Enabling the Next Generation of High-Performance and Sustainable Industry by Multilevel Inverters and Model Predictive Control

Abstract: Industrial motor drives account for more than 60% of global electrical energy consumption which makes their efficiency, reliability, and intelligence critical to sustainable industrial development. As industries transition toward electrification, high-power density, and digitalization, conventional two-level inverters and classical control strategies increasingly face limitations in efficiency, power quality, scalability, and dynamic performance.

This keynote explores the transformative role of multilevel inverter (MLI) topologies combined with Model Predictive Control (MPC) in modern industrial motor drive systems. Multilevel inverters enable superior voltage quality, reduced electromagnetic stress, and higher efficiency, particularly in medium- and high-voltage applications. Meanwhile, MPC offers a flexible, constraint-aware, and optimization-based control framework that aligns naturally with the discrete switching nature of power electronic converters.

The talk will present the state of the art, highlight industrial adoption challenges, and outline future research and deployment directions, including digital twins, IoT-enhanced predictive control, and wide-bandgap semiconductor integration. The keynote aims to bridge theory and practice by providing insights for researchers, practicing engineers, and decision-makers shaping the future of industrial motor drive systems.