

## 1. Session Title

High Efficiency, High Power Density, and Fault-Tolerant Motor and Drives for Electric Vehicles and Electric Airplanes – Similarities and Differences

## 2. Abstract

The electric vehicle business is booming and the all-electric aircraft business is in its infancy. All-electric aircraft use electric propulsion motors and power electronic drives to propel aircraft. Significant research and development are currently underway to design high efficiency and high power density motor design. Both electric vehicle and all-electric aircraft applications require high-efficiency motors and drives having high power density due to space limitations. While electric vehicles require kW/l volumetric power density, electric aircraft favors kW/kg specific power density. Electric aircraft applications typically require robust designs and redundancy whereas electric vehicles may or may not require these capabilities. Integrated motor drives are becoming important where motor and power electronics are built together with a joint cooling. This approach helps with cost, volume, reduced EMI/EMC concerns, and higher integration capabilities.

This special session will focus on new technologies for electric motor and power electronic designs which include new motor and power electronic topologies, optimization, cooling, and additive manufacturing. Integrated motor drive subjects will also be covered along with fault-tolerant drives. Wide bandgap-based power electronic drives will be covered. In this special session, key industry, academic, and government experts will discuss the next-generation motor design that will pave the way for future electric transportation.

## 3. Session Organizers

**Organizer 1:** Dr. Bulent Sarlioglu, Jean van Bladel Associate Professor, University of Wisconsin-Madison; Associate Director, Wisconsin Electric Machines and Power Electronics Consortium



Dr. Bulent Sarlioglu is a Jean van Bladel Associate Professor with the University of Wisconsin-Madison and the Associate Director of the Wisconsin Electric Machines and Power Electronics Consortium. From 2000 to 2011, he was with Honeywell International Inc.'s Aerospace Division, Torrance, CA, USA, most recently as a Staff Systems Engineer.

His expertise includes electrical machines, drives, and power electronics, and he is the inventor or co-inventor of 20 U.S. patents and many international patents. In addition, he has more than 200 technical papers that are published in conference proceedings and journals. Dr. Sarlioglu was the recipient of the Honeywell's Outstanding Engineer Award in 2011, the NSF CAREER Award in 2016, and the 4th Grand Nagamori Award from Nagamori Foundation, Japan, in 2018.

Dr. Sarlioglu is currently IAS VTS distinguished lecturer. He serves as the Chair of PES Motor Subcommittee, one of the co-editors of the IEEE Electrification Magazine. Dr. Sarlioglu was the general Chair of ITEC 2018 and Technical Program Co-Chair for ECCE 2019, and special session chair in ECCE 2020. Dr. Sarlioglu is the recipient of the IEEE PES Cyril Veinott Electromechanical Energy Award in 2021. Dr. Sarlioglu is a Fellow of IEEE and the National Academy of Inventors.

**Organizer 2:** Ozge Taskin, Senior electric machine designer, Ricardo UK



Ozge Taskin received her B.S. degree in Electrical Engineering and her M.S. degree in Mechatronics, Robotic and Automation Engineering from Istanbul Technical University. During her undergraduate studies, she studied electric machine design. She was a student assistant in power electronics and electric machine labs during her last year of education.

While she was working as an application engineer at ANSYS in Germany she completed her master's degree and worked on a linear machine design for her graduation thesis. She is currently employed by Ricardo UK working as a senior electric machine designer where she works on different projects including permanent magnet machines with conventional and unconventional topologies such as claw pole and axial flux structures mostly for automotive applications including research and development of customer and R&D projects

**Organizer 3:** Dr. Ayman M. El-Refaie, Werner Endowed Chair for Energy Sustainability, Marquette University



Ayman M. El-Refaie received the M.S. and Ph.D. degrees in electrical engineering from the University of Wisconsin Madison in 2002, and 2005 respectively. Between 2005 and 2016 he has been a principal engineer and a project leader at the Electrical Machines and Drives Lab at General Electric Global Research Center. Since January 2017 he joined Marquette University as the Werner Endowed Chair for Energy Sustainability. He has over 150 journal and conference publications. He has 48 issued US patents. His interests include electrical machines and drives with special focus on renewable energy and transportation electrification. He was the chair for the IEEE IAS Transportation Systems committee and an associate editor for the Electric Machines committee. He was a technical program chair for the IEEE 2011 Energy Conversion Conference and Exposition (ECCE). He was the general chair for ECCE 2014 and 2015 ECCE steering committee chair. He was the general chair of IEMDC 2019. He is the past chair of the IEEE IAS Industrial Power Conversion Systems Department and member of the IEEE Industry Applications Society executive board. He is an IEEE Fellow.

## 4. Session Panelists/Speakers

**Panelist 1:** Michelle Witherspoon - Controls IPT Lead at GE Aviation

**Title:** System Considerations for High Power Electric Aircraft

**Panelist 2:** Hao Ge, Staff Motor Design Engineer, Tesla

**Title:** Enabling Large Scale Electric Powertrain Optimization

**Panelist 3:** Thomas Jahns – UW-Madison

**Title:** Non-rare earth free Integrated Motor Drive for Electric Vehicle Project

**Panelist 4:** Peter DeBock – US Department of Energy (DOE) ARPA-e

**Title:** ARPA-E ASCEND program on ultra high-power density motors for a Zero Carbon Aviation future

**Panelist 5:** Xavier Collazo-Fernandez, NASA

**Title:** NASA motor and drive efforts for electrified aircraft