The Sixth Annual IEEE Energy Conversion Congress and Exposition (ECCE 2014)
Pittsburgh, Pennsylvania, September 15-18, 2014

TUTORIAL PROPOSAL

Proposal for half-day tutorial to be presented on Sunday, September 14.

1. Title of Tutorial

The Rediscovery of Synchronous Reluctance and Ferrite PM Motors as Valid Competitors to Induction and Rare-Earth PM Motors

2. Abstract (500 word limit, If the tutorial is accepted, this abstract will be published in the conference web page, program, and proceedings)

The considerable recent variability in the price of rare-earth permanent magnets (PM) has caused a resurgence of interest in alternative machine topologies including synchronous reluctance and ferrite PM machines. This tutorial covers the analysis and design of synchronous motors for variable-speed applications, including permanent magnet and synchronous reluctance machines. It does not focus on a specific application, but aims to provide a broad perspective on electrical motors that are becoming a valid alternative to those currently used in variable-speed drives, such as induction motors and rare-earth PM synchronous machines. Among others, synchronous reluctance machines and PM machines without rare-earth materials will be considered and compared with state-of-the-art solutions.

3. Outline of Tutorial (Outline would only define the topics and the subtopics that would be covered. No detail descriptions should be included in the proposal)

Thomas Jahns, University of Wisconsin-Madison, Madison WI, US
"***Overview of PM Synchronous Machines Opportunities and Challenges***"
A brief history of synchronous machines without field windings will be presented, followed by a review of the wide opportunities for these types of variable-speed machines. Attention is devoted to the impact of the recent price variability of rare-earth magnets and the alternative machine topologies that are now being examined.

Nicola Bianchi, University of Padova, Padova, Italy
"***Synchronous Reluctance and PM-Assisted Reluctance Motors***"
The potential of synchronous reluctance and PM-assisted reluctance machines is described with the help of numerical models. The analysis criteria are presented, mainly based on finite element analysis. A comparison between predictions and measurements validates the presented procedures.

Wen Soong, University of Adelaide, Adelaide, Australia
"***PM Synchronous Machine Modelling and Design***"
A general approach will be presented that is based on fundamental principles of electric and magnetic loading to compare the performance of synchronous machines with different PM magnet types (including no magnets).

Gianmario Pellegrino, Politecnico di Torino, Turin, Italy
"***Experimental Identification of PM Synchronous Machines for Design and Control***"
The various machine parameters are determined on the basis of experimental tests to obtain a proper control calibration and an accurate prediction of the drive capability. Self-commissioning techniques and off-line techniques are presented and compared.

Francesco Cupertino, Politechnic of Bari, Bari, Italy
"***Automated Design of Synchronous Reluctance and Interior PM Motors***"
An optimization-oriented approach to the design of synchronous motors with anisotropic rotor will be presented. The major focus is on identification of the suitable optimization variables and optimization constraints, and analysis of the optimization results.

4. Lead Instructor (Name / Affiliation & contact information)
Gianmario Pellegrino, see below

5. Other Instructors (Name / Affiliation & contact information)
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6. Instructor Bios: 150 words each (Please provide a brief biography of each instructor, describing the qualifications for presenting the proposed tutorial, including the work and publications that are most relevant to the proposal)

Thomas M. Jahns received the Ph.D. degree in electrical engineering from M.I.T. in 1978. He was with GE Corporate Research and Development, Niskayuna, NY, for 15 years. Since 1998, he has been with the University of Wisconsin - Madison, where he is the Grainger Professor of Power Electronics and Electric Machines in the Department of Electrical and Computer Engineering and a Co-Director of WEMPEC. His research interests include high-performance PM synchronous machines and distributed energy resources, including microgrids. Dr. Jahns is the recipient of the 2005 IEEE Nikola Tesla Award and the William E. Newell Award by the IEEE Power Electronics Society (PELS) in 1999. He has been recognized as a Distinguished Lecturer by the IEEE Industry Applications Society during 1994–1995 and by the IEEE-PELS during 1998–1999. He served as President of PELS (1995–1996) and as Division II Director on the IEEE Board of Directors (2001–2002).

Nicola Bianchi received the Laurea and Ph.D. degrees in electrical engineering at University of Padova, Padova, Italy, in 1991 and 1995, respectively. Since 2005 he is an Associate Professor in Electrical Machines, Converters and Drives. His activity is in the Electric Drive Laboratory, Department of Industrial Engineering, University of Padova. His research and teaching activities include the design of electrical machines, particularly for drive applications. He is responsible for various projects for local and foreign industries. He is author and co-author of several scientific papers on electrical machines and drives, and international books on the same subject. He is a 2014 IEEE Fellow.

Wen Soong received the B.Eng. degree from the University of Adelaide, Adelaide, S.A., Australia, in 1989, and the Ph.D. degree from the University of Glasgow, Scotland, U.K., in 1993. He worked at General Electric Corporate Research and Development, Schenectady, New York, before joining the University of Adelaide, in 1998. His research interests include permanent magnet and reluctance machines, renewable energy generation, and condition monitoring.

Gianmario Pellegrino, received the M.Sc. and Ph.D. degrees in electrical engineering from Politecnico di Torino, Turin, Italy, in 1998 and 2002, respectively. Since 2002 he is with Politecnico di Torino. His research interests include the design of electrical machines and the control of electrical drives. He is involved in research projects with industry and has more than 20 journal papers and one patent. Dr. Pellegrino is an Associate Editor for the IEEE Transactions on Industry Applications and an IEEE Senior Member. He is the co-recipient of three Prize Paper Awards. He was a guest researcher at Aalborg University, Denmark, in 2002, a visiting fellow at Nottingham University, UK, in 2010/2011, and an honorary fellow at the University of Wisconsin-Madison, USA, in 2013.

Francesco Cupertino, received the Laurea degree and the PhD degree in Electrical Engineering from Politecnico di Bari, Italy, in 1997 and 2001 respectively. From 1999 to 2000 he was with PEMC research group, University of Nottingham, UK. Since July 2002 he is an Assistant Professor at Politecnico di Bari, Electrical and Electronic Engineering Department. His research interests include the design of permanent magnet electrical machines, intelligent motion control, and applications of computational intelligence to control and design. He is the author or co-author of more than 90 scientific papers. He participated and coordinated several research projects mainly founded by companies, Italian Ministry of University and European Union. He is the scientific director of the laboratory Energy Factory Bari (EFB), a joint initiative of Politecnico di Bari and AVIO AERO GE, aimed at developing research projects in the fields of aerospace and energy. He is an IEEE senior member.