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Tutorial Proposal

TUTORIAL TITLE:

Self-commissioning techniques for AC motor drives

TUTORIAL PRESENTERS:

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BIOS OF THE PRESENTERS:

Paolo Pescetto is an Assistant Professor at Politecnico di Torino, Italy. He received the M.Sc. and PhD degrees with full grades and honors from Politecnico di Torino, Turin, Italy, in 2015 and 2019. Since fall 2019, he has been working as a researcher and tenure-track lecturer in the Energy Department of Politecnico di Torino. He is a member of the Power Electronics Innovation Center (PEIC) of Politecnico di Torino. He authored or co-authored 40+ scientific works, with 14 IEEE journal papers. Since fall 2022 he has been the vice chair of the IEEE IA/IE/PEL North Italy Joint Chapter. His main research interests include synchronous motor drives, sensorless control, self-commissioning techniques, and integrated battery chargers for EVs. Dr. Pescetto received five IEEE paper Awards and two IEEE PhD thesis awards.

Shafiq Odhano is with Newcastle University, Newcastle upon Tyne, United Kingdom, where he is a lecturer in electric drives. He obtained his MSc and PhD degrees from Politecnico di Torino, Italy. He was previously affiliated with the Politecnico di Torino (Italy) and the University of Nottingham (United Kingdom) as a research fellow. His research interests include parameter identification for high-performance control of electric drives, fault-tolerant control of multiphase machines and drives, position sensorless control of synchronous motor drives and direct power control of doubly fed induction generators.

Marko Hinkkanen (IEEE Fellow) received the M.Sc.(Eng.) and D.Sc.(Tech.) degrees in electrical engineering from the Helsinki University of Technology, Espoo, Finland, in 2000 and 2004, respectively. He is currently an Associate Professor (tenured) with the School of Electrical Engineering, Aalto University, Espoo, Finland. His research interests include control systems, electric machine drives, and power converters. Dr. Hinkkanen was the corecipient of eight paper awards and of the 2020 SEMIKRON Innovation Award. He was the General Cochair of the 2018 IEEE 9th International Symposium on Sensorless Control for Electrical Drives (SLED). He is an Associate Editor of IEEE Transactions on Energy Conversion and the IET Electric Power Applications.

Luca Peretti (IEEE Senior Member) received the M. Sc. degree in Electronic Engineering in 2005 from the University of Udine, Italy, and the Ph.D. degree from the University of Padova, Italy, in 2009. From August 2010 to August 2018, he was with ABB Corporate Research, Västerås, Sweden in different roles as principal scientist, project leader and strategy coordinator. He has also been an Affiliated Faculty member at KTH, division of Electric Power and Energy Systems, since July 1, 2016. From September 2018 Luca is an Associate Professor at KTH, division of Electric Power and Energy Systems, in the field of Electric Machines and Drives. His main scientific interests relate to the automatic parameter estimation in electric machines, sensorless control, loss segregation in drive systems, multiphase drives, condition monitoring of machines and drives, in the context of industrial, wind energy and traction applications.

ABSTRACT:

Accurate identification of the electric machine parameters is a mandatory step in many ways, both in R&D projects and in the conventional operation of electric drives. For example, the validation of a machine design, and the implementation of model-based control schemes (model predictive control, advanced flux observers, position-sensorless control, and more) require precise knowledge of parameters. In addition, while precise motor characterization is doable in a laboratory environment, practical identification of machine parameters is often a complicated matter in industrial scenarios due to the absence of dedicated testing equipment, the high parametric dispersion of parameters due to the manufacturing process, the time constraints in the production lines, and the impossibility of removing the machine from the mechanical load in case of installation of a new converter.

For these reasons, a self-commissioning approach is often preferred in industrial environments, where the necessary motor parameters are measured through rapid and automatic tests, with the motor directly mounted on its target application, and without

requiring any measurement hardware out of the drive itself. If possible, the automatic commissioning should also be performed at standstill or quasi-standstill conditions.

Among all the motor parameters, the measurement of the saturation curve of the flux linkage is a particularly critical step, since it deeply affects the drive performance.

This tutorial is intended to describe the state of the art of self-commissioning procedures proposed for synchronous and asynchronous motor drives. The tutorial is intended for young researchers and practitioners in the field of electrical drives, as well as senior experts in related fields. The authors will provide optional exercises for those intending to further practice on this topic.

List of contents:

- Basics of motor and inverter modeling adopted for defining the test campaign.
- Measurement of the self- and cross-saturation characteristics of synchronous machines.
- Measurement of magnetic saturation curve for induction motors, including magnetizing and leakage inductance.
- Thermal model definition and experimental measurement of the related parameters, aiming at the full exploitation of the machine overload capability (time permitting).