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*The Electrical and Computer Engineering Program presents*

*ECEN Seminar Series*

# Modelling and Control of Multiphase Machines

Prof. Emil Levi
Liverpool John Moores University, U.K.

**Wednesday, 13 February 2013, 3.30 – 4.30 p.m.**

**Lecture Hall 144**

Although three-phase machines are the workhorse of the industry, there are nowadays numerous applications where the use of machines with a higher phase number is regarded advantageous for one reason or the other. As long as the machine is connected to the grid through a power electronic converter as the power conditioning interface, the actual number of phases of the machine is a design variable that can be selected to suit a given application.
This lecture will at first address specifics of multiphase machines that make them a favorable choice for modern-day applications. Due attention will be in this context also paid to the different stator winding design possibilities, although the subsequent discussion will apply to multiphase machines with near-sinusoidal magneto-motive force distribution. Next, the presentation will discuss the principles of multiphase machine modeling, using an induction machine as the example. The emphasis will be placed on similarities and differences, when compared to a three-phase machine modeling, in an attempt to make the understanding of the topic easier.

The major part of the talk will discuss rotor flux oriented control (vector control), as applied in conjunction with multiphase machines. Again, an attempt will be made to relate the topic to the corresponding vector control of a three-phase machine, which is regarded as well-known. Illustrations collected from experimental prototypes will be used throughout this section to underpin the theoretical considerations. A considerable portion will be occupied by discussion of the current control related issues, since these constitute the major area of difference when compared to a three-phase machine. Some of the newest developments will be reviewed in this context, including multiple current controller configurations for compensation of dead time effects and inherent asymmetries in the machine. Applicability of the model predictive control principles to current control of a multiphase machine, as a substitute for the conventional PI control, will be addressed. Finally, a simple method of post-fault tolerant control, which requires minimum software reconfiguration and does not ask for the change of either the transformation matrix or the machine model, will be presented.

**Emil Levi** received his Dipl. Ing. (1st Class Honours) degree in Electrical Power Engineering from the University of Novi Sad, Yugoslavia, in 1982 and his MSc and the PhD degrees in Electrical Engineering from the University of Belgrade, Yugoslavia in 1986 and 1990, respectively.

From 1982 till 1992 he was with the Dept. of Electrical Engineering, University of Novi Sad. He joined Liverpool John Moores University, UK in May 1992, and was promoted to a Readership in 1995. Since September 2000 he is Professor of Electric Machines and Drives.

He serves as a Co-Editor-in-Chief of the IEEE Trans. on Industrial Electronics, as the Editor-in-Chief of the IET Electric Power Applications and as an Editor of the IEEE Trans. on Energy Conversion. He was elevated to the IEEE Fellow grade in 2009, and is the recipient of the Cyril Veinott Award of the IEEE Power and Energy Society for 2009 and the Best Paper Award of the IEEE Trans. on Industrial Electronics for 2008.

**FOR MORE INFORMATION:**

Noha Ezzat
noha.ezzat@qatar.tamu.edu
+974.4423.0152

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