored in the onboard battery, to cover for those sections of the road that are not electrified. As it will be shown in the course, a sufficiently dense ERS network would lead to significantly less need for EV batteries, much lower need for fast charging stations and an overall lower electromobility cost. However, there are some challenges associated with ERS as well, and in order to assess them, several pilot-tests are currently being demonstrated on public roads.

Thursday, June 20, 2019

Afternoon Breakout Sessions



Short Course 4: Thermal Materials, Components, and Systems: Key Solutions for Vehicle Electrification

Thursday, June 20th, 2019

2:00PM – 5:40PM (3:20PM-4:20PM Coffee Break in Exhibit Hall)

Venue: Legacy 4

Speaker:

Dave Saums - DS&A LLC

Short Biography:

Dave Saums founded DS&A LLC as an independent consulting firm in 2003, assisting firms in assessing electronic thermal management markets and systems requirements for new business strategy, new product development concepts, and new product testing and introduction. Prior to this fifteen year period as an independent consultant, Dave worked for four different thermal management component, systems, and materials manufacturers over a twenty-five year period. This included managing a product development engineering team, managing development of a new manufacturing business with tens of millions of heat sink assemblies shipped per month, with evaluation of TIMs for those assemblies. Work experience also included business development for CTE-matched thermal materials, work on the first phase-change TIMs, mil-grade air movers, and two-phase liquid cooling systems, with hundreds of visits to engineering groups globally in power electronics, telcom, computing, and semiconductor manufacturing companies. He has been the general chair for an advanced technology workshop on thermal management for nineteen years and has served as co-chair for four power electronics thermal management workshops in the EU. Dave earned BS and MBA degrees from Clarkson University, was named Society Fellow for IMAPS in 2010, and is a member of IEEE and SAE.

Summary:

Electronic design at the system level consists of integration of an array of different individual semiconductor and electrical components. Integration of disparate component types for vehicle electrification includes IGBT power semiconductors, ICs, RF devices, discrete power semiconductors, capacitors, battery cells, and subassemblies such as DC-DC converters. Many of these component types, while highly efficient, also dissipate heat and a major failure mechanism for electronic systems is inadequate heat dissipation, both for individual components and at the system level. It is the single largest cause of failure, with vibration and dust and other environmental factors as examples of other factors. Thermal management systems include both air cooling and several types of liquid cooling technologies. Liquid cooling technologies include heat pipes, thermosyphons, single-phase pumped liquid systems, and two-phase liquid cooling systems, with either water/glycol or dielectric coolants. Thermal interface materials (TIMs) provide a critical intermediary between processors, power transistors, IGBT power modules, battery cells and cold plates, and other components that generate heat and heat sinks and mechanical components to allow transfer and spreading of a given heat load to larger metallic surfaces and ultimately to the ambient air. Categorizing and evaluating this range of thermal management technologies is increasingly important as a key component of vehicle electrification, and as the industry moves towards higher temperature operation of power semiconductors (silicon, GaN, and SiC). This tutorial presentation will provide insight across this range of different technologies and will include examples of system implementations for vehicle electrification.

Thursday, June 20, 2019

Afternoon Breakout Sessions



Panel 4: Electric Vehicle Grid Integration and Services

Thursday, June 20th, 2019

2:00PM – 3:20PM

Venue: Cornerstone 5

Panel Organizer and Moderator:

Hossein Ghassempour Aghamolki - Eaton

Panelists:

- Ron Thompson - Eaton
- David Ganger – Eaton
- Santosh Veda – NREL
- Chris Bilby - Holy Cross Energy

Panel Summary:

Ever increasing integration of Electric Vehicles (EVs) brings unprecedented opportunities and challenges for the power system. Although integration of EVs, through charging strategies and aggregation, can support and provide valuable services to contribute to the reliable management of the electricity grid, wrong smart charging strategies could cause a significant increase in peak load which requires generation or capacity expansions. Therefore, it is important for the power industry to investigate the effect of EV integration and explore its challenges and opportunities in order to develop a proper roadmap and plan for the future grid. In this panel, different panelists from the power industry will discuss opportunities and challenges of EV integration to the electricity grid and their company's roadmap and active projects to address some of those main technical.



Thursday, June 20, 2019



Afternoon Breakout Sessions

Panel 5: WBG Devices in Automotive Applications

Thursday, June 20th, 2019

2:00 PM – 3:20 PM

Venue: Cornerstone 6

Panel Organizer and Moderator:

Brij Singh - John Deere Electronics Solutions, Inc.

Panelists:

- Steven Boyd - US Department of Energy
- Anant Agrawal - The Ohio State University
- Armen Baronian - Eaton Corporation
- Rick Eddins - GE Aviation Systems

Panel Summary:

Wide bandgap (WBG) power devices have gained quite a bit of traction due to significant efforts placed by academia, industry and government agencies. The successful realization of high-temperature, high-frequency, and high-efficiency SiC and GaN devices packaged in discrete and power modules has enticed many industries to launch R&D programs. Technology innovative industries may have WBG R&D programs that could be targeted to gain system level performance vis-à-vis silicon power converter technology. Moreover, academic led R&D work has tremendously helped industries, because many unknown issues are either solved or have acceptable solutions in place. Issues related to wide bandgap power devices that need additional attention are reliability, uniformity in specifications, gate drive requirements, system level cost-parity, etc. Experts from academia, industry, and government organizations will discuss these challenges and will provide their thoughts about how to overcome technical challenges. Some successful implementations of SiC power devices in vehicle application will also be covered.



Thursday, June 20, 2019

Afternoon Breakout Sessions



Tutorial 5: Fundamentals and Review of Battery State Estimation

Thursday, June 20th, 2019

2:00 PM – 3:20 PM

Venue: Cornerstone 1

Speaker:

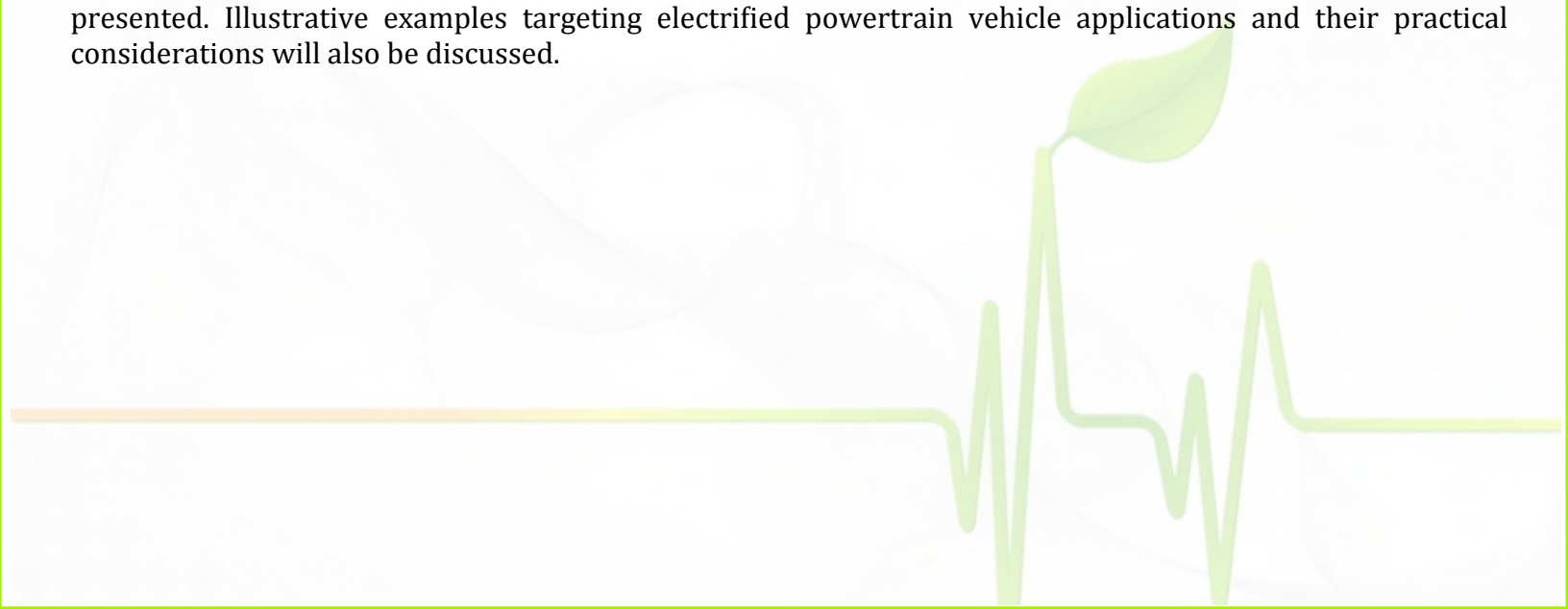
Pawel Malysz – Fiat Chrysler Automobiles

Short Biography:

Dr. Pawel Malysz received a B.Eng. degree (summa cum laude) in engineering physics as well as M.A.Sc. and Ph.D. degrees in electrical engineering from McMaster University, Hamilton, ON, Canada, in 2005, 2007 and 2011 respectively. Throughout his graduate studies he received scholarship awards such as the Ontario Graduate Scholarship, Queen Elizabeth II graduate Scholarship, and National Science and Engineering Research Council (NSERC) of Canada graduate scholarships. From 2012-2014 he was a Principal Research Engineer at the McMaster Institute for Automotive Research and Technology, a Canada Excellence Research Centre. He is a licensed professional engineer (P. Eng.) in the province of Ontario, a Golden Key International Honor Society member, and currently a Senior Technical Specialist at Fiat Chrysler Automobiles in Michigan, USA. Dr. Malysz co-received the Chrysler Innovation Award in 2014. In 2015, he was appointed Adjunct Assistant Professor in the department of Electrical and Computer Engineering at McMaster University. In 2017, Dr. Malysz became a Senior Member of IEEE (SMIEEE), and was part of the Mechanical Engineering department of Lawrence Technological University, Southfield, MI, USA, as an adjunct professor where he taught a course in hybrid electric and all-electric vehicles. He holds three patents and has published over 37 peer-reviewed journal/conference papers. His research interests include energy systems, battery management software design, electrified transportation, and advanced control engineering.

Summary:

This introductory short-course/tutorial presentation will cover concepts, methods, and challenges of battery state estimation, otherwise known as SOx estimation. This typically includes State-Of-Charge (SOC), power availability estimation, and battery health estimation/prediction. These are critical software components of battery/energy storage systems. An overview of common algorithms such as recursive least squares, Kalman filtering methods, and machine learning approaches will be described. Moreover, systematic methods to validate performance of these algorithms and related battery models to support their development shall be presented. Illustrative examples targeting electrified powertrain vehicle applications and their practical considerations will also be discussed.



Thursday, June 20, 2019

Afternoon Breakout Sessions



TEC Committee Meeting

Thursday June 20th, 2019

2:30PM - 4:00PM

Venue: Cornerstone 2



The IEEE Transportation Electrification Community (TEC) brings together both IEEE Societies and entities (ITEC sponsors PELS, IAS, and PES as well as four others) as well as individuals with an interest in the broad field of transportation electrification. This meeting is a formal meeting of TEC's steering committee. It is open to anyone, especially individuals who want to be more involved in one or another of TEC's activities, or simply want to be more informed about the behind the scene workings of TEC and IEEE.



Thursday, June 20, 2019

Afternoon Breakout Sessions



Panel 6: Aviation Electric Propulsion Systems

Thursday, June 20th, 2019

4:20PM – 5:40PM

Venue: Cornerstone 5

Panel Organizers and Moderators:

Yue Cao - Oregon State University

Jiangbiao He - University of Kentucky

Panelists:

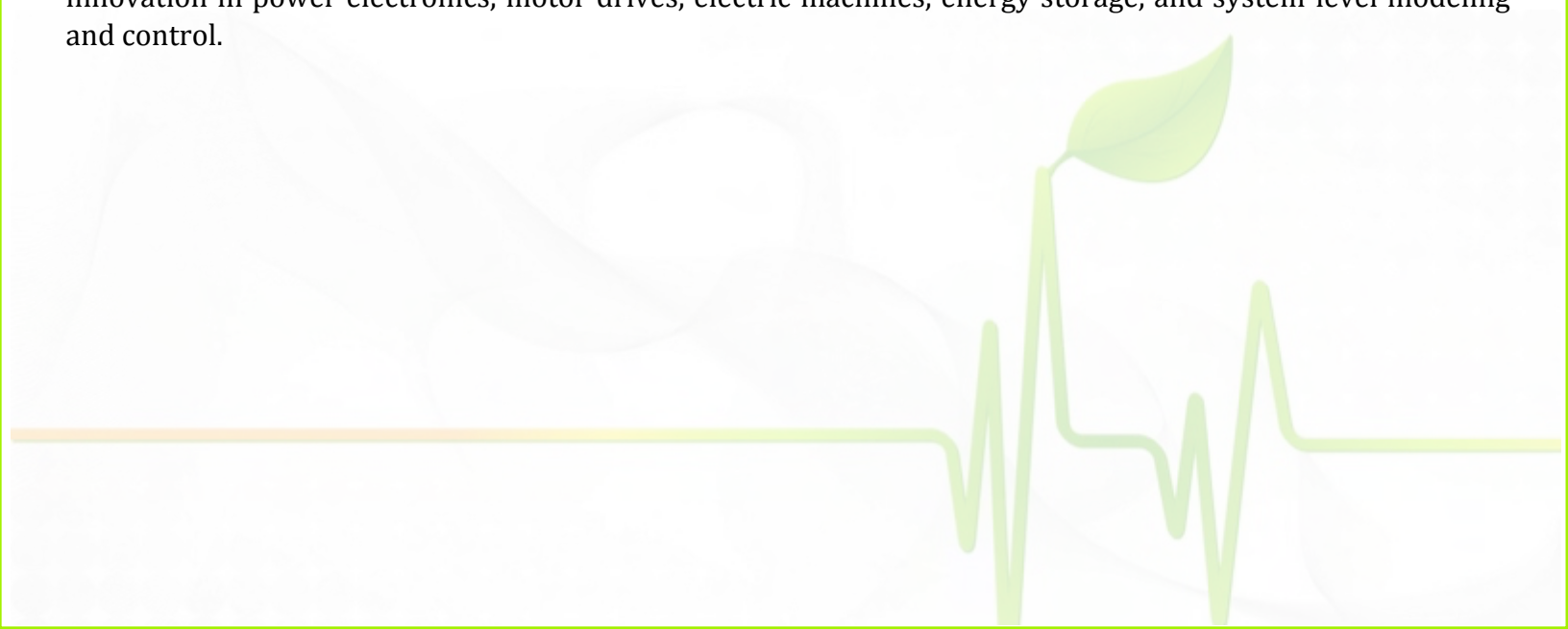
- Manish Dalal - GE Aviation
- Rodger Dyson - NASA Glenn Research Center
- Shengyi Liu - Boeing Company
- Daniel M. Saban - SAE AE-7 Committee

Panel Summary:

With the advent of more-electric and hybrid-electric aircraft technologies, electrical propulsion systems have become more critical compared to the past. The reliability, safety, certification and logistics support are pivotal areas of focus along with optimizing the value such as substantial fuel savings, reduced emissions and noise, increased speed, range and payload, reduced life cycle operating cost and the like.

We are already familiar with more electric aircraft, such as Boeing 787. As we are heading to all electric aircraft, many emerging flying vehicles serve as intermediate platforms to demonstrate state-of-the-art electrification technology. Examples include unmanned aerial vehicles carrying packages or passengers, and regional passenger aircraft seating fifty or less, etc.

There are challenges that must address increased power, propulsion, airframe, and thermal integration as well improvement in the key component performance parameters of specific power and efficiency. These challenges are being met through the development of a new class of high voltage flight-weight powertrain components (e.g., high-density electric machines and drives), unique test facilities, and integrated system solutions. In addition, efficient and reliable power systems are critical to these applications, often requiring innovation in power electronics, motor drives, electric machines, energy storage, and system-level modeling and control.



Thursday, June 20, 2019

Afternoon Breakout Sessions



Panel 7: Advancements and Developments in Electric Vehicle Charging Systems

Thursday, June 20th, 2019

4:20 PM – 5:40 PM

Venue: Cornerstone 6

Panel Organizer and Moderator:

Sriram Jala – GM

Panelists

- Jing Xu - ABB
- Mohammad Shadmand - KSU
- Veda Galigekere - ORNL
- Rich Scholer - FCA

Panel Summary:

All major vehicle and charging system manufacturers tend to jointly develop commonly accepted charging standards (such as common charger plugs) so that electric vehicle should be compatible with nearly all non-fast charging workplace and public chargers. This panel will discuss recent advancements, developments, standards, and challenges in electric vehicle charging systems related to conductive charging and inductive charging systems. Experts from vendors, automobile manufacturers, academia institutes, and national labs will share and discuss insights, opportunities, and ongoing efforts in technology and commercial-ready products development.



Thursday, June 20, 2019

Afternoon Breakout Sessions



Industry Presentations

Thursday, June 20th, 2019

4:20 PM - 5:40 PM

Venue: Cornerstone 1

4:20 PM - Presentation 1:

Title: External Influences on Sintered NdFeB Magnets.

Company: Tridus Magnetics & Assemblies

Speaker: Jeff Calvert

Short Biography:

Jeff Calvert is the Engineering Manager at Tridus Magnetics & Assemblies. Jeff has over 30 years of experience in the Rare Earth Permanent Magnet industry that has included alloy development, manufacturing process specification and development, magnet material characterization, quality control and operations. Prior to joining Tridus International, Jeff has held positions from Development Metallurgist to General Manager with major REPM manufacturers worldwide, and has consulted on occasion. Jeff has had the privilege of working with some fantastic people over the years including studying under the discoverers of the SmCo-based REPMs, Dr. Karl Strnat and Dr. Alden Ray, and collaborating with the discoverer of NdFeB-based materials, Dr. Masato Sagawa. Jeff received his undergraduate degree in Mechanical Engineering and graduate degree in Materials Engineering from the University of Dayton while working in Dr. Strnat's Magnetic Materials Laboratory at UD's Research Institute.

In his free time, Jeff enjoys the great outdoors as much as possible, food from various cultures, and time with family and friends.

5:00 PM - Presentation 2:

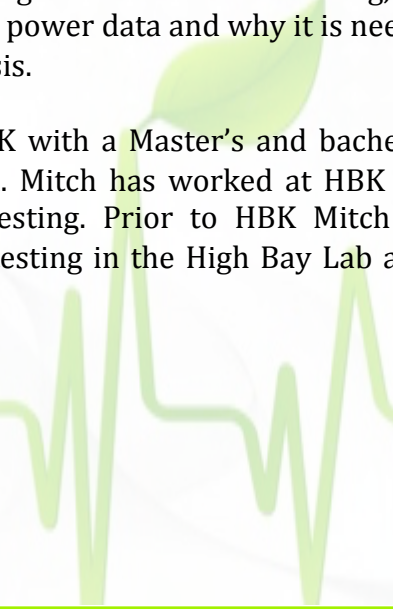
Title: In Vehicle Electric Power Measurement

Company: HBK

Speaker: Mitch Marks

Abstract: In vehicle testing has been a staple in the automotive world since its inception. As the number of electric vehicles increases there is a need to understand how electric powertrain functions in a vehicle. For many years this has been a challenge but the HBM eDrive has unique features which make electric powertrain analysis possible in vehicle. This seminar will cover the reasoning behind in vehicle testing, eDrive's unique features which make mobile testing possible, examples of mobile power data and why it is needed, correlation to existing DAQ systems, and a brief look at mobile control analysis.

Speaker Bio: Mitch Marks is a motor testing specialist for HBK with a Master's and bachelor's degrees in Electrical Engineering from University of Wisconsin – Madison. Mitch has worked at HBK for 3 years and providing application and sales support for electric motor testing. Prior to HBK Mitch worked at the University of Wisconsin where he ran electric motor and grid testing in the High Bay Lab at the Wisconsin Energy Institute.



Friday, June 21, 2019



Morning Breakout Sessions

Short Course 5: Electrified Powertrain, an Overview for Plug-in Hybrids and Electric Vehicles

Friday, June 21st, 2019

8:30AM – 12:00PM (Coffee Break at 10:00AM-10:30AM)

Venue: Legacy 1

Instructor:

Mengyang Zhang – Hynovation Technologies

Short Biography:

Dr. Mengyang Zhang had 22 years with US auto companies including Fiat Chrysler, GM, Delphi Automotive, and Visteon Corp. His technical experience includes research and development of electrified powertrains, and automotive system controls. He was leading advanced development for Fiat Chrysler Electrified Powertrain before joined Skywell Automobiles as VP and CTO in 2016 where Mr. Zhang was responsible for R&D in electrification technologies and intelligent vehicle technologies. Mr. Zhang is the president of Hynovation Technologies Inc. in Shenzhen China, developing fuel cell systems for transportation and stationary applications.

Summary:

The course will provide an overview of some of plug-in hybrid electric vehicles, battery electric vehicles and fuel cell electric vehicles, particularly from powertrain perspectives regarding architectures, performances, fuel economy and emissions etc. The course will cover technical discussions on electrified powertrain design and controls, system operating strategies, regulations and test procedures. The class will also provide introductions to some of critical subsystems such as electric propulsion systems, battery systems and fuel cell systems.



Friday, June 21, 2019

Morning Breakout Sessions



Short Course 6: Applying Wide-bandgap Devices in EV Battery Chargers

Friday, June 21st, 2019

8:30AM – 12:00PM (Coffee Break at 10:00AM-10:30AM)

Venue: Legacy 2

Instructor:

Kevin Bai - UTK

Short Biography:

Dr. Kevin Bai received B S and PHD degree from Department of Electrical Engineering of Tsinghua University, Beijing, China in 2002 and 2007, respectively. He was assistant professor in Kettering University (former General Motor Institute) in 2010 and associate professor in UM-Dearborn since 2017. He joined CURENT, University of Tennessee, Knoxville as associate professor in 2018. His research interest includes power electronics with motor drive system, EV battery chargers, auxiliary power module and battery management system. He is the author of 2 books, 52 peer-reviewed IEEE journal papers and 45 conference papers. Meanwhile he holds 10 industrial patents and acts as the associate editor of SAE International Journal of Alternative Powertrains and guest associate editor of Journal of Emerging and Selected Topics on Power Electronics.

Summary:

With the progressing of electric vehicles (EVs), on-board level-1 and level-2 chargers and off-board fast chargers are immediate needs to expedite the EV acceptance. As the largest electronics system on board which requires the electrical isolation due to the safety standard, the EV charger is in need of shrinking passive components (inductor, capacitor, transformer, heatsinks, etc), making wide-bandgap (WBG) devices a perfect device candidate, thanks for their superior switching performance. This tutorial will cover requirement and categories of EV chargers, topology candidate (LLC, DAB, CLLC, etc), component selection, circuit layout, control algorithm and ultimately demonstration of applying WBG devices to different EV chargers. A level-2 6.6kW >97%-efficiency battery charger using GaN HEMTs/SiC MOSFETs, a SWISS rectifier based SiC EV charger, and an off-board high-voltage fast charger using SiC MOSFETs will be discussed. Methods to enhance the performance and keep cost competitiveness are covered as well. This tutorial faces the intermediate and advanced-level audience with multiple-year experience of power electronics.



Friday, June 21, 2019

Afternoon Breakout Sessions



Women in Engineering

Friday, June 21st, 2019

12:00PM - 2:00PM (A Buffet Lunch Will Be Served)

Venue: Cornerstone 2

Presentation 1:

Title: A Reinvention Retrospective

Speaker: Karen Smiley - Lead Principal Scientist - ABB US Corporate Research

Presentation 2:

Title: Experiences and Tools to Engineer Your Way Through Academia as a Woman

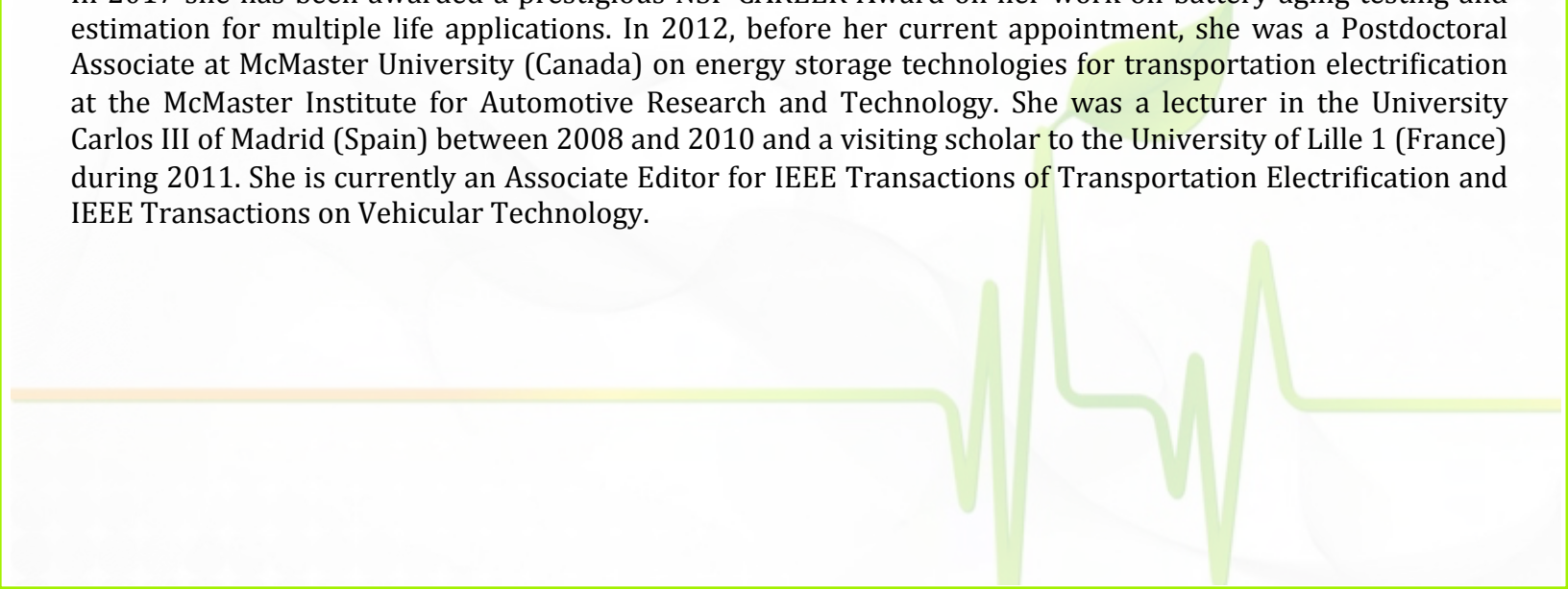
Speaker: Lucia Gauchia - Assistant Professor - Michigan Tech University

Short Biographies:

Ms. Karen Smiley has over 30 years of practical experience developing and managing analytical, real-time, and database systems through the full lifecycle of multiple industrial software-hardware products and service systems. Her experience spans small startups to large global enterprises across the domains of steel manufacturing, aerospace and military, fleet logistics, data networking, telecommunications, industrial automation, power grids, and electrification. Ms. Smiley has built deep expertise in agile research and development and in analysis of scientific and technical data. To date, she has co-invented on 6 US patents and authored or co-authored over 40 academic and industrial papers. She regularly serves on conference program committees for several of her areas of expertise. As a Lead Principal Scientist at ABB US Corporate Research, Ms. Smiley currently leads the US Analytics Solution Center activities in global collaborations on advanced industrial analytics, and supports ABB research teams in lean/agile adoption. Her most recent focus at ABB is on edge and hybrid analytics for renewable energy grids. Ms. Smiley holds a Bachelor of Science degree in Industrial Engineering and Operations Research from the University of Pittsburgh in Pittsburgh, PA, and a Master of Science degree in Computer Science from Stevens Institute of Technology in Hoboken, NJ. She became a Certified ScrumMaster™ in 2003.

Lucia Gauchia is the Richard and Elizabeth Henes Assistant Professor of Energy Storage Systems at Michigan Tech University since Fall 2013 and she holds a joint appointment in the ECE and ME-EM departments. She obtained her Ph.D. on Electrical Engineering at the University Carlos III of Madrid (Spain) in 2010.

In 2017 she has been awarded a prestigious NSF CAREER Award on her work on battery aging testing and estimation for multiple life applications. In 2012, before her current appointment, she was a Postdoctoral Associate at McMaster University (Canada) on energy storage technologies for transportation electrification at the McMaster Institute for Automotive Research and Technology. She was a lecturer in the University Carlos III of Madrid (Spain) between 2008 and 2010 and a visiting scholar to the University of Lille 1 (France) during 2011. She is currently an Associate Editor for IEEE Transactions of Transportation Electrification and IEEE Transactions on Vehicular Technology.



Friday, June 21, 2019

Morning Technical Sessions

Technical Session 1: Electric Machine Modeling, Characterization, and Testing

Session Chairs: Le Sun, Nanjing University of Science and
Berker Bilgin, McMaster University

Friday, June 21, 2019
8:30 AM – 10:10 PM, Legacy 3

TS1-1	Rheometer-Based Cogging Torque Measurement for Sub-Fractional HP Permanent Magnet Motors <i>Stefan Leitner^{1,2}, Georg Krenn³, Hannes Gruebler^{1,2}, Annette Muetze^{1,2} – (1) Christian Doppler Laboratory for Brushless Drives for Pump and Fan Applications, (2) Graz University of Technology, Electric Drives and Machines Institute, (3) Anton Paar GmbH</i>
TS1-2	Modeling and Steady-State Analysis of a Rotary Transformer-Based Field Excitation System for Wound Rotor Synchronous Machine <i>Josiah Haruna¹, Tsarafidy Raminosoa² – (1) Tennessee Tech University, (2) Oak Ridge National Laboratory</i>
TS1-3	Fast Computation Of Inductances Accounting for Saturation and Slotting Effect by Air Gap Characterization in Salient Pole Machines <i>Pablo Castro Palavicino, Bulent Sarlioglu - University of Wisconsin-Madison</i>
TS1-4	Self-Calibrating Method for Motor Performance Data Without Dyno <i>Gene Smiley - MDS, Inc</i>
TS1-5	Driving Cycle Simulation of Wound-Rotor Synchronous Machine with Hairpin Windings Considering AC-Losses <i>Daniel Bachinski Pinhal, Dieter Gerling - Bundeswehr University Munich</i>

Technical Session 2: Battery Charger Design and Control

Session Chairs: Jianwu Cao, EnerSys and Lea Dorn-Gomba, McMaster University

Friday, June 21, 2019
8:30 AM – 10:10 AM, Legacy 4

TS2-1	A Modified Bridgeless Cuk Converter Based EV Battery Charger with Improved Power Quality <i>Radha Kushwaha, Bhim Singh - Department of Electrical Engineering, Indian Institute of Technology</i>
TS2-2	A Flexible V2V Charger as a New Layer of Vehicle-Grid Integration Framework <i>Emin Ucer¹, Ramona Buckreus¹, Mithat Kisacikoglu¹, Eyuphan Bulut², Mustafa Guven³, Yilmaz Sozer⁴, Luigi Giubolini⁵ – (1) University of Alabama, (2) Virginia Commonwealth University, (3) Caterpillar Inc., (4) University of Akron, (5) Andromeda Power, LLC</i>
TS2-3	A Contribution to Protective Measures Against Electric Shock at DC Charging Stations <i>Daniel Herbst, Robert Schuerhuber, Ernst Schmutzner, Graz University of Technology - Institute of Electrical Power Systems</i>
TS2-4	Silicon Carbide Based Interleaved Bi-Directional DC-DC Converter Design for High Power Density Fast Charging Stations <i>Salman Harasis¹, Sifat Chowdhury¹, Mithat Kisacikoglu², Lokman Erzen¹, Yilmaz Sozer¹ – (1) University of Akron, (2) University of Alabama</i>
TS2-5	A Stochastic Model for Fast Charging Stations with Energy Storage Systems <i>Islam Safak Bayram¹, Muhammad Ismail² – (1) Qatar Environment and Energy Research Institute, Hamad Bin Khalifa University, (2) Texas A&M University at Qatar</i>

Friday, June 21, 2019

Morning Technical Sessions

Technical Session 3: Heavy Duty Vehicle Applications

Session Chairs: Meng (Rachel) Wang, Eaton Corporation and
Yanming Hou, Oshkosh Corporation

Friday, June 21, 2019
8:30 AM – 10:10 AM, Cornerstone 1

TS3-1	Off-Road Vehicle Hybridization Methodology Applied to a Tractor Backhoe Loader <i>Frederico Mendes^{1,2}, Danilo Brandão¹, Thales Maia¹, Braz Cardoso Filho¹, - (1) Graduate Program in Electrical Engineering, Federal University of Minas Gerais, (2) CNH Industrial Brasil Ltda</i>
TS3-2	Numerical Methods for Optimal Control of Hybrid Electric Agricultural Tractors <i>Chao Jia, Wei Qiao, Liyan Qu - University of Nebraska-Lincoln</i>
TS3-3	Linear Electric Machine Design for an Off-Highway Vehicle Hydraulic Charge Pump <i>Anvar Khamitov¹, Jenny Swanson², Eric Severson¹, James Van de Ven² - (1) University of Wisconsin-Madison, (2) University of Minnesota</i>
TS3-4	Electrification of a Compact Agricultural Tractor: a Successful Case Study <i>Matteo Dalboni¹, Paolo Santarelli², Paolo Patroncini², Alessandro Soldati¹, Carlo Concari¹, Davide Lusignani³ - (1) University of Parma, (2) 4e-consulting srl, (3) eDriveLAB s.r.l.</i>
TS3-5	A Feasibility Study for Tractor Electrification: Duty Cycles Simulation and Consumption Comparison <i>Diego Troncon¹, Luigi Alberti¹, Michele Mattetti² - (1) University of Padua - Department of Industrial Engineering, (2) University of Bologna - Department of Agricultural and Food Sciences</i>

Technical Session 4: Power Electronics Devices, Packages, and Failure Analysis

Session Chairs: Zahra Amjadi, Florida Polytechnic University and
Seung-Ki Sul, Seoul National University

Friday, June 21, 2019
8:30 AM – 10:10 PM, Cornerstone 5

TS4-1	On-board SiC MOSFET Degradation Monitoring through Readily Available System Current / Voltage Sensing <i>Shi Pu, Fei Yang, Enes Ugur, Bhanu Teja Vankayalapati, Chi Xu, Bilal Akin - The University of Texas at Dallas</i>
TS4-2	Estimating Power Module Lifetime with a Drive Schedule to Determine Effectiveness of Module Packaging Technologies <i>Mark Steiner, Eric Motto - Mitsubishi Electric US</i>
TS4-3	A Machine Learning Approach for Adaptive Classification of Power MOSFET Failures <i>Donald McMenemy¹, Weiqiang Chen¹, Lingyi Zhang¹, Krishna Pattipati¹, Ali Bazzi^{1,2}, Shailesh Joshi³ - (1) University of Connecticut, Storrs, (2) American University of Beirut, (3) Toyota Research Institute of North America</i>
TS4-4	SiC MOSFET Aging Detection based on Miller Plateau Voltage Sensing <i>Shi Pu, Fei Yang, Enes Ugur, Chi Xu, Bilal Akin - The University of Texas at Dallas</i>
TS4-5	Partial Discharge Phase and Amplitude Distribution of Insulation Systems Fed by Multilevel Inverters <i>Paolo Seri¹, Gian Carlo Montanari^{1,2}, Robert Hebner² - (1) DEI - University of Bologna, (2) Center for Electromechanics, University of Texas</i>

Friday, June 21, 2019

Morning Technical Sessions

Technical Session 5: Autonomous Vehicles and Cyber Security

Session Chairs: Azrin Mohd Zulkefli, Eaton Corporation and
Zonggen Yi, Idaho National Laboratory

Friday, June 21, 2019
8:30 AM – 10:10 PM, Cornerstone 6

TS5-1	An On board Real Time-Implementable Framework for Calculating the Optimal Cruising Speed of Electric Autonomous Vehicles <i>Ata Meshginqalam, Jennifer Bauman - McMaster University</i>
TS5-2	Development of an Energy-Efficient Routing Algorithm for Electric Vehicles <i>Aries Gatmaytan Garcia, Lew Andrew Ravelas Tria, Marc Caesar Reyes Talampas - Electrical and Electronics Engineering Institute, University of the Philippines Diliman</i>
TS5-3	Path Planning for an Autonomous Electric Vehicle Based on Attractors Dynamics and Differential Evolution <i>Pedro Bautista-Camino, Francisco J. Perez-Pinal, Martín A. Rodríguez-Licea, Ibsan U. Castillo-Zamora - Celaya Institute of Technology - TecNM</i>
TS5-4	Vulnerability Analysis and Risk Assessment of EV Charging System under Cyber-Physical Threats <i>Devin N Reeh, Francisco Cruz Talpia, Yu-Wei Chung, Behnam Khaki, Peter Chu, Rajit Gadh - UCLA Smart Grid Energy Research Center</i>
TS5-5	Impact Analysis of Data Integrity Attacks on Power Electronics and Electric Drives <i>Bowen Yang, Lulu Guo, Fangyu Li, Jin Ye, Wenzhan Song - University of Georgia</i>

Technical Session 6: Electric Machine Design I

Session Chairs: Silong Li, Ford Motor Company and
Brock Howey, McMaster University

Friday, June 21, 2019
10:30 AM – 12:10 PM, Legacy 3

TS6-1	Driving Cycle Analysis Using Data Clustering for Machine Design Optimization <i>Mohamad Salameh, Ian Brown, Mahesh Krishnamurthy - Illinois Institute of Technology - Dept. of Electrical & Computer Engineering</i>
TS6-2	Parametric Analysis on Tradeoffs between Transient and Steady-state Loss Reduction for Induction Machines of Different Sizes <i>Yuying Shi, Bulent Sarlioglu, Robert Lorenz - University of Wisconsin-Madison</i>
TS6-3	Influence of Mixed Stator Winding Configurations and Number of Rotor Flux-Barriers on Torque and Torque Ripple of Five-Phase Synchronous <i>Mbika Muteba - University of Johannesburg</i>
TS6-4	Operation Enhancement of Permanent Magnet Excited Motors with Advanced Rotor Cooling System <i>Benedikt Groschup, Maxim Komissarov, Svetomir Stevic, Kay Hameyer - Institute of Electrical Machines (IEM)</i>
TS6-5	Design and Control of a High Speed Motor and Generator Unit for Electric Turbocharger (E-Turbo) Application <i>Co Huynh, Liping Zheng - Calnetix Technologies</i>

Friday, June 21, 2019

Morning Technical Sessions

Technical Session 7: Battery State of Charge and Capacity Estimation

Session Chairs: Pawel Malysz, FCA USA LLC and
Lucia Gauchia, Michigan Tech University

Friday, June 21, 2019
10:30 AM – 12:10 AM, Legacy 4

TS7-1	Prediction of Li-Ion Battery State of Charge Using Multilayer Perceptron and Long Short-Term Memory Models <i>Asadullah Khalid, Aditya Sundararajan, Ipsita Acharya, Arif Sarwat - Florida International University</i>
TS7-2	Comparative Study of State-of-Charge Estimation with Recurrent Neural Networks <i>Nikolaos Wassiliadis, Thomas Herrmann, Leo Wildfeuer, Christoph Reiter, Markus Lienkamp - Institute of Automotive Technology, Technical University of Munich</i>
TS7-3	Li-ion Battery State of Charge Estimation using Long Short-Term Memory Recurrent Neural Network with Transfer Learning <i>Carlos Vidal, Phillip Kollmeyer, Ephrem Chemali, Ali Emadi - McMaster University</i>
TS7-4	Impact of the State of Charge Estimation on Model Predictive Control Performance in a Plug-in Hybrid Electric Vehicle Accounting for Equivalent Fuel Consumption and Battery Aging <i>Nicolas Sockeel¹, Masood Shahverdi², Michael Mazzola¹ – (1) Energy Production and Infrastructure Center, (2) California State University</i>
TS7-5	Online Estimation of Lithium-Ion Battery Capacity Using Transfer Learning <i>Sheng Shen, Mohammad Sadoughi, Chao Hu - Iowa State University</i>

Technical Session 8: Electric Bus and Rail Applications

Session Chairs: Payam Naghshtabrizi, Eaton Corporation and
Jennifer Bauman, McMaster University

Friday, June 21, 2019
10:30 AM – 12:10 PM, Cornerstone 1

TS8-1	Traction Motor Bearing Failures Due to Bearing Currents in Electric Locomotives <i>Ambermani Sundaresan¹, Mukul Chandorkar² - (1) Indian Railways (2) Indian Institute of Technology</i>
TS8-2	Dynamic (Transient) Modeling and Study of Light Rail Transit System In EMTP, Including Loading and Unloading Effect <i>Mehrdad Boloorchy, Mehrdad Rostami - Stantec</i>
TS8-3	Performance of 200-kW Inductive Charging System for Range Extension of Electric Transit Buses <i>Anthony Calabro, Benjamin Cohen, Andrew Daga, John Miller, Frank McMahon - Momentum Dynamics Corporation</i>
TS8-4	Incorporation of Battery Electric Buses in the Operation of Intercity Bus Services <i>Nader El-Taweel, Hany Farag - York University</i>
TS8-5	Optimizing Charging Schedules for Electric Bus Fleets through Service-centric Virtual Power Plant Operations <i>Andreas F. Raab¹, Enrico Lauth², Jan F. Heinekamp¹, Kai Strunz¹, Dietmar Göhlich² - (1) Technische Universität Berlin, Department Sustainable Electric Networks and Sources of Energy (SENSE), (2) Technische Universität Berlin, Department Methods for Product Development and Mechatronics (MPM)</i>

Friday, June 21, 2019

Morning Technical Sessions

Technical Session 9: Wireless Power Transfer Session Chairs: Pavol Bauer, Delft University of Technology and Francisco J. Márquez-Fernández, Lund University

Friday, June 21, 2019
10:30 AM – 12:10 PM, Cornerstone 5

TS9-1	Long-Distance and High-Power Capacitive Power Transfer Based on the Double-Sided LC Compensation: Analysis and Design <i>Hua Zhang 1, Chong Zhu 2, Fei Lu 1 – (1) Drexel University, (2) Shanghai Jiaotong University</i>
TS9-2	Misalignment Tolerant DWPT Charger for EV roadways with Integrated Foreign Object Detection and Driver Feedback System <i>Ahmed Azad, Vladimir Kulyukin, Zeljko Pantic - Utah State University</i>
TS9-3	A Novel Technique for Discrimination of Foreign Object from Misalignment in Wireless Charging Systems <i>Hassan Jafari, Temitayo Olowu, Masood Moghaddami, Arif Sarwat - Florida International University</i>
TS9-4	Sensitivity Analysis of an LCC-LCC Compensated 20kW Bidirectional Wireless Charging System for Medium-Duty Vehicle <i>Mostak Mohammad, Omer Onar, Jason Pries, Veda Galigekere, Gui Su, Saeed Anwar, Jonathan Wilkins, Randy Wiles - Oak Ridge National Laboratory</i>
TS9-5	A New Calibration Strategy for Transfer-Power Measurement of Wireless Charging of Electric Vehicles <i>Sung Yul Chu, Al-Thaddeus Avestruz - University of Michigan</i>

Technical Session 10: Permanent Magnet Machine Drive and Control Session Chairs: Raja Ramakrishnan, Halla Mechatronics and Sandun Kuruppu, Saginaw Valley State University

Friday, June 21, 2019
10:30 AM – 12:10 PM, Cornerstone 6

TS10-1	Optimal Current Trajectory Control of IPMSM for Minimized Torque Ripple <i>Hyung-June Cho, Yong-Cheol Kwon, Seung-Ki Sul - Seoul National University</i>
TS10-2	Improved Optimal Control of Interior Permanent Magnet Synchronous Machine with Simplified Inverter Nonlinearity Compensation <i>Zekun Xia ¹, Shamsuddeen Nalakath ¹, Yingguang Sun ², Jason Wiseman ², Ali Emadi ¹ – (1) Department of Electrical and Computer Engineering, McMaster University, (2) BorgWarner Waterloo, Inc.</i>
TS10-3	Resistance Imbalance in Feed Forward Current Controlled Permanent Magnet Synchronous Motor Drives for Mass Manufacturing Applications <i>Prerit Pramod - Nexteer Automotive Corporation</i>
TS10-4	Non-linear Optimization-Based Temperature Estimation of IPMSM <i>Le Sun ^{1,2}, Sumedh Dhale ¹, Shamsuddeen Nalakath ¹, Mustafa Mohamadian ³, Daniel Luedtke ³, Matthias Preindl ⁴, Ali Emadi ¹ - (1) McMaster University, (2) Nanjing University of Science and Technology, (3) FCA US LLC, (4) Columbia University</i>
TS10-5	Intelligent Nonlinear Sensorless Predictive Field Oriented Control of PMSM Drive for Three Wheeler Hybrid Solar PV-Battery Electric Vehicle <i>Sreejith R., Bhim Singh - Indian Institute of Technology Delhi</i>

Friday, June 21, 2019

Afternoon Technical Sessions

Technical Session 11: Electric Machine Design II
Session Chairs: Matthew Johnson, U.S. Army Research Laboratory and
Eric Severson, University of Wisconsin-Madison

Friday, June 21, 2019
2:00 PM – 3:40 PM, Legacy 3

TS11-1	Comparison of Modular PM Propulsion Machines for High Power Density James Swanke, Dheeraj Bobba, Thomas Jahns, Bulent Sarlioglu - Wisconsin Electric Machines and Power Electronics Consortium (WEMPEC), University of Wisconsin-Madison
TS11-2	Design of a Novel Axial Flux-Switching PM Machine Integrated with Centrifugal Compressor with Radial Impellers Hao Ding, Bulent Sarlioglu - Wisconsin Electric Machines and Power Electronics Consortium (WEMPEC), University of Wisconsin
TS11-3	Dual Mechanical Port Machine With Interior PM Outer-Rotor for Hybrid Electric Vehicles Zhiwei Zhang - Department of Electrical and Computer Engineering, The Ohio State University
TS11-4	WAVED: A Coreless Axial Flux PM Motor for Drive Systems with Constant Power Operation Narges Taran, Vandana Rallabandi, Dan Ionel - University of Kentucky
TS11-5	Design Optimization of a Synchronous Reluctance Machine for High Performance Applications Mazharul Chowdhury ^{1,2} , Mohammad Islam ¹ , Abraham Tesfamichael ¹ , Iqbal Husain ² – (1) Halla Mechatronics, (2) North Carolina State University

Technical Session 12: Battery and Energy Storage Modeling and Balancing
Session Chairs: Hengzhao Yang, California State University Long Beach and
Javier Gazzarri, MathWorks

Friday, June 21, 2019
2:00 PM – 3:40 PM, Legacy 4

TS12-1	Characterizing Li-ion Battery Relaxation Effects with EIS Marvin Messing ^{1,2} , Tina Shoa ² , Saeid Habibi ¹ – (1) Department of Mechanical Engineering, McMaster University (2) Cadex Electronics
TS12-2	An Electric Vehicle Battery Modular Balancing System Based On Solar Energy Harvesting Chen Duan ¹ , Hongjun Tao ¹ , Jianfei Chen ¹ , Caisheng Wang ¹ , Xinru Zhao ² , Xuan Zhou ² – (1) Wayne State University, (2) Kettering University
TS12-3	A Lightweight, High-Speed Kinetic Battery for Hybrid and Electric Vehicles Xiaojun Li ^{1,2} , Lingnan Hu ² , Alan Palazzolo ² – (1) Gotion Inc, (2) Texas A&M University
TS12-4	Modeling and Control of a Hardware Efficient Low-Voltage-To-Cell Battery Balancing Circuit for Electric Vehicle Range Extension Christina Riczu, Jennifer Bauman - Electrical and Computer Engineering Department, McMaster University
TS12-5	Integration of Second Life Batteries into a Smart Overhead Contact System Based on SiC-Technology Sascha Kratz, Paul Hanses, Benjamin Krüger, Ralf Wegener, Stefan Soter, – University of Wuppertal, Institute of Electrical Machines and Drives

Friday, June 21, 2019

Afternoon Technical Sessions

Technical Session 13: Electric Aircraft and Aircraft Applications

Session Chairs: Saeid Habibi, McMaster University and
Jiangbiao He, University of Kentucky

Friday, June 21, 2019
2:00 PM – 3:40 PM, Cornerstone 1

TS13-1	Analysis and Modeling of UAV Power System Architectures <i>Alastair Thurlbeck, Yue Cao - Oregon State University</i>
TS13-2	Performance Evaluation of a Dual Stator-Winding Three-Phase Asynchronous Generator with Armature Reaction Effect <i>Mbika Muteba - University of Johannesburg</i>
TS13-3	Electric Aircraft System Co-simulation Including Body, Propeller, Propulsion, and Energy Storage Models <i>Damien Lawhorn, Vandana Rallabandi, Dan Ionel - University of Kentucky</i>
TS13-4	Charging Analysis of Ground Support Vehicles in an Electrified Airport <i>Kyle Gulan, Eduardo Cotilla-Sanchez, Yue Cao - Oregon State University</i>
TS13-5	Wireless Charging System for an Electric Autonomous Micro-transit Transportation Vehicle <i>Alireza Dayerizadeh, Andrew Galamb, Oscar Montes, Srdjan Lukic - North Carolina State University</i>

Technical Session 14: Grid Impacts of Vehicle Charging I

Session Chairs: Vahid R. Disfani, University of Tennessee Chattanooga and
Mike Ippoliti, HDR

Friday, June 21, 2019
2:00 PM – 3:40 PM, Cornerstone 5

TS14-1	Location Planning of Fast Charging Station Considering its Impact on the Power Grid Assets <i>Daijiafan Mao ¹, Jiankang Wang ¹, Jun Tan ², Guangyi Liu ², Yiran Xu ³, Jie Li ⁴, - (1) The Ohio State University, (2) Global Energy Interconnection Research Institute North America (GEIRINA), (3) State Grid Nanjing Power Supply Company, (4) State Grid U.S. Representative</i>
TS14-2	Mesosopic Approach to Modeling Electric Vehicle Fleets Based Upon Driving Activity Data to Investigate Recharge Strategies' Impact on Grid Loads <i>Michael Duoba, Alejandro Fernandez Canosa - Argonne National Laboratory</i>
TS14-3	Flexible Charging Coordination for Plug-in Electric Vehicles based on Uniform Stochastic Charging Demand and Time-of-Use Tariff <i>Kanggu Park, Seungwook Yoon, Euseok Hwang - Gwangju Institute of Science and Technology</i>
TS14-4	Coordinated Control Scheme for Electric Vehicles Connected to Droop-Controlled MicroGrids <i>El Hassane Margoum ^{1,2}, Samy Faddel ¹, Hassan Mharzi ², Osama Mohammed ¹ - (1) Energy Systems Research Laboratory, Department of Electrical & Computer Engineering, Florida International University, (2) Department of Electrical Engineering, National School of Applied Sciences</i>
TS14-5	Impact of Building Loads on Cost Optimization Strategy for a Plug-in Electric Vehicle Operation <i>Jubair Yusuf, Sadrul Ula - Department of Electrical and Computer Engineering, University of California Riverside</i>

Friday, June 21, 2019

Afternoon Technical Sessions

Technical Session 15: Power Electronics Topologies

Session Chairs: Weimin Zhang, SERES (SF Motors) and
Yigeng Huangfu, Northwestern Polytechnical University

Friday, June 21, 2019
2:00 PM – 3:40 PM, Cornerstone 6

TS15-1	A Comparison of 100 kW SiC DC-DC Converters for Electric Vehicles <i>Ze Ni, Yanchao Li, Chengkun Liu, Mengxuan Wei, Dong Cao - Electrical and Computer Engineering Dept, North Dakota State University</i>
TS15-2	Single-stage Bi-directional Matrix Converter with Regenerative Flyback Clamp Circuit for EV Battery Charging <i>Parthasarathy Nayak, Kaushik Rajashekara - University of Houston</i>
TS15-3	An Asymmetric 3-Level T-Type Converter for Switched Reluctance Motor drives in Hybrid Electric Vehicles <i>Peter Azer, Jennifer Bauman - Department of Electrical and Computer Engineering, McMaster University</i>
TS15-4	Single Stage Boost-Inverter Integrated Electric Drives for Electric Vehicles <i>Baoming Ge, Lihua Chen, Fan Xu - Ford Motor Company</i>
TS15-5	One Zero-Voltage-Switching Voltage-fed Three-Phase Push-Pull DC/DC Converter for Electric Vehicle Applications <i>Qunfang Wu¹, Mengqi Wang¹, Weiyang Zhou¹, Xiaoming Wang¹, Qin Wang² – (1) ECE Department, University of Michigan-Dearborn, (2) College of Automation Engineering, Nanjing University of Aeronautics and Astronautics,</i>

Technical Session 16: Electric Machine Control

Session Chairs: Long Wu, John Deere and
Dakai Hu, Mathworks

Friday, June 21, 2019
4:00 PM – 5:40 PM, Legacy 3

TS16-1	Analysis of a Five-Phase Dual Mechanical Port Machine With Harmonic Current Injection for Torque Capability Improvement <i>Zhiwei Zhang - Department of Electrical and Computer Engineering, The Ohio State University</i>
TS16-2	Deadbeat Flux Vector Control for Dynamic Six-Step Operation of Synchronous Machines <i>Marc Petit¹, Bulent Sarlioglu¹, Robert Lorenz¹, Brent Gagas², Caleb Secrest² – (1) UW-Madison, WEMPEC, 2 General Motors</i>
TS16-3	Optimal Control of Induction Motor in Field Weakening Region Considering Inverter Nonlinearity <i>Rasul Tarvirdilu-Asl¹, Shamsuddeen Nalakath¹, Yingguang Sun², Jason Wiseman², Ali Emadi¹ – (1) McMaster Automotive Resource Center (MARC), (2) BorgWarner Waterloo Inc.</i>
TS16-4	Accurate Discrete-Time Modeling for Improved Torque Control Accuracy for Induction Machine Drives at Very Low Sampling-to-Fundamental Frequency Ratios <i>Yang Xu¹, Chikara Morito², Robert Lorenz¹ – (1) University of Wisconsin-Madison, Madison, WI, USA, (2) Toshiba Mitsubishi-Electric Industrial Systems Corporation (TMEIC), Tokyo, Japan</i>
TS16-5	A Fixed-Switching-Frequency Sliding Mode Current Controller for Mutually Coupled Switched Reluctance Machines using Asymmetric Bridge Converter <i>Kun Hu, Jin Ye, Javad Mohammadpour Velni, Lulu Guo, Bowen Yang - University of Georgia</i>

Friday, June 21, 2019

Afternoon Technical Sessions

Technical Session 17: Hybrid Electric Vehicle Energy Management

Session Chairs: Devendra Patil, Eaton Corporation and
Mengyang Zhang, Hynovation Technologies Inc

Friday, June 21, 2019
4:00 PM – 5:40 PM, Legacy 4

TS17-1	Mathematical Optimization of Gear Shift Schedules for Hybrid Electric Vehicle's Fuel Economy Improvement <i>Abdul Motin, Shuzhen Liu, Ben Nault - Feature Calibration and System Analysis, Ford Motor Company</i>
TS17-2	Deep Q-Learning Based Energy Management Strategy for a Series Hybrid Electric Tracked Vehicle and Its Adaptability Validation <i>Dingbo He¹, Yuan Zou¹, Jinlong Wu¹, Xudong Zhang¹, Zhigang Zhang², Ruizhi Wang² – (1) National Engineering Laboratory for Electric Vehicles, Beijing Institute of Technology, (2) Zhengzhou Fuguang Electric Power Equipment Co., Ltd</i>
TS17-3	Real-Time Optimal Energy Management of Electrified Powertrains with Reinforcement Learning <i>Atriya Biswas¹, Pier Anselma², Ali Emadi¹ – (1) McMaster Automotive Resource Centre (MARC), McMaster University, (2) Department of Mechanical and Aerospace Engineering (DIMEAS), Politecnico di Torino</i>
TS17-4	A Predictive Supervisory Controller for an HEV Operating in a Zero Emission Zone <i>Dhrupad Biswas¹, Susenjit Ghosh¹, Somnath Sengupta², Siddhartha Mukhopadhyay¹ – (1) Department of Electrical Engineering, Indian Institute of Technology Kharagpur, (2) Advanced Technology Development Centre, Indian Institute of Technology Kharagpur</i>
TS17-5	An Economy Evaluation Method for Fuel Cell Hybrid Powertrain System <i>Zunyan hu¹, Liangfei Xu¹, Haiyan Huang¹, Jianqiu Li¹, Ziyong Song^{1,2}, Mnggao Ouyang¹ – (1) State Key Lab of Automotive Safety and Energy, Beijing, China, (2) Department of Electric Engineering and Computer Science, Ann Arbor, MI, USA</i>

Technical Session 18: Vehicle System Design, Test, and Simulation

Session Chairs: Poria Fajri, University of Nevada Reno
and Alan Callegaro, McMaster University

Friday, June 21, 2019
4:00 PM – 5:40 PM, Cornerstone 1

TS18-1	Investigation on Electrical Power Demand of Chassis Control Systems in All-Wheel Steered Vehicle <i>Nikolaus Reiland, Dieter Gerling - Bundeswehr University</i>
TS18-2	Optimized Operation of Hybrid Energy Storage Systems for High-Power Electric Vehicles <i>Thomas Nemeth^{1,2}, Phillip Kollmeyer³, Ali Emadi³, Dirk Uwe Sauer^{1,2,4} – (1) Institute for Power Electronics and Electrical Drives, RWTH Aachen University, (2) Juelich Aachen Research Alliance, JARA-Energy, Juelich / Aachen (3) McMaster Automotive Resource Centre, (4) Institute for Power Generation and Storage Systems, RWTH Aachen University</i>
TS18-3	Soft Body Modeling: a Scalable and Efficient Formulation for Control-Oriented Simulation of Electric Vehicles <i>Matteo Dalboni, Alessandro Soldati - University of Parma</i>
TS18-4	A Hardware-in-the-Loop Test Platform for a Vehicular Auxiliary Power System with Onboard PV <i>Dennis Michaelson, Jin Jiang - The University of Western Ontario</i>
TS18-5	Selection Method of a Driving Simulator Motion System <i>Lucas Bruck, Ali Emadi, Stephen Veldhuis - McMaster University</i>

Friday, June 21, 2019

Afternoon Technical Sessions

Technical Session 19: Grid Impacts of Vehicle Charging II

Session Chairs: Hany Farag, York University and
Santosh Veda, National Renewable Energy Laboratory

Friday, June 21, 2019
4:00 PM – 5:40 PM, Cornerstone 5

TS19-1	Fast Charging Systems to Enable Electrification of Transportation: An Operational Constrained Based Analysis <i>Iman Babaeiyazdi, Afshin Rezaei-Zare, Shahab Shokrzadeh - York University,</i>
TS19-2	Scalable Electric Submeter Challenges For Electric Vehicle Charging; Low Level AC To DC Extreme Fast Charging For Commercial Vehicles <i>Theodore Bohn - Argonne National Laboratory</i>
TS19-3	Effect of Tariff on Optimal Electric Vehicle Connection to the Grid in Residential Sector <i>Roghieh Biroon¹, Zoleikha Abdollahi², Ramtin Hadidi¹ – (1) Clemson university, (2) university of Florida</i>
TS19-4	A Stochastic Simulation Model to Assess the Impacts of Electric Vehicle Charging on Power Generation: A Case Study for Qatar <i>Islam Safak Bayram - Qatar Environment and Energy Research Institute, Hamand Bin Khalifa University</i>
TS19-5	Investigation of Grid Benefits from a Solar-Powered Electric Vehicle Using Real-World Driving Data <i>Muhammad Hosnee Mobarak¹, Rafael Kleiman², Jennifer Bauman¹ – (1) Department of Electrical and Computer Engineering, McMaster University, (2) Department of Engineering Physics, McMaster University</i>

Technical Session 20: DC/DC Converter Design and Control

Session Chairs: Mithat Can Kisacikoglu, The University of Alabama and
Agasthya Ayachit, Mercedes-Benz Research and Development North America

Friday, June 21, 2019
4:00 PM – 5:40 PM, Cornerstone 6

TS20-1	High-Order ESO-Based Voltage Control for High-Gain DC-DC Floating Interleaved Boost Converter with Time-Varying Disturbance <i>Shengrong Zhuo, Arnaud Gaillard, Damien Paire, Fei Gao - FEMTO-ST Institute, Univ. Bourgogne Franche-Comté, UTBM</i>
TS20-2	Robust Control of a Interleaved Boost Converter Which Feeds a Constant Power Load for Electric Vehicles <i>Liangcai Xu¹, Yigeng Huangfu¹, Qian Li¹, Rui Ma¹, Dongdong Zhao¹, Qingchao Zhang² – (1) Northwestern Polytechnical University, (2) Shenyang Aircraft Corporation</i>
TS20-3	Analysis and Control of Multi-input, Single-output, Non-isolated DC/DC Converter for Effective Renewable Energy Management <i>Hassan AboReada, Sheldon Williamson, Vijay Sood - University of Ontario Institute of Technology</i>
TS20-4	Robust Flatness Based Control with Disturbance Observers of Non-ideal Boost Converter for Electric Vehicles <i>Qian Li, Yigeng Huangfu, Liangcai Xu, Dongdong Zhao - School of Automation, Northwestern Polytechnical University</i>
TS20-5	Design, Analyses and Validation of Sliding Mode Control for a DAB DC-DC Converter <i>Shenli Zou^{1,2}, Sheng Zheng¹, Madhu Chinthavali¹ – (1) Oak Ridge National Laboratory, (2) University of Maryland</i>



June 24-26, 2020
Navy Pier,
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- 5) Electric, Hybrid Electric, and Plug-in Hybrid Electric Vehicle System Architectures
- 6) Connected and Automated Vehicles, Smart Mobility, Intelligent Transportation Systems, and Vehicle Security
- 7) Smart Grid, Electrical Infrastructure, and V2G/V2I Applications
- 8) Electrification of Heavy-Duty and Off-Road Vehicles
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Technical track name, paper title, name(s) of author(s), affiliation(s), mailing address(es), and e-mail address(es). If there are multiple authors, please identify the corresponding author. An abstract of maximum 100 words and a digest of maximum 5 pages (single-column, double spaced, including figures and tables).



June 24-26, 2020
Navy Pier
Chicago, IL, USA

Key Dates:

Deadline for submission of paper proposals (abstracts/digests): **November 1, 2019**

Author's notification of acceptance: **February 20, 2020**

Deadline for submission of final camera-ready manuscripts: **April 20, 2020**

Deadline for early registration: **May 1, 2020**

General Chair: Prof. Babak Nahid-Mobarakeh – University of Lorraine, France

Call for Short-Course, Tutorial, and Panel Sessions

If you would like to lecture a short-course or a tutorial please contact the General Chair Prof. Babak Nahid-Mobarakeh at babak.nahid@univ-lorraine.fr with a one paragraph short-course/tutorial summary with a short-biography.

If you would like to organize a panel session or would like to be a panelist in one of the ITEC 2020 industry panel sessions, please contact the General Chair with details.

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Exhibitor package includes:

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