Control of Modular Multilevel Converters for Variable Speed Drives

Research Focus

- Energy Balancing Strategy for Variable Frequency Operation
- Model Predictive Pulse Pattern Control
- Voltage Sensor Reduction Method

Contact

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Short Description

The Modular Multilevel Converter (MMC) is a potential candidate for medium- and high-power applications, especially for HVDC transmission systems and medium-voltage drive systems. MMC allows a significant reduction in harmonic distortion in the output voltages and currents compared to traditional two- or three-level voltage-source converters. Furthermore, MMC is modular and scalable, enabling it to meet any voltage-level requirements.

State-of-the-art hierarchical controllers for MMC typically include output current control, circulating current control, and capacitor voltage control to address the multiple control objectives in this system. However, hierarchical schemes with multiple PI control loops exhibit unsatisfactory performance during transients. The Model Predictive Control (MPC) is a promising control strategy due to its fast dynamics and flexibility in incorporating multiple control objectives and system constraints. The main task of this project is to apply the MPC strategy to MMC control.

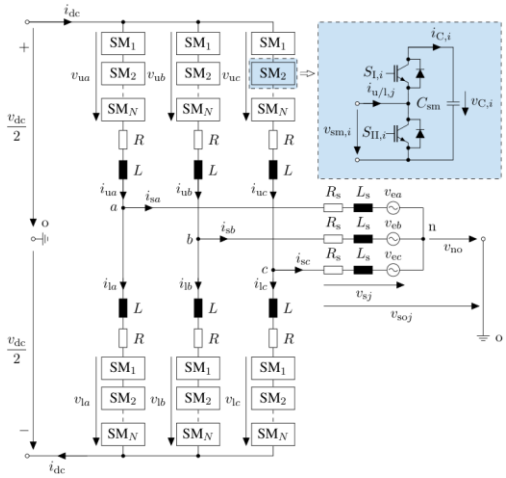

Figure: Schematic of a three-phase MMC.

Publications

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- X. Gao, W. Tian**,** Y. Pang and R. Kennel, "Model Predictive Control for Modular Multilevel Converters Operating at Wide Frequency Range with a Novel Cost Function," in *IEEE Transactions on Industrial Electronics,* vol. 69, no. 6, pp. 5569-5580, June 2022, **DOI**: 10.1109/TIE.2021.3090705.
- W. Tian**,** Y. Pang, X. Gao, Q. Yang and R. Kennel, "Computationally Efficient Optimization Method for Model Predictive Pulse Pattern Control of Modular Multilevel Converters," *2020 IEEE Energy Conversion Congress and Exposition (ECCE)*, Detroit, MI, USA, 2020, pp. 5723-5730. **DOI:** 10.1109/ECCE44975.2020.9235619.
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