



EPE'22 ECCE Europe – Tutorial Announcement

INTEGRATED MOTOR DRIVES USING SiC and GaN **WIDE BANDGAP DEVICES**

Name(s) and Affiliation(s) of the Lecturer(s):

Bulent Sarlioglu
Professor, Fellow IEEE, and NAE
UNIVERSITY OF WISCONSIN-MADISON
1415 Engineering Drive, Madison, WI 53706 USA
sarlioglu@wisc.edu
608 262 2703

Scope and Benefits:

The scope of this tutorial is present the new developments on integrated motor drives using SiC and GaN wide bandgap devices. Integrated motor drives have many benefits; eliminating the cable between the motor and power electronic converter, reducing EMI emissions, achieving joint cooling of the motor and converter, and reducing weight, volume, and cost. There is a growing interest in integrated motor drives in many areas, including electric vehicles and aerospace, due to their high power density, compactness, and cost savings. By attending this tutorial, participants will learn about integrated motor drives, new semiconductor switches, and challenges and opportunities creating high power density integrated motor drives for next generation products and systems.

Contents:

The objective of this tutorial is to present the advancements in integrated motor drives, especially by using wide bandgap devices. Wide bandgap device (SiC and GaN) technology will be reviewed first in the tutorial. Most recent devices will be presented along with their impact on power electronics. Challenges associated with WBG devices as applied to power electronic drives will be covered, including EMI, insulation, bearing current, etc. Bi-directional switches will be reviewed, including the monolithic devices. Both voltage source and current source inverters will be presented. The benefits of integrated motor drives will be explained, and state-of-the-art information will be provided.

This tutorial consists of two parts: the first part will cover wide bandgap devices, including bi-directional switch realizations. The second part will present integrated motor drives using voltage source and current source inverters using WBG devices.



Schedule:

The schedule is as follows:

Monday, 5 September 2022 - 1st Tutorial Day - Morning

09:30 - 11:00 Tutorials Morning - Part 1

Introduction: (Estimated time: 5 minutes)

- Introduction of Speaker and Tutorial

Overview: (Estimated time: 5 minutes)

- Overview, Wide bandgap Devices
- Overview, Integrated Motor Drives

Real Tutorial, Theme 1, Wide Bandgap Devices (Estimated time: 80 minutes)

- SiC Devices – State-of-of-the art
- GaN Device – State-of-of-the art
- Challenges using SiC and GaN Devices (Voltage overshoots, motor insulation, bearing current issues)
- Bi-directional switches and their application to Matrix Converters, T converter, and Current Source Inverters
- Monolithic Bi-Directional Switches – New developments in the field

11:00 - 11:30 Coffee break

11.30 - 13:00 Tutorials Morning - Part 2

Real Tutorial, Theme 2, Integrated Motor Drives (Estimated time: 80 minutes)

- Benefits of Integrated Motor Drives (IMD)
- IMDs using Voltage Source Inverters (VSI)
- IMDs using Current Source Inverters (CSI)
- EMI/EMC Comparisons of VSI and CSI Inverters

Conclusions and Q and A (Estimated time: 10 minutes)

- The conclusion will summarize the benefits and challenges of integrated motor drives using WBG devices.

Who should attend:

The targeted audience is people interested in designing and applying electric machines and drives and learning more about wide bandgap (WBG) power electronics devices.



The audience should have a fundamental knowledge of electric machinery and power electronics.

This presentation would be interesting for the audience such as:

- Graduate student and junior researchers in relevant areas.
- Industrial engineers and scientists in relevant sectors.
- Senior engineers and scientists working in other fields and interested in motor drives.

Technical Level:

Technical Level: Both beginners and advanced

About the Lecturers:



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, with a particular emphasis on electrification of transportation and industrial applications. 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 for his outstanding contribution to aerospace, the NSF CAREER Award in 2016, and the 4th Grand Nagamori Award from Nagamori Foundation, Japan, in 2018.

Dr. Sarlioglu involves in many IEEE activities. He currently serves as the Chair of the PES Motor Subcommittee, Chair of the IAS Transportation Committee, and Educational Activity Chair of the PELS TC4 Electrical Transportation Systems. Dr. Sarlioglu was nominated and selected to become a Distinguished Lecturer for both the IEEE Vehicle Technology Society (2021-Present) and IEEE Industrial Application Society (2019-2021). Dr. Sarlioglu is the recipient of the IEEE PES Cyril Veniott Award in 2021. Dr. Sarlioglu became a fellow for the National Academy of Inventors in 2021 and an IEEE Fellow in 2022.