24th International Conference on Electrical Machines (ICEM'2020)
Gothenburg, Sweden, August 23rd-26th, 2020

Tutorial-3: Sunday, 23rd August 2020, 09:00-11:30 CET.

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A Flux-oriented-based Analysis of Three-phase Induction Machines

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Tutorial Abstract:
The tutorial will describe a complete finite-element analysis procedure for induction motors, including squirrel cage motor. One of the main novelties of the proposed approach is that the machine performance is obtained performing only magneto-static finite element analyses. The synergy between analytical and finite element model leads to a rapid and precise estimation of the rotor induced current. The rotor currents are assigned as source and their value is adjusted in at maximum three simulation steps. Adopting magneto-static analysis, saturation phenomena are carefully considered in any operating condition. In addition, computational time is very low, since time-stepping analyses are avoided. The procedure proposed allows the motor performance to be directly derived, without any preliminary knowledge of the machine equivalent circuit. In the tutorial, how to apply this analysis procedure will be described in details. In addition, strategies to include the analysis of skewed rotors, MMF space harmonics, iron losses evaluation, ... will be explained.

Brief summary of the contents:

1. Theoretic introduction to highlight the rotor flux in the induction machine equations.
2. How to set stator and rotor currents into the magneto-static analysis of the machine.
3. How to consider the skewing of the rotor.
4. How to consider the Magneto-Motive-Force (MMF) harmonics.
5. Parameter and losses estimation is a key feature of the proposed procedure.
6. Efficiency map of the machine (thanks to the rapidity of the magneto-static simulations).
7. Particular applications.

Biographies:

Mr. Matteo Carbonieri received the master's degree in electrical engineering from the University of Padova, Padova, Italy, in 2017. He is currently Ph.D. student in the Electric Drives Laboratory, University of Padova, working on the design and analysis of electric machines.

Prof. Nicola Bianchi received the Laurea and Ph.D. degrees in electrical engineering from the University of Padova, Padova, Italy, in 1991 and 1995, respectively. He is a Full Professor in the Electric Drives Laboratory, Department of Electrical Engineering, University of Padova. His research activity is in the field of the design of electrical motors for electric drive applications.

Dr. Luigi Alberti received the Laurea and Ph.D. degrees in electrical engineering from the University of Padova, Padova, Italy, in 2005 and 2009, respectively. He is currently an Associate Professor in the Electric Drives Laboratory, University of Padova, working on the design, analysis, and control of electric machines.