PERMANENT MAGNET MACHINE DESIGN AND APPLICATIONS

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SCOPE AND BENEFITS

For many applications, the compactness and power/weight ratio are the major factors of the efficiency. Permanent magnet (PM) synchronous machines are being used more and more widely because of the advantages such as volume and weight reduction. Thanks to development of the permanent magnet (PM) material over the past few decades, very high-power density (more than 10 kW/L) could be achieved for PM machines. Different types of PM machine have been studied and used in academies and industries such as interior PM machine, surface PM machine and flux-switching PM machine. Even though the PM machines have many advantages, there are many challenges that need to be considered, including the losses in core and PM, selection of winding topology and manufacturing. For high quality PM machine design, special considerations should be taken to overcome these challenges.

CONTENTS

This tutorial consists of three parts: the first part gives a general presentation on the design of PM machine, including the sizing equation, loss calculation, together with some example of PM machine design. The second part introduce a special design of flux-switching PM machine, with 6 stator slots and 4 rotor poles. The third part presents a motor-compressor design which integrates a PM machine with compressor.

Schedule is as follows:

Monday, 17 September 2018 - Tutorial day (Location: RTU, Riga, Latvia)

Part I (14 :00-15 :30): PM Machine Design Fundamental

- Overview - PM machine types and application
- Common winding types
- Sizing equation
- Losses in electrical machines
- Examples of PM machine design

Coffee break (30 min)

Part II (16 :00-16 :45): PM Machine Applications

- PM machines in electric vehicles (EV)
- PM machines in aerospace applications
- High-speed PM machines

Part III (16 :45-17 :30) : Special PM Machine topology: Flux-switching PM Machine

- Flux-switching permanent magnet machine overview
- Low pole FSPM machine with dual-stator structure
- Axial flux low pole FSPM machine with dual-stator structure
- Innovation in multidisciplinary: Integrated motor-compressor

WHO SHOULD ATTEND

The targeted audience are people interested in high-speed machine or device for high-speed application. The audience should have fundamental knowledge of different machine topologies, and electromagnetic laws. The presentations of the design of low-pole FSPM machine and motor-compressor would be interesting for 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 high-speed machine or high-speed application.

Technical Level:

Intermediate

ABOUT THE INSTRUCTORS

Bulent Sarlioglu is Professor at University of Wisconsin–Madison, and Associate Director, Wisconsin Electric Machines and Power Electronics Consortium (WEMPEC). Dr. Sarlioglu spent more than ten years at Honeywell International Inc.'s aerospace division, most recently as a staff system engineer, earning Honeywell's technical achievement award in 2003 and an outstanding engineer award in 2011. Dr. Sarlioglu contributed to multiple programs where high-speed electric machines and drives are used mainly for aerospace applications. One of the example was a turbo-compressor system where the turbine, compressor, and PM motor are mounted on the same shaft. The compressor and turbine are used as part of an air supply system for a Department of Energy 80-kW fuel cell system. The motor was variable speeds up to 100,000 rpm and power up to 17 kW. Dr. Sarlioglu is the inventor or co-inventor of sixteen US patents and many other international patents. His research areas are high speed electric machines, novel electric machines, and application of wide bandgap devices to power electronics to increase efficiency and power density. Dr. Sarlioglu was a recipient of the Honeywell's Outstanding Engineer Award in 2011. He received the NSF CAREER Award in 2016.