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TUTORIAL

A Modern Approach to the Analysis of PM Motors using Finite Element Method

Presented by

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Synopsis

Starting from the basic concepts of finite element analysis, the tutorial deals with several procedure for the computation of the PM motor performance. The finite element method is presented in a easy way, so as to allow the beginners to understand how it operates and how it can be used for the analysis of PM machines. Therefore, the tutorial core is focused on the computation of the PM motor parameters (such as PM flux linkage or inductance, according to the given geometry and winding arrangement), and performance (torque-to-current ratio, cogging torque, and so on). In addition, the PM machine capability under a given control strategy will be described, as well as the computation of the main characteristics of the PM motor drive (e.g., the MTPA and the MPTV trajectory, the torque versus speed curve under current and voltage limits, the rotor position sensorless detection capability).

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A report of the tutorial course notes is under preparation for the tutorial attendees.

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Intended audience

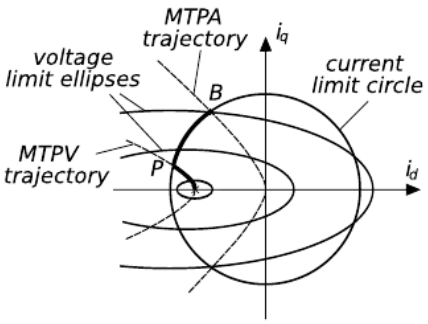
This tutorial is intended to researcher that are interested to both the design of PM motors and analysis of high-performance control strategies of the PM machines. In the tutorial course, the attendees will be guided to how modelling the PM machines and how get the PM machine performance under a given control strategy. The tutorial starts with basic concepts of finite element analysis (proper for the beginners, with expected basic knowledge in the matter). Then, after an introduction of permanent magnet materials and motor classification, the tutorial focuses on the computation of the capability of a given PM machine under given controlled operating conditions.

Such a computation requires a medium knowledge in electrical machine theory. Finally, the tutorial concludes presenting the high-level research on the PM machine design and control, developed in the last years. It is the research of MTPA and MPTV trajectory, of the limit torque versus speed performance, the fault-tolerant capability, and the sensorless rotor position detection capability. Therefore, although the tutorial does not require an advanced knowledge, the purpose is to show how to start a modern kind of analyse of PM machines.

About the Speakers

Nicola Bianchi received the Laurea and Ph.D. degree in Electrical Engineering from the Department of Electrical Engineering, University of Padova, Padova Italy, in 1991 and 1995 respectively. In 1998, he joined the Department of Electrical Engineering of the same University, as Assistant Professor in Electrotechnique. Since 2005 he was an Associate Professor in Electrical Machines, Converters and Drives. His activity is at the Electric Drive Laboratory, Department of Electrical Engineering, of the University of Padova. His teaching activity deals with the Design Methods of Electrical Machines, where he introduced the finite element analysis of the machines. His research activity is in the field of the design of electrical machines especially for drives applications.

In the same field, he is responsible for various projects for local and foreign industries. He is member of IEEE IAS and IEEE PES. He is a member of the Electrical Machines Committee and the Electrical Drives Committee of the IEEE IA Society. He is author and co-author of about 100 scientific papers on electrical machines and drives, and two international books on the same subject.



Massimo Barcaro received the B.S. and M.S. degrees in Electrical engineering from the University of Padova, Italy, in 2004 and 2006, respectively. In the following year, he received a boursary scheme at the Electric Drives laboratory, Department of Electrical Engineering, University of Padova. Since 2008, he has been working toward the Ph.D. degree
in the same laboratory. His research activities are concentrated on the design of permanent magnet synchronous machines, especially for automotive and propulsion applications. He is co-author of about 14 scientific papers on electrical machines.