Guest Editorial Model Predictive Control in Energy Conversion Systems

MODEL predictive control (MPC) refers to a broad range of control strategies that make explicit use of a model of the system/device to be controlled optimally. In order to obtain the optimal control signal (or sequence of control signals), MPC optimizes a certain cost function at regular intervals. Due to its unique capabilities to deal with constraints on actuators and system states as well as its theoretical basis, MPC has been widely received and successfully used for many decades, mostly for control of slow industrial plants. However, with continuous advances of control theory and increasing computational capabilities of modern microprocessors, this control strategy has recently became a technically feasible solution for control of energy conversion systems that operate at much faster times scales. Some notable examples of such systems are non-conventional electric power generating and energy storage equipment, electric machinery and electrical vehicles, where electrical power converters commonly regulate energy conversion process (including maximum power extraction, variable speed operation, charging). These individual systems can also make use of advanced energy conversion and communication technologies in order to coordinately support the legacy grid or to form and effectively control small autonomous grids, also known as microgrids. This Special Section of the IEEE TRANSACTIONS ON ENERGY CONVERSION presents the latest discoveries and results in the area of MPC applications for control of power and energy conversion systems.

A total of 102 abstracts were received, and 57 full papers were invited for full submission. After a selective review process, 24 papers are finally selected for publications in this Special Section. The Special Section opens with two parts "Review Type" papers entitle "*A Review of Predictive Control Techniques for Switched Reluctance Machine Drives. Part I: Fundamentals and Current Control*" and "*A Review of Predictive Control Techniques for Switched Reluctance Machine Drives. Part II: Torque Control, Assessment and Challenges*" where different aspects of MPC techniques for Switched Reluctance Machine Drives are covered. The other 22 papers accepted for publications in this Special Section reveals the wide diversity of relevant topics included:

- An Optimal Non-Integer MPC-based Load Frequency Control for Modern AC Power Grids with V2G Technology
- Hybrid Model Predictive Control of DC-DC Boost Converters with Constant Power Load
- Discrete Space Vector Modulation Based Model Predictive Flux Control with Reduced Switching Frequency for IM Drive
- Multistage Predictive Current Control Based on Virtual Vectors for the Reduction of Current Harmonics in Six-Phase PMSMs
- Stable shortest horizon FCS-MPC output voltage control in non-minimum phase boost-type converters based on input-state linearization
- Grid-aware Distributed Model Predictive Control of Heterogeneous Resources in a Distribution Network: Theory and Experimental Validation
- Robust Model Predictive Control of DC-DC Floating Interleaved Boost Converter with Multiple Uncertainties
- Distributed MPC of Residential Energy Storage for Voltage Regulation and Peak Shaving Along Radial Distribution Feeders
- Design of a Linear Time-Varying Model Predictive Control Energy Regulator for Grid-Tied VSCs
- Data-Driven Stochastic Model Predictive Control for DC-Coupled Residential PV-Storage Systems
- Model Predictive Controller Utilized as an Observer for Inter-Turn Short Circuit Detection in Induction Motors
- Optimization-Based Fast-Frequency Estimation and Control of Low-Inertia Microgrids
- An MPC Based Algorithm for a Multipurpose Grid Integrated Solar PV System with Enhanced Power Quality and PCC Voltage Assist
- Optimal Virtual Power Plant Management for Multiple Grid Support Services
- Model Predictive Torque Control for Dual Three-Phase PMSMs with Simplified Deadbeat Solution and Discrete Space-Vector Modulation
- Grid congestion mitigation and battery degradation minimisation using model predictive control in PV-based microgrid
- Model-Based Predictive Rotor Current Control Strategy for Indirect Power Control of a DFIM Driven by an Indirect Matrix Converter
- Model Predictive Control for Torque Ripple Suppression Caused by Misalignment of the Gearbox
- Robust Nonlinear Economic MPC based Management of a Multi Energy Microgrid
- MPC Based Centralized Voltage and Reactive Power Control for Active Distribution Networks

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- Variable-Switching Constant-Sampling Frequency Critical Soft Switching MPC for DC/DC Converters
- Neural Network based Model Predictive Controllers for Modular Multilevel Converters

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TOMISLAV DRAGIČEVIĆ, *Guest Editor-in-Chief*
Technical University of Denmark, Demark
E-mail: tomdr@elektro.dtu.dk

ALESSANDRA PARISIO, *Guest Editor*
University of Manchester, U.K.
E-mail: alessandra.parisio@manchester.ac.uk

JOSE RODRIGUEZ, *Guest Editor*
Universidad Andres Bello, Chile
E-mail: jose.rodriguez@unab.cl

COLIN N. JONES, *Guest Editor*
EPFL Lausanne, Switzerland
E-mail: colin.jones@epfl.ch

DANIEL E. QUEVEDO, *Guest Editor*
University of Paderborn, Germany
E-mail: dquevedo@ieee.org

LUCA FERRARINI, *Guest Editor*
Politecnico di Milano, Italy
E-mail: luca.ferrarini@polimi.it

MATTHIAS PREINDL, *Guest Editor*
Columbia University, USA
E-mail: matthias.preindl@columbia.edu

QOBAD SHAFIEE, *Guest Editor*
University of Kurdistan, Iran
E-mail: q.shafiee@uok.ac.ir

THOMAS MORSTYN, *Guest Editor*
University of Oxford, U.K.
E-mail: thomas.morstyn@eng.ox.ac.uk