iTEC 2024

2024 IEEE Transportation Electrification Conference and Expo

Chicago,
Illinois USA
June 19-21

Sponsored by:

IEEE

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IEEE POWER ELECTRONICS SOCIETY
Powering a Sustainable Future

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IEEE TRANSPORTATION ELECTRIFICATION COUNCIL

Schedule at a Glance

CONFERENCE SCHEDULE

	Wednesday	Thursday	Friday
7:30 AM		Registration Opens	
8:30 AM	Welcome & Awards Plenary Sessions 1 & 2	Welcome & Awards Plenary Sessions 4 & 5	Oral Sessions 9 – 12 Short Course 4
10:00 AM		Coffee Break	
10:30 AM	Plenary Session 3 Plenary Panel	Plenary Session 7	Oral Sessions 13 – 16 Short Course 4 (cont'd)
12:00 PM	Lunch in Expo Hall Poster Session 1 in Expo Hall	Lunch in Expo Hall Poster Session 2 in Expo Hall TC4 Luncheon	WIE Luncheon
2:00 PM	Short Course 1 Panels 1 & 2 Tutorial 1 Oral Sessions 1 & 2	Short Courses 2 & 3 Panels 4 & 5 Oral Sessions 5 & 6	Oral Sessions 17 – 21
3:30 PM		Coffee Break in Expo Hall	
4:30 PM	Short Course 1 (cont'd) Panel 3 Tutorials 2 & 3 Oral Sessions 3 & 4	Short Courses 2 & 3 (cont'd) Panel 6 Tutorial 4 Oral Sessions 7 & 8	Oral Sessions 22 – 25

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Useful Information

Conference App

ITEC provides multiple functionalities through the conference app.

Use this app to submit questions to panel moderators, network, plan your program schedule and more.

Wi-Fi

NETWORK NAME
Boingo

Detailed Session Information and Speaker Bios

To provide more space in the printed program for note taking, the session information has been limited to basic descriptions. Much more detailed descriptions and speaker profiles are viewable on the conference app.

Download the ITEC App Here!

Last Minute Technical Session Changes

Please note that there may be discrepancies between the session schedule listed in the printed program and the publication file. For the most up to date information about presentations, please check the conference app.

iTEC2024

Welcome To ITEC

On behalf of the organizing committee, it is my honor to welcome you to the IEEE Transportation Electrification Conference and Expo (ITEC) 2024, hosted at the Donald E. Stevens Convention Center, Rosemont, Illinois, from June 19th to 21st. As we gather in the vibrant city of Rosemont, we continue our journey towards an electrified future, reflecting on the progress we've made and the paths yet to be explored.

ITEC 2024, like previous editions, stands as a testament to the dynamic evolution of transportation electrification. The conference offers insightful keynotes, engaging panel discussions, in-depth tutorials and short courses, and a diverse range of technical presentations. This year's agenda spotlights state-of-the-art topics in the field, such as the paramount importance of EV charger reliability, the transition challenges from ICE to BEV in America, and the promising solutions for the electrification of heavy-duty vehicles. Through these discussions, we aim to address both the opportunities and the obstacles that lie in our collective pursuit of a sustainable, electrified future.

This year's conference not only features approximately 300 technical papers across various areas such as Power Electronics, Electric Machines, and Smart Mobility but also hosts pioneering panels on topics such as off-highway vehicle electrification, battery technology, and electric vehicle charging infrastructure. Moreover, 8 high-quality tutorials and short courses are carefully selected to enrich the program.

ITEC is always marked by the significant support of our sponsors: IEEE Power Electronics Society (PELS), Industry Applications Society (IAS), Power and Energy Society (PES), and notably, for the first time this year, the new IEEE Transportation Electrification Council (TEC). This underscores the importance and growth of transportation electrification in our society, highlighting the expanding horizon of our collective efforts.

In closing, I extend my deepest gratitude to our organizing and steering committee members, session chairs, and reviewers for their exceptional efforts. Their unwavering commitment to excellence forms the foundation of our conference, making ITEC 2024 the premier event in our field. Thank you for joining us in Rosemont. As we embark on this exciting three-day journey, let's embrace the opportunities to learn from one another, forge new connections, and reignite old ones. Let's make this conference a memorable experience in our shared journey towards a better, electrified world.

Warmest regards,
Prof. Fei Gao
General Chair, ITEC 2024

Organizing Committee

Thank you to all of the publication track chairs and many reviewers who served countless hours.
You made it possible to accommodate a record number of submissions this year!

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>> Woongkul Matt Lee, *Michigan State University*
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>> Zichao Jin, *Illinois Institute of Technology*
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>>Hao Ding, *Rivian Automotive, Inc.*
>>Dehong Liu, *Mitsubishi Electric Research Laboratories*
>>Romina Rodriguez, *Mcmaster University*
>>FNU Nishanth, *General Electric Research*
>>Sreedevi Krishnan, *Ansys Inc*

POWERTRAIN: DESIGN, THERMAL MANAGEMENT, PACKAGING, AND OPTIMIZATION TRACK CHAIRS

>>Yue Zhou, *Cardiff University, UK*
>>Ratnak Sok, *Waseda University, Tokyo*
>>Peng Han, *Ansys, Inc*
>>Poria Fajri, *University of Nevada, Reno*

BATTERY, FUEL CELL AND ENERGY STORAGE SYSTEMS TRACK CHAIRS

>>Dakshina Murthy-Bellur, *Cummins Inc*
>>Zhixue Zheng, *University of Lorraine, France*
>>Chanyeop Park, *University of Wisconsin-Milwaukee*
>>Qi Yao, *Mcmaster University, Canada*
>>Hengzhao Yang, *Shanghai Tech University*

ELECTRIC, HYBRID ELECTRIC, PLUG-IN HYBRID ELECTRIC VEHICLE SYSTEM ARCHITECTURES AND CONTROL TRACK CHAIRS

>>Ankit Patel, *University of Minho, Portugal*
>>Mohsen Rahimian, *University of Kashan*
>>Pier-Giuseppe Anselma, *Nissan Formula-E, France*
>>Di Zhu, *Ford Motor*

CONNECTED AND AUTONOMOUS VEHICLES, SMART MOBILITY, AND VEHICLE FUNCTIONAL SAFETY TRACK CHAIRS

>> Quan Zhou, *University of Birmingham, UK*
>>Chao Huang, *The Hong Kong Polytechnic University*
>>Ji Li, *University of Birmingham, UK*

SMART AND MICRO GRIDS, EV-INTERACTING SMART GRID AND ELECTRICAL INFRASTRUCTURE TRACK CHAIRS

>> Binesh Kumar, *Atom Power Inc*
>>Junho Hong, *University of Michigan*
>>Zhe Zhang, *Eaton*

ELECTRIFICATION OF HEAVY-DUTY AND OFF-ROAD VEHICLES TRACK CHAIRS

>> Benedikt Schmulling, *University of Wuppertal, Germany*
>>Sumeet Singh, *EMWorks Inc., Montreal, Canada*

ELECTRICAL SYSTEMS AND COMPONENTS FOR SEA, UNDERSEA, AIR, AND SPACE VEHICLES

>>Hang Dai, *General Electric*
>>Tao Yang, *The University of Nottingham*

RAPID PROTOTYPING, REAL-TIME SIMULATION, HIL AND SIL FOR TRANSPORTATION ELECTRIFICATION TRACK CHAIRS

>>Reza Kheirollahi, *Tesla Motor*
>>Yuchen He, *Florida State University*

BATTERY CHARGERS: ONBOARD, WIRELESS, FAST, AND ULTRA-FAST TRACK CHAIRS

>>Hua Zhang, *Rowan University*
>>Nil Patel, *Concordia University*
>>Gautham Ram, *TU Delft*
>>Zedong Zheng, *Tsinghua University*

CODES, STANDARDS, POLICIES, AND REGULATIONS FOR TRANSPORTATION ELECTRIFICATION TRACK CHAIRS

>> Shuyan Zhao, *Drexel University*

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Special Events

TC4 Mentorship Luncheon
June 20 | 12:00pm – 2:00pm
Location: Room 53

Sponsored by IEEE Power Electronics Society (PELS), ITEC 2024 will hold a roundtable mentorship luncheon, which is open to individuals at any stage in their careers. The Mentorship Program was established in April 2017 by PELS as a member benefit to help members propel and further their career goals. ITEC 2024 will hold 6 round tables to discuss topics including career development in both academia and industry, preparedness for both academia and industry, and difference & switching between academia and industry. Lunch, desserts, and beverages will be served. There is no cost to attend this event.

Expo Reception
June 19 | 6:00pm – 8:00pm
Location: Expo Hall

Mingle with industry professionals at our Expo Industry Reception. To top it off, enjoy a delicious dinner on us. This is an event you won't want to miss!

Young Professional Reception
June 20 | 6:00pm – 10:00pm
Location: Dave and Buster's |
9870 Berwyn Ave, Rosemont, IL 60018

Get ready to connect, learn, and shape the future of tech together with like-minded professionals from around the world. Mark your calendars and prepare for an extraordinary event full of innovation, networking, and inspiration.

*Note: You must pre-register for this event. Tickets may still be available at the registration desk.

Industry Night Out
June 20 | 6:00pm – 10:00pm
Location: Fogo de Chao | *661 N. LaSalle Blvd, Fogo de Chao Parking, Chicago, IL 60654-8637*
Looking for great food and even better networking opportunities? Look no further. Come join us for a night away from the rigors of the conference to relax and connect with other electrical engineers.

*Note: You must pre-register for this event. Tickets may still be available at the registration desk.

Women in Engineering Luncheon
June 21 | 12:00pm – 1:30pm | Location: Room 52/53

SPEAKER: **Rashmi Tumkur,** *Engineering Director and Regional Product Group Owner for Occupant Safety Solutions at Bosch*

Come join the WIE Committee in celebrating women in engineering. She will be discussing women engineers leading global teams. A buffet lunch will be served.

Abstract: In today's connected world, the workforce operates in global setups driven by various factors such as cost-efficiency, round-the-clock productivity, and access to diverse talent pools. However, navigating the complexities of global teams presents challenges, including different time zones, different cultures and language barriers. To thrive in such environments and harness the power of diversity, it is imperative to overcome these differences effectively. This talk explores strategies for effectively managing global teams and maximizing personal and professional success within a global company. Key focus areas include essential skills like networking, negotiation, and global people management. The talk offers tips for women engineers, recognizing their unique experiences and challenges in working with global teams. Leveraging these skills will help foster collaboration, drive innovation, and achieve desired outcomes in the global workplace.

*Note: This event is complimentary but you must pre-register. Tickets may still be available at the registration desk

Argonne National Laboratory Tour
June 21 | 9:30am – 11:30am | Location Argonne National Laboratory

The scientists at Argonne National Laboratory are graciously opening their doors to ITEC attendees who sign up for this amazing tour. Argonne, located in Lemont, IL, is home to groundbreaking discoveries and transformative technologies across many science domains. The research at ANL spans from physics and chemistry to clean energy and transportation.

*Bus loads at 8:30am in the circle drive of Donald E. Stephens Convention Center

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Keynotes

Welcome & Awards
June 19 | 8:30am – 9:00am | Location: Room 42 |
CONFERENCE CHAIRS: Fei Gao, Hong Yang

8:30am | **Welcome to ITEC 2024**
PRESENTER: Fei Gao

8:45am | **PELS Vehicle and Transportation Systems Achievement Award**
PRESENTER: Mahesh Krishnamurthy

8:50am | **IEEE Transportation Electrification Council Introduction**
PRESENTER: Don Tan

Plenary Session 1
June 19 | 9:00am – 11:30am | Location: Room 42 |

9:00am | **Powering for the Long Haul: the ICE to BEV Transition of America's Best-Selling Vehicles**
SPEAKER: Jackie DiMarco, *Vehicle Programs Director, F-Series and Commercial Truck, Ford*

9:30am | **Innovating Energy Futures: How Argonne National Laboratory Develops and Deploys Net-Zero Technology and Prepares the Next-Generation Workforce**
SPEAKER: Claus Daniel, *Associate Laboratory Director, Advanced Energy Technologies, Argonne National Laboratory*

10:00am | **Coffee Break**

10:30am | **Overcoming Reliability Challenges to Unlock a Fully-Charged EV Future**
SPEAKER: Ryan Kennedy, *Co-Founder and Chief Evangelist, Atom Power*

11:00am | **Plenary Panel - Emerging EV Charging Technology and Policy Trends**
MODERATORS: Binesh Kumar, Riddhi Padariya
SPEAKERS: Ted Bohnne, *ANL;* Erik Anderson, *CurbElectric;* Kumar Anjan Hemanth, *Frost & Sullivan*; Subho Mukherjee, *Oak Ridge National Laboratory;* Ryan Kennedy, *Atom Power*

Society Meetings

Meetings are 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 these meetings if you are interested in getting involved with the IEEE-PELS and/or IEEE-IAS activities including ITEC,

>> IEEE PELS Technical Committee 4 Meeting
Wednesday, June 19 | 2:00pm – 3:30pm | Location: Rooms 52/53

>> IEEE Transactions on Transportation Electrification Editorial Board and Steering Committee Meeting
Wednesday, June 19 | 4:30pm – 6:00pm | Location: Rooms 52/53

>> ITEC Steering Committee Meeting
Thursday, June 20 | 2:00pm – 3:00pm | Location: Boardroom

Keynotes *(continued)*

Welcome & Awards

June 20 | 8:30am – 8:45am | Location: Room 42

8:30am | Welcome to Day 2!
PRESENTER: **Fei Gao**

8:30am | IEEE Transactions on Transportation Electrification Best Paper Awards
PRESENTER: **Alireza Khaligh**

Plenary Session 2

June 20 | 8:45am – 11:30am | Location: Room 42

8:45am | Unique Challenges and Valeo Solutions for North America Vehicle Electrification
SPEAKER: **Sanjaka Wirasingha,** *R&D Director for Powertrain Electrified Mobility at Valeo*

9:15am | Electric Machines in Agriculture: Charting the Path to Electrified Farming
SPEAKER: **Arshan Khan,** *Director - Power Electronics at CNH*

9:45am | Coffee Break

10:15am | ITEC 2024 Best Paper Awards
PRESENTER: **Fei Gao**

10:30am | The Real Electric Mobility Challenge: Scaling Electrified Mobility Products
SPEAKER: **Alexandra Cattelan,** *COO at Fermata Energy*

11:00am | GE Aerospace Bringing Hybrid Electric Flight to Reality
SPEAKER: **Christine Andrews,** *Executive Hybrid Electric Systems Leader at GE Aerospace*

For most recent speaker content, see the ITEC 2024 app.

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Industry Panels

Panel 1: Revolutionizing Electrified Mobility with Autonomy & Connectivity

June 19 | 2:00 pm – 3:30 pm | Location: Room 48

MODERATOR: **Atriya Biswas,** *McMaster University*

SPEAKERS: **Arun Kumar Verma**, *IIT Jammu;* **Sanyogeeta Lawande**, *Ford Motor company*

Vehicle autonomy and vehicle-to-everything (V2X) connectivity are poised to fundamentally reshape the future of electrified vehicles by fostering smarter, more efficient, and safer transportation ecosystems. Autonomous vehicles, with their advanced sensors and AI-driven decision-making capabilities, can optimize energy use by adapting driving patterns to traffic conditions and enhancing the integration with charging infrastructure. Meanwhile, V2X connectivity, which enables vehicles to communicate with other vehicles, infrastructure, and even pedestrians, can streamline traffic flow, reduce congestion, and improve safety. This connectivity can lead to synchronized platooning of electric vehicles, reducing aerodynamic drag and energy consumption, and facilitating more efficient charging through real-time data exchange. Ultimately, the combination of vehicle autonomy and V2X connectivity can create a seamless, adaptive, and energy-efficient transportation network that accelerates the adoption of electrified vehicles while reducing emissions and enhancing the overall travel experience.

Panel 2: Off-Highway Vehicle Electrification

June 19 | 2:00 pm – 3:30 pm | Location: Room 44

MODERATOR: **Carlos Vidal,** *McMaster*

SPEAKERS: **Shanmukh Sarode,** *Parker Hannifin;* **Jason McConnell,** *Workhorse);* **Perry Li,** *University of Minnesota);* **Eric Severson,** *University of Minnesota;* **Suresh Natarajan,** *Dana Inc.*

Conventional off-highway vehicles use gasoline/diesel engines and hydraulic actuators. The hydraulics significantly reduce their efficiency to as low as 20% from engine shaft to implement due to throttle-based control and result in disproportionately high emissions. This panel will discuss the challenges involved in the electrification of off-highway vehicles, current industry trends and focus, and the unique requirements on power electronics and electric machine to meet these challenges.

Panel 3: From "Need" to "Speed"!

June 19 | 4:30 pm – 6:00 pm | Location: Room 46

MODERATOR: **Elizabeth Trickett,** *MDA Space*

SPEAKERS: **Hossein Dadkhah,** *Dana Inc;* **Nicolas Olmedo; Babak Nahid,** *McMaster University*

This panel will go through the high performance motor drive pipeline from the inception of the requirements and specifications of a motor drive system to its development, manufacture and deployment. Industry experts in power electronics, motor controls, motor design and manufacturing will discuss their pieces that make this process work. The panel will focus on similarities and differences across motor applications and how the pipeline has developed and where it's going.

Panel 4: Sustainable Freight Transportation

June 20 | 2:00 pm – 3:30 pm | Location: Room 44

MODERATOR: **Vishnu Pandi,** *Cummins*

SPEAKERS: **Jeffrey Diwakar,** *Cummins;* **Nadia Gkritza,** *Purdue;* **Bart Sowa,** *GTI Energy;* **Robert Wimmer,** *Toyota*

As global trade continues to grow, the environmental impact of freight transportation has emerged as a critical concern, necessitating a shift towards more sustainable practices. The state-of-the-art in electric freight vehicles, including heavy-duty trucks, electric rail, and marine transport, is a key focus area. Innovations in battery technology, charging infrastructure, and energy management systems are pivotal for meeting the long-haul and high-load demands of freight transportation. The economic implications of transitioning to electric freight, encompassing investment, operational costs, and potential savings, are critical factors under consideration.

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Panel 5: Advanced Battery Technology

June 19 | 2:00 pm – 3:30 pm | Location: Room 46
MODERATOR: **Weihan Li**, *RWTH Aachen*
SPEAKERS: **Noah Paulson**, *Argonne National Laboratory;* **Juner Zhu**, *Northeastern University;* **Oindrilla Dutta**, *Sandia National Laboratories;* **Weihan Li**, *RWTH Aachen University;* **Ryan Ahmed**, *McMaster University*

As battery technology is fundamental to the global transition to sustainable energy, understanding these advancements is essential for driving efficiency, reliability, and longevity in energy storage solutions. This session will provide detailed technical insights into advanced battery modeling, diagnosis, and aging prediction, tailored for both automotive and stationary applications. Our expert speakers will highlight innovative approaches to accurately simulate battery behavior, cutting-edge diagnostic tools for real-time issue detection, and sophisticated techniques for forecasting battery lifespan. With a special emphasis on data-driven methodologies and machine learning, this session will showcase how these technologies are revolutionizing battery management by enabling precise predictions, adaptive diagnostics, and intelligent optimizations.

Panel 6: Grid-Tied Electric Vehicle Integration with Artificial Intelligence Advancements

June 20 | 2:00pm - 3:30pm | Location: Room 46
MODERATOR: **Sheldon Williamson**
SPEAKERS: **Anurag Srivastava**, *West Virginia University;* **Rick Szymczyk**, *Automotive Centre of Excellence, Ontario Tech University;* **Sanjida Moury**, *Lakehead University;* **Mohammed Fahim**, *IntellectuLogy Solutions Inc.;* **Jinia Roy**, *University of Wisconsin-Madison;* **Radha Krishnamoorthy**, *ORNL*

The integration of electric vehicles (EVs) into smart grids represents a critical step towards achieving sustainable energy systems. This panel discussion explores the synergies between grid-tied EV integration and advancements in artificial intelligence (AI). By leveraging AI technologies, such as machine learning and predictive analytics, smart grids can optimize EV charging schedules, balance energy demand, and enhance grid stability. The discussion will delve into the potential benefits, challenges, and opportunities associated with this convergence, highlighting the role of collaboration among stakeholders from the automotive, energy, and technology sectors. Insights shared will shed light on the transformative potential of combining EV integration with AI advancements in shaping the future of smart grids and sustainable mobility. The role of power electronics, battery storage technology, intelligent control, fast charging, and wireless charging will be discussed in detail, followed by Q&A sessions with the audience.

Short Courses

Short Course 1: Energy Management Strategy Design for Fuel Cell Hybrid Electric Vehicles

June 19 | 2:00pm - 6:00pm | Location: Room 41
　　　　　　　3:30pm - 4:30pm | Coffee Break
SPEAKER: **Zhongliang Li**, *University of Franche-Comté;* **Alexandre Ravey**, *University of Technology of Belfort-Montbeliard*

In this short course, the development of energy management strategy for hybrid electric vehicle, particularly fuel cell hybrid electric vehicles, will be talked about in the following aspects:

- Introduction of fuel cell hybrid electric vehicles
- Modelling of powertrain components
- Energy management problem formulation and method classification
- Rule based energy management strategies

Short Course 2: Adaptive Geometric and Dimensions Alignment Guided Approach Design Optimization for Efficiency Improvement of WPT Systems

June 20 | 2:00pm – 6:00pm | Location: Room 48
3:30pm – 4:30pm | Coffee Break

SPEAKERS: **Osama Mohammed,** *Florida International University;* **Ahmed S. Soliman***, Florida International University.*

This lecture will focus on Wireless Power Transfer systems WPTs with their different configurations for electric vehicles EVs applications. The detection of the secondary-side coil in wireless power transfer systems (WPTSs) for electric vehicles (EVs) is essential for establishing whether the car is in the effective charging zone. However, most sensor-based detection methods currently in use necessitate altering the vehicle's structure, which has a number of drawbacks, including restricted vehicle adaptability, compromised structural integrity of the original magnetic coupler, and potential magnetic interferences with primary-side coil operation.

Driven by the current issues, the lecture will focus on the design considerations for two different coil types, mainly ring and spiral circular coils, that are widely adopted in WPTSs. A detailed analytical estimation for inductive characteristics is provided for WPT. Then, design optimization of the WPT system based on coil geometrical parameters and relative placement is proposed. COMSOL software is used to accurately determine the inductive parameters to validate theoretical analysis for our developed 500W charging coils. Finally, the coupling coefficients of various coreless and cored charging pads are investigated with different geometric dimensions and coil alignments, with I-core being recommended to avoid bifurcation phenomena.

Short Course 3: Digital Control and FPGA-based Rapid Prototyping in Switched Mode Power Converters

June 20 | 2:00pm – 6:00pm | Location: Room 41
3:30pm – 4:30pm | Coffee Break

SPEAKERS: **Santanu Kapat***, IIT Kharagpur, India;* **Philip Krein***, University of Illinois Urbana–Champaign, US*

Leading power electronics and power management industries are aggressively exploring digital control solutions for their mainstream product lines in the near future to meet ever increasing demands of performance, efficiency, safety, EMI, hot swapping, scalability, modularity, adaptability, compatibility with smart digital communication. This short-term course will benefit industry practitioners, students and researchers to know about latest digital control trends in power electronics industries, particularly to understand (i) benefits of digital control, (ii) modulation and digital control architectures, (iii) MATLAB customized model development for simulation, (iv) modeling and analysis techniques, (v) design and tuning methods, (vi) embedded control implementation platforms, (vii) Verilog HDL and fixed point implementation, and (viii) hardware development and FPGA-based prototyping with case studies and practical demonstration.

Short Course 4: Commercial Aviation Electrification: Challenges and Opportunities
June 21 | 8:30am - 12:00pm | Location: Room 46
            10:00am - 10:30am | Coffee Break
SPEAKER: **Matilde D'Arpino**, *Ohio State University*

This course will provide an overview on the challenges and opportunities in electrification of commercial aircraft and current state of the art, including more electric aircraft and electric propulsion. Hybrid-electric gas turbine generators and distributed propulsion are considered promising technologies for more efficient and sustainable air transportation. Improved efficiency and reduced emissions are key benefits, that need to balance the weight and cost increase. The selection, proper design and control of the battery technology are key factors to unlock benefits of electrification.

The example of the Ohio State NASA University Leadership Initiative projects will be used to describe possible approaches for the optimization of design and control for hybrid electric aircraft. A modular framework of reduced-order models of hybrid-electric distributed-propulsion system components and systems has been developed and exercised for evaluating the relative performance of different Li-ion cell technologies considering different pack sizes and mission range. Both state-of-the-art and future battery technologies are evaluated, with energy density ranging from 230-400 Wh/kg and power density ranging from 350-1200 W/kg.

This course will then focus on the development of a real-time flight, thermal and propulsion control for the hybrid turboelectric architecture, which guarantees the aircraft to follow the desired mission profile and to determine the control variables for optimally using the battery and the engine in terms of electrical power and cooling requirements. The developed controller is tested and validated in a Controller Hardware In the Loop (CHIL) test setup that includes a realistic model of the airframe, the propulsion system and the physical communication interface between the controller and the propulsor. The robustness of the controller is tested considering signal discretization effects and communication delays.

Tutorials

Tutorial 1: Using Multiphysics Tools to fit a PMSM Simulation model with Experimental Results

June 19 | 2:00pm – 3:30pm | Location: Room 44
SPEAKER: **Lavanya Vadamodala,** Altair Engineering; **Philippe Wendling**, Altair Engineering.

Permanent Magnet Synchronous Machines (PMSM) are widely considered for different applications such as electric vehicles (EV), industry, or electric appliances. Some PMSMs are designed for versatility across environments to meet complex requirements. Making machine models align with real-world measurements is crucial. A fitted Multiphysics simulation model helps predict machine behavior, even in adverse conditions like short circuits, eccentricity, and overloads, preventing motor damage during testing.

Fitting complex models with measurements in the Multiphysics domain is challenging, requiring specialized knowledge for real-world experiments. To fit complex models, identifying geometric and physical tolerances is essential for proper fitting. Then, the most relevant variables should be selected for each model. Adjust the variables in the tolerance range to fit with measurements.

This tutorial proposes a complete Multiphysics model, which includes electromagnetic, thermal, and vibration domains, fitting them with experimental results. The variables significant in various domains will be identified and adjusted for each part. This will enhance model robustness, making it the ideal candidate for designing strategies and fault analysis.

To obtain measurements, the Ikermaq machine is coupled to traction motor test bench, which is equipped with sensors to measure required quantities. For the simulation of Ikermaq, Altair Flux, FluxMotor, and Hyperstudy tools are used.

Tutorial 2: Multi-Objective Design Optimization of Electric Propulsion Drive Systems for Aviation

June 19 | 4:30pm - 6:00pm | Location: Room 44
SPEAKER: **JiangBiao He,** *University of Kentucky;* **Benjamin Luckett***, University of Kentucky*

Driven by the global motivation to achieve zero-emission transportation, the mobility sector has been experiencing a rapid revolution of electrification. Unfortunately, the mature technologies used in the present electrification of ground vehicles and ships cannot be directly applied when tackling the distinct set of challenges posed by the working environment of an aircraft, which is characterized by high altitude, severe operating conditions, and complicated mission profiles. When designing an electric propulsion system which will be subjected to these harsh circumstances, reliability must heavily influence all decisions.

But simultaneously, the drivetrain needs to be lightweight, compact, efficient, and cost effective as well. These various objectives typically prove to be impossible to satisfy concurrently, and therefore trade-offs need to be established in order to extract the highest overall system performance. The degree of importance placed upon each objective and the resulting compromises can be troublesome to explicitly quantify when designing a single system, but a Pareto front of many candidate power converters can be established without these constraints. The most optimal design for a specific application can then be chosen from this qualified set- This tutorial focuses on multi-objective design optimization of electric propulsion drive systems for hybrid and electric aircraft.

The discussed approach employs a genetic algorithm which generates many high performing designs that exhibit optimal trade-offs between competing objectives, such as reliability and specific power. Computationally efficient time-based electro-thermal simulations of multiple converter topologies, which forms the backbone of the framework, will be discussed. Also, the sizing and selection of all system elements realized though off-the-shelf components will be examined. Finally, a software package has been developed which encapsulates the described framework, and its functionality will be showcased throughout the tutorial.¬

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Tutorial 3: XiL Rapid Controls Development through Simulation of an Electrified Vehicle with AVL CRUISE M Physics-Based Models

June 19 | 4:30pm – 6:00pm | Location: Room 48
SPEAKER: **Michael Bambula,** *AVL.*

With the increase of electrification in the mobility segment, it has become increasingly important to reduce the time to market for a given vehicle. One way to do this is to save time and effort on the engineering of the vehicle. With the increased interaction of the E-Axle, Battery, and Thermal Management System to impact energy range/performance, there seems to be an almost infinite possibility of controls/software development paths. Testing all of these on a real vehicle will be time consuming and costly. Prototyping these algorithms on data or through a fundamentals approach might also not lead to an ideal.

Using a physics-based system model of the electric vehicle allows controls and software engineers to test their strategies in closed-loop on a virtual model that responds realistically and has low cost and runs faster than a real vehicle test. It also opens the door to parallelize these analysis to determine controls robustness and minimize the variance of range/performance during edge-case operation.

In this course we will teach the audience how to set up an electric vehicle from the Battery Modeling to the Motor Modeling to the Inverter Model and Thermal System and finally we will package the model to run in an XiL workflow for controls and algorithm prototyping.

Tutorial 4: Design & Optimization of High Torque Density Permanent Magnet Synchronous Machines with Optimal Weakening for Traction Applications

June 20 | 4:30pm – 6:00pm | Location: Room 46
SPEAKER: **Mohanraj Muthusamy,** *Powersys Inc., Montreal;* **Vedanadam Mudumbai Acharya**, *Powersys Inc., USA;* **Dheeraj Bobba**, *Powersys Inc., USA.*

Electric machines play an important role in traction applications; high torque and high-power density are important aspects that must be considered while designing an electric machine. This tutorial will emphasize practical design considerations, trade-offs, and design procedures to meet the required technical specifications of an electric motor using the JMAG FEA package. The tutorial will have three different parts. The first part presents the fundamental design of an electric machine, which includes the selection of slot/pole, and the selection of machine parameters such as overall diameter, stack length, magnet dimensions, turns per coil, parallel path, current density and flux density.

The second part presents the benchmarking of the Toyota Prius (2010) electric motor, and it presents the design steps of an example electric motor to meet the Toyota Prius (2010) specifications by considering the fundamental design aspects presented in the first part. Also, it presents the comparison of cogging torque, phase back EMF, average torque, torque ripple, and the characteristic current requirement to achieve optimal flux weakening for two different slot/poles which are designed to meet Toyota Prius specifications. It also includes the efficiency map comparison at the base speed and maximum speed for both the slot/pole designs. The best slot/pole combination is selected for further analysis. The third part focuses on the coupled multi-physics-based (electromagnetic and structural) multi-objective parametric optimization for the selected best/slot pole to improve the electromagnetic performance of the motor. Finally, it compares electromagnetic performances between the initial and optimized designs.

Oral Session Schedule

OS 1   Fuel Cells and Hydrogen

Location: Room 40
SESSION CHAIRS: **Qian Xun,** *RISE Research Institutes of Sweden;* **Meryem Benzine,** *Université de technologie de Belfort-Montbéliard*

2:00pm | Robust Flatness - Sliding Mode Controller with Non-Linear Observer and Open-Circuit Diagnosis for Coupled Inductors Interleaved Boost Converter Used in Fuel Cell Applications [5194]
Meryem Benzine, Issam Salhi, Arnaud Gaillard, Fei Gao Université de Technologie de Belfort-Montbéliard, CNRS, FEMTO-ST Institute, France

2:20pm | Thermal Management of Water-Cooled PEM Fuel Cell System with DDPG-FLC Strategy [5217]
Ruoyang Song{1}, Yongliang Ni{2}, Zhongbao Wei{1}, Yuqi Tong{2}, Tianze Wang{2} {1}Beijing Institute of Technology, China; {2}China North Vehicle Research Institute, China

2:40pm | Multiport Converter Based Auxiliary Power Supply for Heavy Duty Fuel Cell Power Train [5340]
Subhajyoti Mukherjee, Vivek Sujan, Shajjad Chowdhury, Omer Onar Oak Ridge National Laboratory, United States

3:00pm | A Model Predictive Controller with Adaptive Tuning Weights for Energy Management in Fuel Cell Hybrid Electric Vehicles [5140]
Qian Xun{1}, Qiuyu Li{2}, Hengzhao Yang{2} {1}RISE Research Institutes of Sweden, Sweden; {2}ShanghaiTech University, China

3:20pm | Hydrogen Fuel Cell Electric Vehicles in Surface Mining [5093]
Jorge Mari Semikron Danfoss GmbH, Germany

OS 2   WBG Power Electronics

Location: Room 50
SESSION CHAIRS: **Yuchen He,** *Florida State University;* **Simon Kim,** *Infineon Technologies Korea*

2:00pm | SiO2/Si3N4 Electret Incorporated AlN Substrates for Partial Discharge Mitigated WBG Power Electronics [5024]
Asif Muhammad Juberi, Pradip Chandra Saha, Omar Faruqe, Chanyeop Park University of Wisconsin-Milwaukee, United States

2:20pm | A SiC MOSFET Propulsion Inverter Design with Power Redundancy, Considering Unwanted Events, for Electrical Aircrafts [5099]
Simon Kim{4}, Dong Hyun Lee{2}, Ainhoa Puyadena Mier{3}, Myeonghyo Kim{1}, Byunggil Kwak{1} {1}Hanwha Aerospace, Korea; {2}Hanwha Systems, Korea; {3}Infineon Technologies Germany, Germany; {4}Infineon Technologies Korea, Korea

2:40pm | E Gallium Nitride (GaN) Based High-Power Multilevel H-Bridge Inverter for Wireless Power Transfer of Electric Vehicles [5359]
Javad Sadeghi Chevinly{1}, Shervin Salehi Rad{1}, Elias Nadi{3}, Bogdan Proca{2}, John Wolgemuth{2}, Anthony Calabro{2}, Hua Zhang{3}, Fei Lu{1} {1}Drexel University, United States; {2}InductEV Wireless Charging, United States; {3}Rowan University, United States

3:00pm | Model Design for Evaluating Oscillating Voltage Characteristic in Hybrid-Switch T-Type Converter Considering Parasitics [5008]
Amir Babaki{4}, Mohammad Sadegh Golsorkhi{4}, Thomas Ebel{4}, Nicklas Christensen{1}, Stefan Behrendt{3}, Jesco Beyer{2} {1}Danfoss Drives A/S, Gråsten, Denmark; {2}FuE-Zentrum FH Kiel GmbH, Germany; {3}Semikron Danfoss GmbH, Germany; {4}University of Southern Denmark, Denmark

3:20pm | De-Skewing Algorithm for Accurate Switching Loss Calculation in GaN HEMT [5252]
Akash Gangwar{1}, Abhishek Chanekar{1}, Sandeep Anand{1}, Amit Verma{2} {1}Indian Institute of Technology Bombay, India; {2}Indian Institute of Technology Kanpur, India

OS 3   Fault Detection, Management, and Control

Location: Room 40
SESSION CHAIRS: **Dehong Liu,** *Mitsubishi Electric Research Lab;* **Yan Li,** *Penn State University*

4:20pm | Fault Tolerant PM Drive Control for Electric Vehicles with Two Faulted Phase Current Sensors [5246]
Ciro Attaianese{2}, Matilde D'arpino{1}, Mauro Di Monaco{3}, Luigi Pio Di Noia{2} {1}Ohio State University, United States; {2}Università degli Studi di Napoli Federico II, Italy; {3}University of Cassino and Southern Lazio, Italy

4:40pm | Fault-Tolerant Axial Flux Coreless PM Machines with Independent Phase Modules [5182]
Yaser Chulaee{2}, Ali Mohammadi{2}, Matin Vatani{2}, Dan M. Ionel{1} {1}SPARK Laboratory, University of Kentucky, United States; {2}University of Kentucky, United States

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Oral Session Schedule

5:00pm | Comparative Analysis of Reliability for Single-Phase and Three-Phase Dual Active Bridge Converters [5145]
Cun Wang, Jennifer Bauman McMaster University, Canada

5:20pm | Effects of Vehicle-to-Grid Systems on Transmission Grid Congestion [5170]
Sonia Martin, Ram Rajagopal Stanford University, United States Management of Grid Impacts of Electrified Vehicles

OS 4 Fast and On-Board Chargers

Location: Room 50
SESSION CHAIRS: **Bo Zhang,** *Idaho National Lab;* **Jennifer Bauman**, *McMaster University*

4:20pm | 1 kV 150 a Bidirectional Isolated DC/DC Converter with Full Range ZVS for Charger Application [5259]
Rajendra Prasad Kandula, Rafal Wojda, Jonathan Harter, Christian Boone Oak Ridge National Laboratory, United States

4:40pm | Bidirectional Over-Voltage Protection Circuit for Three-Phase Single-Stage Indirect Matrix Converter [5265]
Avinash Dornala, Woongkul Lee Michigan State University, United States

5:00pm | Design Optimization of a Multi-Level Converter Supercapacitor System for Electrochemical Impedance Spectroscopy in EV Fast-Charging Stations [5037]
Avram Kachura, Mohammad Shawkat Zaman, Olivier Trescases University of Toronto, Canada

5:20pm | A Reinforcement Learning-Augmented Lyapunov Optimization Approach to DC Fast Charging Station Management [5298]
Mohammad Hossein Abbasi{1}, Ziba Arjmandzadeh{2}, Dillip Mishra{1}, Jiangfeng Zhang{1}, Bin Xu{2}, Venkat Krovi{1} {1}Clemson University, United States; {2}University of Oklahoma, United States

5:40pm | Bidirectional Multilevel Universal Charger with Decentralized Control Structure for Powering Light Electric Mobility Applications [5200]
Mohammad Babaie, Kamal Al-Haddad École de Technologie Supérieure, Canada

OS 5 DC/DC Power Conversion

Location: Room 40
SESSION CHAIRS: **Xiaofeng Yang**, *Beijing Jiaotong University;* **Ben Luckett**, *University of Kentucky*

2:00pm | Design Analysis of High-Frequency, High Power 3-Phase DAB Transformer for Electric Vehicle Charger Applications [5062]
Uvais Mustafa, Ioannis Kougioulis, Alan Watson, Patrick Wheeler, Rishad Ahmed University of Nottingham, United Kingdom

2:20pm | Capacitor-Less Buck Converter Using Integrated Planar Electromagnetic Components [5077]
Haitham Kanakri, Euzeli Cipriano Dos Santos Jr, Maher Rizkalla Purdue School of Engineering and Technology, United States

2:40pm | A Unidirectional Isolated Resonant Switched Capacitor Converter and the Suppression of Voltage Oscillation [5098]
Yan Liu{1}, Xiaofeng Yang{1}, Haixia Tan{1}, Wentao Mu{1}, Trillion Q Zheng{1}, Seiki Igarashi{2} {1}Beijing Jiaotong University, China; {2}Fuji Electric Co., Ltd., Japan

3:00pm | Design Methodology to Improve Efficiency of Semi-Dual Active Bridge Converter [5233]
Siva Prabhakar{1}, Nachiketa Deshmukh{2}, Sandeep Anand{1}, Shiladri Chakraborty{1}, Mayank Deo{2}, Pramod Chaudhary{2} {1}Indian Institute of Technology Bombay, India; {2}Varroc Engineering Limited, India

3:20pm | State-Feedback Design Framework for Current-Mode-Controlled Multiphase Boost Converters with Fast Transient Response and Adaptive On-Time [5224]
Teja Golla{1}, Santanu Kapat{1}, Philip T. Krein{2} {1} Indian Institute of Technology Kharagpur, India; {2}Zhejiang University-University of Illinois Urbana-Champaign Institute, China

OS 6 Electric Motor Control

Location: Room 50
SESSION CHAIRS: **Subarni Pradhan**, *McMaster University;* **Lianshan Lin**, *Oak Ridge National Laboratory*

2:00pm | Delamination and Buckling Analysis of a Laminated Component in a High-Speed Permanent Magnet Motor [5247]
Lianshan Lin, Himel Barua, Vandana Rallabandi, Praveen Kumar, Burak Ozpineci Oak Ridge National Laboratory, United States

iTEC2024

Oral Session Schedule

2:20pm | Influence of Machine Parameter Variation on Quantified PSOE in Feedforward Controlled PMSM [5049]
Ujala Maha Gamage, Sandun Kuruppu Western Michigan University, United States

2:40pm | Sequential Model Predictive Torque Control with Virtual Vectors Applied to Six-Phase Induction Machine [5186]
Paola Maidana, Christian Medina, Osvaldo González, Jorge Rodas, Magno Ayala, Larizza Delorme, Raul Gregor, Carlos Romero Laboratory of Power and Control Systems, Universidad Nacional de Asunción, Paraguay

3:00pm | Hybrid Current Control of Rare Earth Free Biaxial Excitation Synchronous Machines [5324]
Krishna Mpk Namburi{2}, Prerit Pramod{1}, Ritvik Chattopadhyay{3}, Ion Boldea{4}, Iqbal Husain{3} {1}MicroVision Inc, United States; {2}Nexteer Automotive, North Carolina State University, United States; {3}North Carolina State University, United States; {4}Politehnica University Timisoara, Romania

3:20pm | Fixed-Switching Model-Free Predictive Current Control of Switched Reluctance Motor Using Parameter Estimation [5075]
Sadra Tavakolian, Gaoliang Fang, Sumedh Dhale, Babak Nahid-Mobarakeh McMaster University, Canada

| Thursday, June 20 | 4:20pm – 6:00pm |

OS 7 Electric Vehicle Architecture

Location: Room 40
SESSION CHAIRS: **Xiaofeng Yang,** *Beijing Jiaotong University;* **Cun Wang,** *McMaster University*

4:20pm | Analytic Selectivity Evaluation of Vehicular Electronic Fuses' Wire Protection Algorithms [5044]
Christoph Mayer{2}, Martin Baumann{1}, Hans-Georg Herzog{3} {1}BMW Group, Germany; {2}BMW Group, Technische Universität München, Germany; {3}Technische Universität München, Germany

4:40pm | Fast Triggering Time Determination of a Vehicular Electronic Fuse's Wire Protection Algorithm [5045]
Christoph Mayer{2}, Martin Baumann{1}, Hans-Georg Herzog{3} {1}BMW Group, Germany; {2}BMW Group, Technische Universität München, Germany; {3}Technische Universität München, Germany

5:00pm | Comparison of Torque-Split Strategies for an Independent Axle, Dual-Motor All-Wheel Drive Electric Vehicle [5127]
Sopan Kane, Douglas Nelson, Scott Huxtable Virginia Polytechnic Institute and State University, United States

5:20pm | Single- Versus Dual-Motor Battery Electric Vehicles Energy Consumption Comparison Across Payloads and Cycles [5115]
Eduardo Louback{1}, Phillip J. Kollmeyer{1}, Fabricio A. Machado{2}, Alexander Allca-Pekarovic{1}, Eduardo Akira Shiguemoto{1}, Gaetano Dilevrano{3}, Ali Emadi{1} {1}McMaster Automotive Resource Centre, McMaster University, Canada; {2}McMaster University, Canada; {3} Politecnico di Torino, Italy

5:40pm | Simulation Based Evaluation of Simple Hybrid Electric Topologies for a Small Two-Wheeler for Characterizing the Performance and Emission Benefits [5085]
Pradeev Elango, Mayank Mittal, Ramesh Asvathanarayanan Indian Institute of Technology Madras, India

OS 8 Wireless Power Transfer

Location: Room 50
SESSION CHAIRS: **Bo Zhang,** *Idaho National Lab;* **Farzad Yaghoobi Notash,** *University of Kentucky*

4:20pm | Optimizing Magnetic Block Structure for Enhanced Coupling Coefficients in Wireless Power Transfer: A Finite Element Analysis Approach [5284]
Xiuhu Sun, Karl Lin, Jiale Zhou, Shen-En Chen, Nicole Braxtan, Tiefu Zhao University of North Carolina at Charlotte, United States

4:40pm | High-Power Polyphase PCB-Type Inductive Coupler for Wireless Electric Vehicle Charging [5291]
Donovin Lewis{3}, Omer Onar{1}, Lucas Gastineau{3}, John F. Eastham{2}, Dan Ionel{3} {1}Oak Ridge National Laboratory, United States; {2}University of Bath, United States; {3}University of Kentucky, United States

5:00pm | Self-Tuning in Dynamic Wireless Power Transfer (DWPT) Systems: Maximum Efficiency Under Misalignment and Load Variation [5218]
Mohammad Rastegar, Milad Bahrami Fard, Babak Fahimi, Poras Balsara University of Texas at Dallas, United States

5:20pm | Lyapunov Function-Based Control Strategy for Suppressing Power Pulsations in Dynamic Wireless Charging of Electric Vehicles [5266]
Milad Behnamfar, Arif Sarwat, Mohd Tariq Florida International University, United States

5:40pm | Demonstration of 9kW, 97% Efficient Capacitive Power Transfer Using Rotary Double Layers [5074]
Sarah Behringer, Daniel Ludois University of Wisconsin-Madison, United States

Oral Session Schedule

OS 9 Electrified Aircraft

Location: Room 44
SESSION CHAIRS: **Feng Guo,** *University of Wisconsin-Milwaukee;* **Sreedevi Krishnan,** *Ansys*

8:30am | Design and In-Flight Analysis of an Electric Aircraft's Battery Thermal Management System [5110]
Sai Sankalp Shekar, Matthew Clarke University of Illinois Urbana-Champaign, United States

8:50am | Hybrid Reconfigurable Battery Pack for All-Electric Aircraft: Synergizing High-Specific-Energy and Power Battery Types [5240]
Mayuresh Bhide{1}, Yawen Liang{1}, Gautham Ram Chandra Mouli{2}, Mohamad Ghaffarian Niasar{1}, Pavol Bauer{1} {1}DC systems, Energy conversion and Storage group, Delft University of Technology, Netherlands; {2}Delft University of Technology, Netherlands

9:10am | Simplified Model Predictive Control of 5L-ANPC Inverter-Fed AFPM Motor Drives in Electric Aircraft Propulsion Systems [5278]
Farzad Yaghoobi Notash, Jiangbiao He University of Kentucky, United States

9:30am | Impact of Battery Cell Chemistry on Urban Air Mobility Electric Aircraft Performance [5301]
Faissal El Idrissi, Matilde D'arpino Ohio State University, United States

9:50am | Design and Analysis of a Detuned Series-Series IPT System with Solenoid Coil Structure for Drone Charging Applications [5335]
Elias Nadi, Hua Zhang Rowan University, United States

OS 10 Rectifiers and Inverters

Location: Room 40
SESSION CHAIRS: **Simon Kim,** *Infineon Technologies Korea;* **Donovin Lewis,** *University of Kentucky*

8:30am | Influence of High-Frequency Power Loop Inductance on GaN-Based Neutral-Point-Less X-Type (NPL.X) Three-Level Inverter [5285]
Ali Halawa{2}, Ben Schuchardt{2}, Jinyeong Moon{1}, Woongkul Lee{2} {1}Florida State University, United States; {2}Michigan State University, United States

8:50am | Model Predictive Space Vector Pattern Control for High Power Current-Source Rectifier with Low Switching Frequency [5081]
Hang Gao Washington State University Vancouver, United States

9:10am | Implementation of Silicon Carbide Four-Switch Three-Phase Inverters [5100]
Hui Zhang State University of New York at Oswego, United States

9:30am | Performance Enhancement of Interleaved Totem-Pole Converter Under Adaptive Reactive Modulation [5331]
Miguel Rivera, Fengqi Gao, Ken King-Man Siu University of North Texas, Hong Kong; University of North Texas, China; University of North Texas, United States

9:50am | Predictive Control to Further Reduce DC-Link Capacitor Current Stress for Segmented Inverter [5188]
Pedro Ribeiro, Shajjad Chowdhury, Gui-Jia Su, Burak Ozpineci, Veda Galigekere Oak Ridge National Laboratory, United States

OS 11 Electric Machine Design

Location: Room 48
SESSION CHAIRS: **Zichao Jin**, *Mercedes Benz R&D North America (Populus Group);* **Subarni Pradhan,** *McMaster University*

8:30am | Design Considerations, Analysis and Comparison for High-Performance Surface Permanent Magnet Vernier Machines [5220]
Jingwei Zhu{1}, Huanzhi Wang{1}, Yiming Shen{1}, Hiroshi Yamamoto{2}, Ryo Kajitani{2}, Christopher Ho Tin Lee{1} {1}Nanyang Technological University, Singapore; {2} Panasonic Industry Co., Ltd., Japan

8:50am | Importance of Flux Fringing for 2-D Modeling of Permanent Magnet Axial Flux Motors [5056]
Benjamin Pfyffer von Altishofen{1}, Michael Lampérth{2}, Ricardo Martinez-Botas{1} {1}Imperial College London, United Kingdom; {2}Phi-Power AG, Switzerland

9:10am | Crack Propagation Modeling of a High-Speed Outer Rotor Motor [5244]
Himel Barua, Lianshan Lin, Praveen Kumar, Vandana Rallabandi, Burak Ozpineci Oak Ridge National Laboratory, United States

9:30am | Modeling and Characterization of Quadruple Three-Phase Winding Permanent Magnet Synchronous Machines [5316]
Prathima Nuli{1}, Vignesh Kumar Ramamurthy

9:50am | On the Optimal Design of Coreless AFPM Machines with Halbach Array Rotors for Electric Aircraft Propulsion [5283]
Matin Vatani{3}, Yaser Chulaee{3}, Ali Mohammadi{3}, David R. Stewart{3}, John F. Eastham{2}, Dan M. Ionel{1} {1}SPARK Laboratory, University of Kentucky, United States; {2}University of Bath, United Kingdom; {3} University of Kentucky, United States

Oral Session Schedule

OS 12 Powertrain Architecture

Location: Room 41
SESSION CHAIRS: **Sadam Ratrout,** *Illinois Institute of Technology (IIT)/Argonne National Laboratory (ANL);* **Summet Slngh,** *EMWorks Inc.*

8:30am | Load Torque Estimation for Efficient Operation of PMSM-Based Electrified Powertrain [5048]
Ahmad Hussain Safder, Athar Hanif, Qadeer Ahmed Ohio State University, United States

8:50am | Electric Vehicle Efficiency Trends and Insights from Calculations of Chassis and Powertrain Energy Usage in EPA Test Cycles [5191]
Michael Duoba{1}, Douglas Nelson{2} {1}Argonne National Laboratory, United States; {2}Virginia Polytechnic Institute and State University, United States

9:10am | Sizing of Electric Vehicle Power Converter Based on Distributed Operating Points [5251]
Syed Rahman{2}, Yebin Wang{1}, Marcel Menner{1}, Dehong Liu{1} {1}Mitsubishi Electric Research Laboratories, United States; {2}Texas A&M University, United States

9:30am | Study of a High-Speed Outer Rotor Burst Containing Enclosure [5258]
Lianshan Lin, Himel Barua, Vandana Rallabandi, Praveen Kumar, Burak Ozpineci Oak Ridge National Laboratory, United States

9:50am | A Powertrain Model for Energy Management Systems Evaluation Based on Power Flux for Heavy-Duty Series Hybrid Vehicles [5106]
Thiago Belina Silva Ramos, Marcelo Vinicius de Paula, João Pedro Carvalho Silveira, Augusto Magno Da Silva, Tárcio André Dos Santos Barros, Juliana de Souza Granja Barros Universidade Estadual de Campinas, Brazil

> **Friday, June 21 | 10:30am – 12:10pm**

OS 13 Battery State of Charge

Location: Room 44
SESSION CHAIRS: **Peng Fang,** *University of Minnesota Duluth;* **Ruoyang Song,** *Beijing Institute of Technology*

10:30am | Multi-Zoned Equivalent Circuit Modelling for Health-Aware Battery Fast Charging Optimization [5148]
Bibaswan Bose{2}, Akhil Garg{1}, Liang Gao{1} {1} Huazhong University of Science and Technology, China; {2} Indian Institute of Technology Delhi, India

10:50am | Experimental Performance Analysis of LG E-66 Cells from a Fast-Charging Porsche Taycan Battery Module [5175]
Lucia Uwalaka, Qi Yao, Josimar Duque, Phillip J. Kollmeyer, Ali Emadi McMaster Automotive Resource Centre, McMaster University, Canada

11:10am | Smart Reconfigurable Battery Packs with Scalable AI Based Cell Balancing [5013]
Yuqin Weng, Cristinel Ababei Marquette University, United States

11:30am | Adaptive Battery State-of-Charge Estimation Using Aging-Driven Equivalent Circuit Parameterization and Electrochemical Impedance Spectroscopy [5323]
Latha Anekal, Sheldon Williamson Ontario Tech University, Canada

11:50am | Cloud-Based Battery Test Bed Development for Life Cycle and Performance Evaluation for Electric Vehicle Applications [5262]
Sai Krishna Mulpuri{2}, Koushik Samanta{2}, Bikash Sah{1}, Praveen Kumar{3} {1}Bonn-Rhein-Sieg University of Applied Sciences, Germany; {2}Indian Institute of Technology Guwahati, India; {3}Oak Ridge National Laboratory, United States

OS 14 Heavy Duty Electrified Vehicles

Location: Room 40
SESSION CHAIRS: **Athar Hanif,** *Ohio State University;* **Sonia Martin,** *Stanford University*

10:30am | Tram System Performance Verification by Virtual Profile with Measurement-Based Simulation [5219]
Simon Kim{3}, Ye-Jun Kim{2}, Kwok Wai Ma{4}, Yeegyu Kim{1} {1}Dabo Corporation, Korea; {2}Hyundai Rotem Co., Korea; {3}Infineon Technologies Korea, Korea; {4}Infineon Technologies Singapore, Singapore

10:50am | Sizing of Fast Charging Infrastructure Site for Commercial Electric Vehicle Fleet Considering Smart Charge Management [5064]
Ahmed Mohamed, Aravind Ingalalli, Waqas Rehman, Vijay Bhavaraju Eaton Corporation, United States

11:10am | Modeling and Optimization of Regenerative DC Trolley Systems for Surface Mining Trucks [5088]
Thomas Zöls, Jorge Mari, Johann Asam Semikron Danfoss GmbH, Germany

11:30am | A Review of Key Technology Enablers and Challenges in Megawatt Scale On-Road and Off-Road Transportation Electrification [5282]
Arshiah Yusuf Mirza Shell International Exploration and Production Inc., United States

Oral Session Schedule

11:50am | **Analysis and Comparison of Different Metrics of DC-DC Converters to Determine Fuel Cell Stack Architectures in Heavy Duty Fuel Cell Vehicle Applications [5339]**

Subhajyoti Mukherjee, Vivek Sujan, Vandana Rallabandi, Omer Onar, Clayton Hickey Oak Ridge National Laboratory, United States

OS 15 Thermal Management

Location: Room 48
SESSION CHAIRS: **Lianshan Lin,** *Oak Ridge National Laboratory;* **Sreedevi Krishnan,** *Ansys*

10:30am | **Thermal Modeling of PCB Windings for Slotless PM Motors [5360]**

Immanuel Williams, Bulent Sarlioglu University of Wisconsin-Madison, United States

10:50am | **Model-Based Active Thermal Management for Neutral-Point Clamped Power Converter with Adaptive Weight [5067]**

S M Imrat Rahman{1}, Ali Moghassemi{1}, Laxman Timilsina{1}, Payam Ramezani-Badr{2}, Qilun Zhu{1}, Robert Prucka{1}, Gokhan Ozkan{1}, Christopher S. Edrington{1} {1}Clemson University, United States; {2} Nexteer Automotive, Clemson University, United States

11:10am | **An Effective Cooling System for High Torque Electric Motors Using Microchannels and Two-Phase Coolants [5124]**

Milad Bahrami Fard, Behnam Mohammadian Mosammam, Mohammad Hassan Ghaderi, Dhruvi Dhairya Patel, Poras Balsara, Babak Fahimi University of Texas at Dallas, United States

11:30am | **Thermal Model of a Soft Magnetic Composite EV Permanent Magnet Traction Motor [5201]**

Amir Kermanizadeh, Muhammet Talha Mercan, Pragasen Pillay Concordia University, Canada; Concordia University, Turkey

11:50am | **Low Resistance Heat Paths Application to Electric Machines Rotor Cooling [5334]**

Islam Zaher{2}, Maaz Khalid{2}, Mohamed Abdalmagid{2}, Giorgio Pietrini{2}, Mikhail Goykhman{1}, Ali Emadi{2} {1} Eaton Corporation, Canada; {2}McMaster Automotive Resource Centre, McMaster University, Canada

OS 16 Coupled Transportation-Power Grids and Micro-grids

Location: Room 41
SESSION CHAIRS:**G.R. (Gautham Ram) Chandra Mouli,** *Delft University of Technology;* **Lingming Kong,** University of Macau

10:30am | **Real-Time Eco-Driving Algorithm for Connected and Automated Vehicles Using Quadratic Programming [5357]**

Shreshta Rajakumar Deshpande, Piyush Bhagdikar, Stanislav Gankov, Jayant Sarlashkar, Scott Hotz Southwest Research Institute, United States

10:50am | **Physics-Informed Data-Enabled Predictive Control for Regulating Mixed Traffic Flows [5039]**

Dongjun Li, Haoxuan Dong, Ziyou Song National University of Singapore, Singapore

11:10am | **Routing Strategies to Enhance Situational Awareness of Connected Vehicles in Unorganised Traffic Junctions [5228]**

Swathi P{1}, Balasubramanian Kandaswamy{2}, Hrishikesh Venkataraman{1} {1}Indian Institute of Information Technology, Sri City, India; {2}Washington State University Vancouver, United States

11:30am | **A Commercial Analysis for Sustainable Public Transit Procurement Approach in India's Buses Electrification Drive [5235]**

Priya Singh{2}, Sai Krishna Mulpuri{2}, Praveen Kumar{2}, Seshu Bhagavathula{1} {1}CityQ, Norway; {2}Indian Institute of Technology Guwahati, India

11:50am | **Tangent and Normal Space-Based Method for Dynamics Identification in Microgrids [5204]**

Hanyang He, John Harlim, Daning Huang, Yan Li Pennsylvania State University, United States

Friday, June 21 | **1:40pm – 3:20pm**

OS 17 HIL and Evidence-Based Design

Location: Room 41
SESSION CHAIRS:**Shreshta Rajakumar Deshpande,** *Southwest Research Institute;* **Farzad Yaghoobi Notash,** *University of Kentucky*

1:40pm | **A Novel Approach in Evaluating Battery Charger Controller Design with Nonlinear PID Controller for an Extendable CHIL Setup [5007]**

Shervin Salehi Rad{2}, Michael Muhlbaier{1}, Oleg Fishman{1}, Javad Sadeghi Chevinly{2}, Elias Nadi{3}, Hua Zhang{3}, Fei Lu{2} {1}Alencon Systems, United States; {2}Drexel University, United States; {3}Rowan University, United States

Oral Session Schedule

2:00pm | **P-HIL Model Development for MW Charging Sites Incorporating Real-World XFC Load Profiles [5303]**

Sadam Ratrout{3}, Daniel Dobrzynski{1}, Bryan Nystrom{1}, Sam Thurston{1}, Mahesh Krishnamurthy{2} {1}Argonne National Laboratory, United States; {2}Illinois Institute of Technology, United States; {3}Illinois Institute of Technology, Argonne National Laboratory, United States

2:20pm | **Impact of Synthesized ICE on Hybrid Drive Efficiency and Operation Behaviour [5035]**

Axel Sturm, Roman Henze, Ferit Küçükay, Carsten Wolgast, Peter Eilts Technische Universität Braunschweig, Germany

2:40pm | **Quantifying the Cold-Weather State-of-Power Benefits Enabled by Multi-Chemistry EV Battery Pack [5036]**

Cheng Feng Wang, Olivier Trescases University of Toronto, Canada

3:00pm | **Numerical Investigation of Different Jet Impingement Configurations for Thermally Unbalanced Power Modules in Aerospace Traction Inverters [5172]**

Mohamed Hefny{3}, Sam Hemming{3}, Linke Zhou{3}, Abdulrhman Allam{3}, Di Wang{3}, Giorgio Pietrini{2}, Piranavan Suntharalingam{1}, Mikhail Goykhman{1}, Ali Emadi{2} {1}Eaton Corporation, India; {1}Eaton Corporation, United States; {2}McMaster Automotive Resource Centre, McMaster University, Canada; {3}McMaster University, Canada

OS 18 Motor Drives

Location: Room 40
SESSION CHAIRS: **Peng Fang,** *University of Minnesota Duluth;* **Donovin Lewis,** *University of Kentucky*

1:40pm | **Continuously-Variable-Pole Induction Machine Drive for Electric Vehicles [5173]**

Soumil Chaubal{1}, Elie Libbos{1}, Debranjan Mukherjee{1}, Anuj Maheshwari{1}, Arijit Banerjee{1}, Philip T. Krein{2} {1} University of Illinois Urbana-Champaign, United States; {2} Zhejiang University-University of Illinois Urbana-Champaign Institute, United States

2:00pm | **A Novel Random PWM Technique for Inverters and AC Drives [5248]**

Shaya Abou Jawdeh, Pengwei Li, Ali Bazzi University of Connecticut, United States

2:20pm | **PSO-IFOC Based PMSM Sensorless Drive for High Performance Hub Configuration Electric Vehicles [5227]**

Rohit Raj, Pramod Agarwal, Sharmili Das Indian Institute of Technology Roorkee, India

2:40pm | **Comparative Analysis of Shunt-Based and SiC MOSFET Rds(on)-Based Autonomous Gate Drivers for TCM-Based ZVS Two-Level Three-Phase Inverters for EV Drive Systems [5118]**

Khizra Abbas, Hans-Peter Nee KTH Royal Institute of Technology, Sweden

3:00pm | **A Study on the Performance Improvement of Axial Flux Permanent Magnet Machines Based on Stator Slot Design with Semi-Closed Slots or Magnetic Wedges [5050]**

Jangho Yun, Brandon Grainger, Paul Ohodnicki University of Pittsburgh, United States

OS 19 Impacts of Electric Vehicle Charging

Location: Room 44
SESSION CHAIRS: **Arash Asrari,** *Purdue University Northwest;* **Sonia Martin,** *Stanford University*

1:40pm | **Measurement-Based Harmonic Analysis of Electric Vehicle Smart Charging [5297]**

Murat Senol{2}, I. Safak Bayram{2}, David Campos-Gaona{2}, Kristian Sevdari{1}, Oliver Gehrke{1}, Benjamin Pepper{2}, Stuart Galloway{2} {1}Technical University of Denmark, Denmark; {2}University of Strathclyde, United Kingdom

2:00pm | **Resilience Evaluation of Power-Transportation Coupled Network with Electric Vehicles' Restoration Service [5133]**

Lingming Kong, Hongcai Zhang, Ningyi Dai State Key Laboratory of Internet of Things for Smart City SKL-IOTSC; Nadi, Rowan University

2:20pm | **An Infrastructure Smart Receptacle Solution for 95% of Daily Passenger Electric Vehicle Charging [5211]**

Raya Mahony{1}, Binhao Wang{2}, Philip T. Krein{2} {1} University of Illinois Urbana-Champaign, United States; {2} Zhejiang University-University of Illinois Urbana-Champaign Institute, United States

2:40pm | **Evaluation of Net Cost Savings for Daytime Charging to Support Transportation Electrification [5078]**

Farzan Zareafifi, Sarah Kurtz University of California, Merced, United States

3:00pm | **Control of Parallel Connected Dual Active Bridge Converters Under Unbalanced Input Voltages in an MV Compliant Solid State Transformer [5292]**

Vasishta Burugula, Shrivatsal Sharma, Shubham Dhiman, Osamah Aljumah, Subhashish Bhattacharya North Carolina State University, United States

Oral Session Schedule

OS 20 Electromagnetic Characterization and Interference

Location: Room 41
SESSION CHAIRS: **Chanyeop Park**, *University of Wisconsin-Milwaukee;* **Dehong Liu,** *Mitsubishi Electric Research Lab*

1:40pm | Identifying the Influence of Skin Effects on PWM-Induced Partial Discharges [5070]
Suaib Al Sufi{2}, Kangbeen Lee{1}, Woongkul Lee{1}, Chanyeop Park{2} {1}Michigan State University, United States; {2}University of Wisconsin-Milwaukee, United States

2:00pm | Electromagnetic Characterization of Multiphase Electronic Pole-Changing Induction Machine (e-PCIM) with Modulated Rotating Magnetic Flux Produced by Transposed Current Excitation [5272]
Seyed Mehdi Seyedi, Yuming Chen, Hamid Toliyat Texas A&M University, United States

2:20pm | A Comprehensive Analysis of Electromagnetic NVH in Electric Powertrain [5051]
Zhenhua Huang, Anthony Tsoulfaidis, Marcel Schmädicke, Dapu Zhang, Greg Fialek, Joe Wimmer Gamma Technologies LLC, Germany; Gamma Technologies LLC, Greece; Gamma Technologies LLC, Switzerland; Gamma Technologies LLC, United States

2:40pm | Increasing Partial Discharge Inception Voltage at Low Pressures Using Electrets [5153]
Pradip Chandra Saha, Omar Faruqe, Asif Muhammad Juberi, Chanyeop Park University of Wisconsin-Milwaukee, United States

3:00pm | Mitigating Partial Discharge in Power Module Using Functional Capacitive Field Grading Material [5257]
Asif Muhammad Juberi, Omar Faruqe, Pradip Chandra Saha, Chanyeop Park University of Wisconsin-Milwaukee, United States

OS 21 Electromagnetic Characterization and Interference

Location: Room 48
SESSION CHAIRS: **Yan Li,** *Penn State University;* **Elias Nadi,** *Rowan University*

1:40pm | Nearest Level Control Based Modular Multi-Level Converters for Power Electronics Building Blocks Concept in Electric Ship System [5131]
Ali Moghassemi{1}, Laxman Timilsina{1}, S M Imrat Rahman{1}, Ali Arsalan{1}, Phani Kumar Chamarthi{1}, Gokhan Ozkan{1}, Behnaz Papari{1}, Christopher S. Edrington{1}, Zheyu Zhang{2} {1}Clemson University, United States; {2}Rensselaer Polytechnic Institute, United States

2:00pm | Dynamic Stability of Constant Power Loads in Electrified Propulsion Systems [5090]
Marius Ulla Hatlehol, Mehdi Zadeh Norwegian University of Science and Technology, Norway

2:20pm | Securing SDN Communication Through Quantum Key Distribution [5206]
Marian Rempola{1}, Andrew Smith{1}, Yan Li{1}, Liang Du{2} {1}Pennsylvania State University, United States; {2}Temple University, United States

2:40pm | 4kV/400A/1.6mW Wireless Coupled Solid-State Circuit Breaker with Modular Active Voltage Clamping and Resonant Current Injection Circuits [5046]
Shuyan Zhao{1}, Reza Kheirollahi{2}, Yao Wang{3}, Liang Du{5}, Hua Zhang{4}, Fei Lu{2} {1}ABB Inc., United States; {2}Drexel University, United States; {3}Nanyang Technological University, United States; {4}Rowan University, United States; {5}Temple University, United States

3:00pm | Sub-Module Voltage Selection for an 800 V DC Bus Equivalent CHB-BESS Based EV Powertrain Design [5326]
Rishab Anand{2}, Peng Han{2}, Alex Huang{2}, Vincent Molina{1} {1}BMW of North America, LLC, United States; {2}University of Texas at Austin, United States

Friday, June 21 | 3:50pm – 5:30pm

OS 22 AI/ML for Electrified Transportation

Location: Room 41
SESSION CHAIRS: **Axel Sturm,** *Technische Universtat Braunschweig;* **Qian Xun,** *RISE Research Institutes of Sweden*

3:50pm | EV Energy Consumption Patterns and Their Correlation with Renewable Power Generation [5349]
Anna Starosta, Phil Saflekos, Alexander Stein, Nina Munzke, Marc Hiller Karlsruher Institut für Technologie, Germany

4:10pm | iTransformer Network Based Approach for Accurate Remaining Useful Life Prediction in Lithium-Ion Batteries [5185]
Anurag Jha, Oorja Dorkar, Atriya Biswas, Ali Emadi McMaster Automotive Resource Centre, McMaster University, Canada

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Oral Session Schedule

4:30pm | **Enhancing Battery Monitoring Under Real-World Driving Profiles Through Physics-Guided Artificial Intelligence [5054]**

Jiawei Zhang{2}, Wei Xu{2}, Yifei Zhang{2}, Weiran Jiang{1}, Qi Jiao{1}, Yao Ren{1}, Ziyou Song{2} {1}Farasis Energy USA, United States; {2}National University of Singapore,

4:50pm | **Predictive Modeling of Surface Flashover Using Deep Learning [5305]**

Vedant Tewari, Suaib Al Sufi, Sean Treleven Benet, Chanyeop Park University of Wisconsin-Milwaukee, United States

5:10pm | **AI-Based Control and Optimization Algorithm for Synthesis of Electrified Drives [5022]**

Axel Sturm, Michele Inglese, Roman Henze, Ferit Küçükay Technische Universität Braunschweig, Germany

OS 23 Battery Thermal Modeling and Management

Location: Room 48
SESSION CHAIRS: **Shreshta Rajakumar Deshpande,** *Southwest Research Institute;* **Sadam Ratrout,** *Illinois Institute of Technology (IIT)/Argonne National Laboratory (ANL)*

3:50pm | **Accurate Surface Temperature Monitoring of Lithium-Ion Batteries [5019]**

Mahyar Koshkouei, Nessa Fereshteh Saniee, Anup Barai University of Warwick, United Kingdom

4:10pm | **Numerical Modelling and Control of Electric Two-Wheeler Battery Thermal Management System with Thermoelectric Coolers [5034]**

Sankhadeep Bhattacharyya, Truong Dinh, Andrew McGordon University of Warwick, United Kingdom

4:30pm | **Optimal Battery Thermal Management During and Prior to Fast Charging Using Dynamic Programming [5047]**

Lukas Acker{2}, Engelbert Trunner{1}, Peter Hofmann{2} {1} Robert Bosch AG Austria, Austria; {2}Technische Universität Wien, Austria

4:50pm | **In-Situ Lithium-Ion Cell Sensing and Thermal Runaway in an Oil Immersed Setup [5086]**

Nessa Fereshteh Saniee, Mahyar Koshkouei, Marek Smalera, Begum Gulsoy, Timothy Vincent, Andrew McGordon University of Warwick, United Kingdom

5:10pm | **Thermal Analysis of Liquid-Cooled Battery Pack with Cell-to-Cell Parameter Variation [5189]**

Luigi Iannucci{1}, Matilde D'arpino{2}, Clemente Capasso{1} {1}Institute of Science and Technology for

OS 24 Battery State of Health and Aging

Location: Room 44
SESSION CHAIRS: **Farzan ZareAfifi,** *University of California;* **Merced Zichao Jin,** *Mercedes Benz R&D North America (Populus Group)*

3:50pm | **Exploring the Frontier: Hybrid Solid-State Batteries Manufacturing and Lifespan Investigation [5060]**

Haofeng Su{2}, Peifeng Li{2}, Rongheng Li{2}, Zhao Wang{1}, Xinru Zhao{1}, Zubo Zhang{1}, Xuan Zhou{2} {1}Camel Energy USA, United States; {2}University of Michigan-Dearborn, United States

4:10pm | **The Impact of Relaxation Time on Cell Degradation Across the Life Cycle Under Diverse Operating Temperatures [5095]**

Sai Krishna Mulpuri{2}, Bikash Sah{1}, Praveen Kumar{3} {1}Bonn-Rhein-Sieg University of Applied Sciences, Germany; {2}Indian Institute of Technology Guwahati, India; {3}Oak Ridge National Laboratory, United States

4:30pm | **An Experimental Study of the Robustness of Electrochemical Impedance Spectroscopy Measurements Within Consecutive Cycles [5136]**

Wenlin Zhang, Ryan Ahmed, Saeid Habibi McMaster University, Canada

4:50pm | **Data-Informed Healthy Cell Clustering Technique for Second-Life Applications of Retired Electric Vehicle Batteries [5327]**

Akash Samanta{1}, Dominic Karnehm{2}, Antje Neve{2}, Sheldon Williamson{1} {1}Ontario Tech University, Canada; {2}Universität der Bundeswehr München, Germany

5:10pm | **Experimental Results of Battery Power Capability Measurement on Cells with Different State of Health Levels [5180]**

Junran Chen{1}, Phillip J. Kollmeyer{1}, Satyam Panchal{2}, Yasaman Masoudi{2}, Oliver Gross{3}, Ali Emadi{1} {1} McMaster Automotive Resource Centre, McMaster University, Canada; {2}Stellantis N.V, United States; {3} Stellantis N.V., United States

Oral Session Schedule

OS 25 Emerging Trends and Applications

Location: Room 46
SESSION CHAIRS: **G.R. (Gautham Ram) Chandra Mouli,** *Delft University of Technology*; **Sonia Martin,** *Stanford University*

3:50pm | Application and Performance Trends of Electric Motors for Aircraft Propulsion [5261]
Matías Sebastian Jiménez Molina, Federica Graffeo, Silvio Vaschetto, Alberto Tenconi Politecnico di Torino, Italy

4:10pm | Steering Towards Eco-Conscious Mobility: Assessing the Energy and Environmental Impacts of Electric Propulsion Motors [5196]
Mercy Koech, Babak Fahimi, Poras Balsara University of Texas at Dallas, United States

4:30pm | Closing the Loop on Circular Economy in Transportation Electrification: Reuse, Repurposing, and Recycling of Power Electronics and Electric Machines [5274]
Mostafa Fereydoonian, Woongkul Lee Michigan State University, United States

4:50pm | A New Test Method for Estimating Rotor Resistance of Induction Motors Utilizing a Dynamometer [5241]
Taekil Kim{1}, Jae-Hak Kim{1}, Jin-Hong Kim{1}, Ju-Hun Lee{1}, Sang-Yong Jung{2} {1}Hyundai Motor Company, Korea; {2}Sungkyunkwan University, Korea

5:10pm | Design and Optimization of Wound Field Synchronous Machines for Traction Applications [5203]
Mohanraj Muthusamy, Sainan Xue, Dheeraj Bobba, Ahmed Shoeb, Vedanadam Mudumbai Acharya, Ryoko Imamura Powersys Solutions Inc, United States; Powersys Solutions Inc, Canada

Poster Session 1

SESSION CHAIRS: **Arash Asrari,** *Purdue University Northwest;* **Peng Fang,** *University of Minnesota Duluth*

AC to DC Converters and Inverters

1 | Inverter Improvement with SiC MOSFET for HVAC System [5105]
Simon Kim{3}, Weidong Chu{1}, Diego Raffo{1}, Dennis Vo{4}, Dharmeshkumar Patel{2} {1}Infineon Technologies America, United States; {2}Infineon Technologies India, India; {3}Infineon Technologies Korea, Korea; {4}Infineon Technologies Vietnam, Vietnam

2 | MPC-Based Harmonic Injection Techniques for Reconfigurable Single/Three-Phase Inverters with Grid Neutral Point Connection [5294]
Liwei Zhou{2}, Matthias Preindl{1} {1}Columbia University, United States; {2}University of Texas at Arlington, United States

3 | Integrated Single-Stage AC-DC Wireless Power Transfer System [5321]
Saman Rezazade, Mohammed Agamy University at Albany, United States

Battery Modeling

4 | Life Cycle Assessment for Manufacturing of Solid Electrolytes [5113]
Zheng Liu, Kai-Wei Lan, Paul Braun, Yumeng Li, Nicola Perry, Pingfeng Wang University of Illinois Urbana-Champaign, United States

Battery State of Health and Aging

5 | A Dual Energy Management for Hybrid Electric Vehicles [5012]
Laxman Timilsina, Okan Ciftci, Ali Moghassemi, Elutunji Buraimoh, S M Imrat Rahman, Phani Kumar Chamarthi, Gokhan Ozkan, Behnaz Papari, Christopher S. Edrington Clemson University, United States

6 | A Battery State of Health Prediction Framework Considering User Behavior for On-Road Electric Vehicles [5167]
Yifei Xu{2}, Yingjie Zhang{1}, Wenjin Yang{2}, Caiying Xu{2}, Fuhao Wang{1}, Hengzhao Yang{2} {1}Shanghai Electric Vehicle Public Data Collecting, Monitoring, and Research Center, China; {2}ShanghaiTech University, China

DC to DC Converter Topologies

7 | Three Phase Transformer Winding Partitioning for Soft Switching Region Expansion in Three Phase Dual Active Bridge [5146]
Mohamed Mansour, Joseph Olorunfemi Ojo Tennessee Tech University, United States

8 | Optimization of IPOP-Connected Dissimilar Power-Rated Converters for EV Charging Requirement of Diverse Power Levels [5162]
Hanfeng Cai{2}, Heyang Sun{1}, Qiao Wang{1} {1}Northeast Electric Power University, China; {2}University of Toronto, Canada

9 | A Bidirectional Synchronous Buck/Boost Converter Design for Hybrid Energy Storage System Topologies Optimized for EMC and Power Integrity [5199]
Manraj Singh Ladhar, Sheldon Williamson Ontario Tech University, Canada

10 | Modeling and Control of Isolated Bidirectional Interleaved Converter Applied to EV and HEV [5277]
Augusto Magno Da Silva, Marcelo Vinicius de Paula, João Pedro Carvalho Silveira, Paulo Robson Melo Costa, Thiago Belina Silva Ramos, Tárcio André Dos Santos Barros Universidade Estadual de Campinas, Brazil

11 | An In-Depth Comparative Analysis and Efficiency Evaluation of Dual- and Quad-Active Bridge for Solid State Transformer Applications [5313]
Ruvini De Seram, Kushan Lulbadda, Tarlochan Sidhu, Sheldon Williamson Ontario Tech University, Canada

Electric Machine - Characterization, Design, Modeling Techniques

12 | Optimization Methods of Axial Flux Machines Using 2D Finite Element Analysis [5009]
Ahmed Shoeb, Sainan Xue, Vedanadam Mudumbai Acharya, Dheeraj Bobba Powersys Solutions Inc, United States

13 | Electric Drives for Automotive Propulsion: A Comparative Study [5114]
Dhruvi Dhairya Patel, Babak Fahimi, Poras Balsara University of Texas at Dallas, United States

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Poster Session 1

14 | Rotordynamic Analysis and Comparative Study of High-Speed Outer Rotor Permanent Magnet Motor Designs [5249]

Himel Barua, Lianshan Lin, Vandana Rallabandi, Mostak Mohammad, Praveen Kumar, Burak Ozpineci Oak Ridge National Laboratory, United States

15 | Pre-Design of Switched Reluctance Motor Applied to Electric Tractor [5273]

Vinícius Batista, Marcelo Vinicius de Paula, Rolando Castro, Bruna Oliveira, Alvaro Arturo Zarate, Tárcio André Dos Santos Barros Universidade Estadual de Campinas, Brazil

Electric Machine - Thermal Management

16 | In-Slot Cooling Enabled Heavy Rare-Earth Free High Power Density Electric Motor for EV Application [5015]

Amitav Tikadar, Yogendra Joshi, Satish Kumar Georgia Institute of Technology, United States

17 | Physics-Informed Machine Learning Approach to Improve the Temperature Estimation Accuracy of Space-Resolved LPTNs [5080]

Stephan Schüller, Sonat Yilmaz, Rik W. De Doncker RWTH Aachen University, Germany

18 | Data-Driven Thermal Modeling for Electrically Excited Synchronous Motors - A Supervised Machine Learning Approach [5232]

Farzaneh Tatari, Davis Trapp, Jason Schneider, Mohsen Mirza Aligoudarzi Control Systems, Drive System Design Inc., United States

19 | Thermal Modeling of an Interior Permanent Magnet Synchronous Motor for an Electric Vehicle Application [5263]

Hams Hefny{2}, Batuhan Sirri Yilmaz{2}, Dhafar Al-Ani{2}, Reemon Z. Haddad{2}, Ali Emadi{1}, Berker Bilgin{2} {1}McMaster Automotive Resource Centre, McMaster University, Canada; {2}McMaster University, Canada

20 | Estimation of Equivalent Thermal Conductivity of Impregnated Slots in Electric Machines Using Artificial Neural Network Surrogate Model [5351]

Dikhsita Choudhary{2}, Mohamed Abdalmagid{1}, Giorgio Pietrini{1}, Ali Emadi{1} {1}McMaster Automotive Resource Centre, McMaster University, Canada; {2}McMaster University, Canada

EMI and Partial Discharge Considerations for Aerospace and Marine

21 | Mitigating Space Charge Injection and Accumulation Using Electrets in Low Pressures [5020]

Pradip Chandra Saha, Omar Faruqe, Asif Muhammad Juberi, Chanyeop Park University of Wisconsin-Milwaukee, United States

General Power Electronics

22 | A Novel Voltage-Balancing Control for MMC with Flying Capacitor Submodules in Medium-Voltage Variable-Speed Drives [5138]

Ducdung Le, Shivam Chaturvedi, Shahid Aziz Khan, Mengqi Wang, Wencong Su University of Michigan-Dearborn, United States

23 | Development of Adaptive Digital Twin for DC-DC Converters Using Artificial Neural Networks [5192]

Benjamin Jessie, Babak Fahimi, Poras Balsara University of Texas at Dallas, United States

24 | A General Approach for Maximizing Heat Transfer and Minimizing Capacitance Between MOSFET Configuration and Heat Sink with Thermal Pads [5314]

Benjamin Drillings, Matthew Jahnes, Matthias Preindl Columbia University, United States

Grid and Charging System Infrastructure

25 | Optimizing EV Chargers Location via Integer Programming [5181]

Seungmo Kim{1}, Yeonho Jeong{3}, Jae-Won Nam{2} {1}Georgia Southern University, United States; {2}Seoul National University of Science and Technology, Korea; {3}University of Rhode Island, United States

Induction Machines

26 | Identification of Induction Motor Parameters Using Auto Self-Commissioning Methods [5112]

Amirreza Mizani{2}, Mahmudreza Changizian{1}, Hang Gao{2} {1}University of Isfahan, Iran; {2}Washington State University Vancouver, United States

27 | Investigating the Effect of Inverter DC Bus Voltage on Variable Pole Induction Motor Performance in Electric Vehicles [5254]

Hasnain Nisar, Ali Bazzi University of Connecticut, United States

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Poster Session 1

28 | Synchronous Machine Rotor Excitation via Rotary Transformer with an Integrated Capacitive Resolver [5121]

Marisa Liben, Connor Akers, Daniel Ludois University of Wisconsin-Madison, United States

Inductors, Capacitors, Transformers, and EMI Filters

29 | A Multi-Phase Energy Management System for Hybrid Fuel Cell Drones [5356]

Mohammad Nayel Alzyod{2}, Ali Taleb Al-Awami{2}, Yeonho Jeong{3}, Seungmo Kim{1} {1}Georgia Southern University, United States; {2}King Fahd University of Petroleum and Minerals, Saudi Arabia; {3}University of Rhode Island, United States

Management of Grid Impacts of Electrified Vehicles

30 | A Novel Wavelet-Based Deep CNN-LSTM Model for Electric Vehicle Travel Behavior Modelling [5084]

Prasanta Kumar Mohanty, Premalata Jena, Narayana Prasad Padhy Indian Institute of Technology Roorkee, India

Motor Control

31 | Implementation of Speed Sensorless Vector Control Using Three-Phase Unfolding [5161]

Mohammad Saleh Khan, Soumya Shubhra Nag, Anandarup Das Indian Institute of Technology Delhi, India

32 | Control Strategy to Improve Control Stability in Transient States of PMSM for xEV [5174]

Yangjin Shin{1}, Suyeon Cho{2}, Dongjae Lee{2}, Hyunsoo Seol{2}, Junyeol Ryu{2}, Geunwan Koo{2}, Junyoung Lee{2}, Joohan Park{2}, Ju Lee{1} {1}Hanyang University, Korea; {2}Korea Automotive Technology Institute, Korea

33 | An Improved Fast Transient Hybrid Overmodulated Flux-Weakening Control for IPMSM Drives [5195]

Jingru Yang, Wesam Taha, Fengyang Sun, Yuhao Wang, Subarni Pradhan, Babak Nahid-Mobarakeh McMaster University, Canada

34 | Novel PSO-Based Speed-Controlled Multiple IM Fed by 3-Level DC-MLI and FC-MLI with a Mitigative Investigation on CMV and Bearing Current [5250]

Asad Hussain, Rohit Raj, Pramod Agarwal Indian Institute of Technology Roorkee, India

35 | ANN Based High Performance Induction Motor Drive for EV [5264]

Kaif Ahmed Lodi, Abdul Rahiman Beig, Khaled Al Jaafari Khalifa University, U.A.E.

36 | Model Predictive Torque Control Based on Virtual Vectors for Six-Phase Induction Machines [5333]

Osvaldo González{2}, Jesus Doval-Gandoy{1}, Magno Ayala{2}, Paola Maidana{2}, Christian Medina{2}, Jorge Rodas{2}, Carlos Romero{2}, Larizza Delorme{2}, Ricardo Maciel{2}, Raul Gregor{2} {1}Applied Power Electronics Technology Research Group, University of Vigo, Spain; {2}Laboratory of Power and Control Systems, Universidad Nacional de Asunción, Paraguay

37 | The Suppression of Torque Sideband Harmonics Above Switching Frequency in the Unbalanced Operation of 3-Module PMSM [5353]

Yutao Du, Zedong Zheng, Chi Li Tsinghua University, China

Management of Grid Impacts of Electrified Vehicles

38 | Material Properties Effects of Hollow Shafts on the Performance of Rotational Eddy Current Speed Sensor [5198]

Mehran Mirzaei, Pavel Ripka Czech Technical University, Czech Rep.

39 | Comparative Analysis of Motors with Inner and Outer Reluctance Rotors and PM Stators [5243]

Oluwaseun Badewa, Dan M. Ionel SPARK Laboratory, University of Kentucky, United States

40 | Comparative Analysis of Vernier Machines with Spoke, Surface Mounted, and Halbach PM Rotors for In-Wheel Traction [5268]

Ali Mohammadi{2}, Aaron Cramer{2}, Dan M. Ionel{1} {1} SPARK Laboratory, University of Kentucky, United States; {2}University of Kentucky, United States

41 | PSO-Infused Speed Controller Design for CHB MLI-Fed Heavy-Duty IM Drives with CMV and Bearing Current Mitigative Study [5270]

Rohit Raj, Asad Hussain, Pramod Agarwal Indian Institute of Technology Roorkee, India

Packaging of Powertrain System

42 | Multi-Winding Planar Transformer-Based On-Board Charger for Small Mobility Applications [5059]

Shahid Aziz Khan{2}, Feng Zhou{1}, Mengqi Wang{2}, Ducdung Le{2}, Shivam Chaturvedi{2} {1}Toyota Research Institute of North America, United States; {2}University of Michigan-Dearborn, United States

Poster Session 1

PM Machines

43 | Transverse Flux Permanent Magnet Machines State of the Art and Design Procedure for Direct Drive Wind Turbines [5004]
Maryam Salehi{2}, Aghil Ghaheri{1}, Alireza Omidi{2}, Ahmad Darabi{1}, Mohammad Hoseintabar Marzebali{1}, Madhav Manjrekar{2} {1}Shahrood University of Technology, Iran; {2}University of North Carolina at Charlotte, United States

44 | Comparative Analysis of Doubly Salient Electrical Machines [5014]
Maryam Salehi, Chandra Sekhar Goli, Madhav Manjrekar University of North Carolina at Charlotte, United States

45 | Reliable Fault-Tolerant Distributed Control for Traction IPMSM in Electric Vehicle/Hybrid Electric Vehicle [5026]
Laxman Timilsina{1}, Payam Ramezani-Badr{2}, Ali Arsalan{1}, Gokhan Ozkan{1}, Behnaz Papari{1}, Christopher S. Edrington{1} {1}Clemson University, United States; {2}Nexteer Automotive, Clemson University, United States

46 | Design of EV Propulsion Motors with Rib-Less IPMSMs: A PWM Harmonic-Based Analytical Current Harmonic Model Approach [5149]
Dohyun Jang{3}, In-Seok Song{3}, Hye-Won Yang{3}, Dong-Youn Shin{2}, Jinhwan Lee{1}, Sang-Yong Jung{3} {1}Chonnam National University, Korea; {2}KCNC, Korea; {3}Sungkyunkwan University, Korea

47 | Rotor Design to Prevent PM Irreversible Demagnetization of Axial Flux Permanent Magnet Motors [5208]
Seah Park, Hyung-Woo Kim, Tae-Hyuk Ji, Sang-Yong Jung Sungkyunkwan University, Korea

48 | Optimization Design of Dual Three-Phase Synchronous Motor Considering Mutual Magnetization Effects [5209]
Hye-Won Yang, Dohyun Jang, In-Seok Song, Seok-Won Jung, Sang-Yong Jung Sungkyunkwan University, Korea

49 | Mitigation and Investigation of NVH Characteristics of Multi-Inverter System on EV Propulsion Motor [5236]
Namho Kim{2}, Jae-Hoon Cho{2}, Jinhwan Lee{1}, Han-Kyeol Yeo{3}, Seok-Won Jung{2}, Sang-Yong Jung{2} {1}Chonnam National University, Korea; {2}Sungkyunkwan University, Korea; {3}Suwon National University, Korea

50 | Improvements in THD and Demagnetization of the Rare-Earth-Free Interior Permanent Magnet Synchronous Reluctance Motor with Novel Magnetization Orientations for EV Application [5239]
Jitendra Kumar, Baylon Godfrey Fernandes Indian Institute of Technology Bombay, India

Power Electronics Control

51 | Input Power Proportional Control of LLC Resonant Converter [5104]
Manikanta Pallantla, Ramkumar Sivakumar Texas Instruments, India; Texas Instruments, United States

52 | A Novel Four Switch Transformerless Inverter with Step Up/Down Capability for PV Fed Grid Connected Systems [5132]
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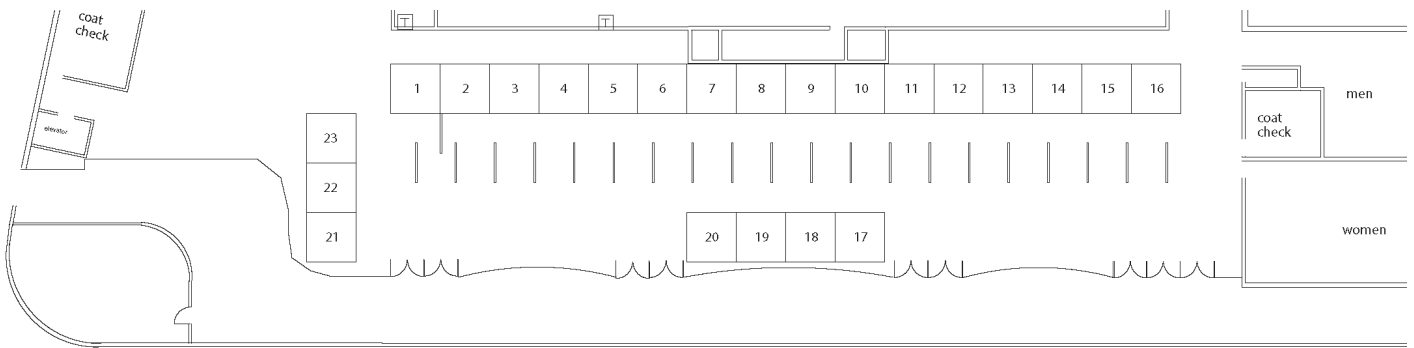## Advanced Test Equipment Corp.   BOOTH **23**
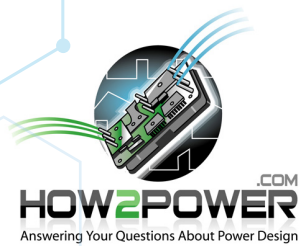
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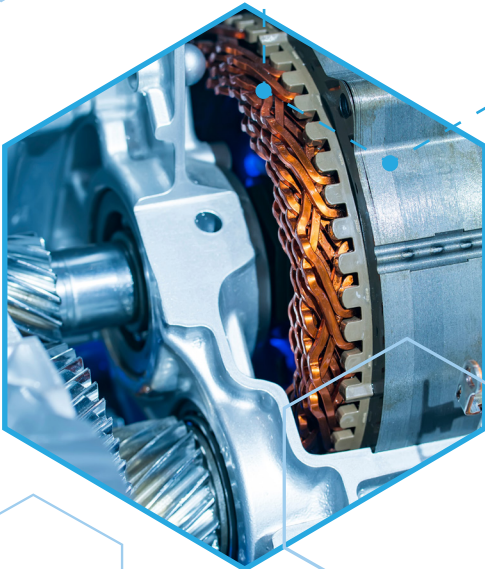**Sponsors:** IEEE · pels IEEE POWER ELECTRONICS SOCIETY Powering a Sustainable Future · IAS IEEE INDUSTRY APPLICATIONS SOCIETY · IEEE TRANSPORTATION ELECTRIFICATION COUNCIL · IEEE PES Power & Energy Society

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