A Feedforward Current Control Strategy for a MMC Based Point to Point HVDC System

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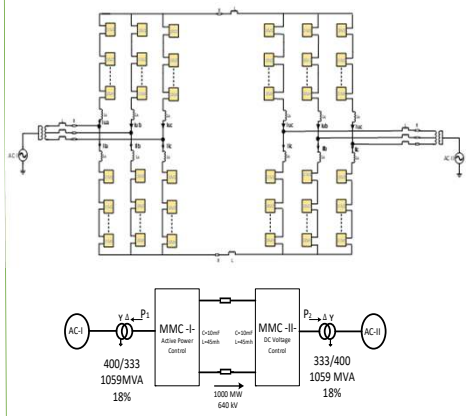
Overview

- The MMC topology is used mainly for power conversion and transmission
- Switching losses and harmonic content are lower
- The circuit configurations is modular and scalable
- Rating of components are low voltage
- Low THD output voltages with reduced dv/dt stresses
- Low di/dt of arm currents
- There is no need for passive filters on AC and DC sides

Motivation

- VSC behaves as a harmonic load from grid point of view if a proper control scheme is not implemented
- Tracking performance of PI controller is not satisfactory when they have to regulate coupled systems
- In order to improve the performance of the PI current controllers in such systems, decoupling terms $(+wLi_q, -wLi_d)$ and feed-forward terms need to be used
- Implementing the feed-forward current control scheme allows;
  - i. Not to concern about bandwidth and stability characteristics
  - ii. Less dependence on PI controllers
  - iii. Improvement on the system dynamic
  - iv. Minimizes the second harmonic in the circulating current
  - v. No negative effect on the main control algorithm
  - vi. Decreases THD in the grid currents of the converter

Model

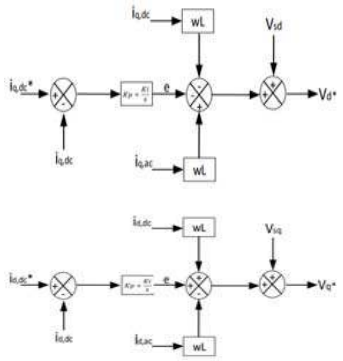


Method

- The proposed method is based on the DC and AC components of grid currents

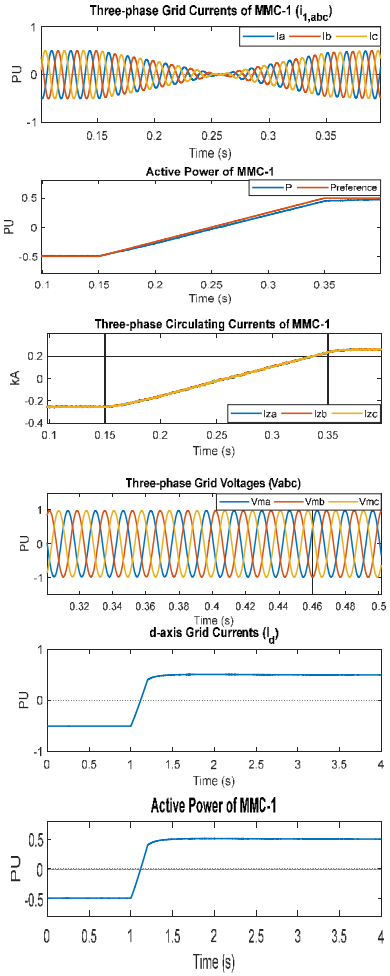
$$v_{m,s} = v_{s,d} - wL\left(i_{q,dc} - i_{q,ac}\right) - e$$

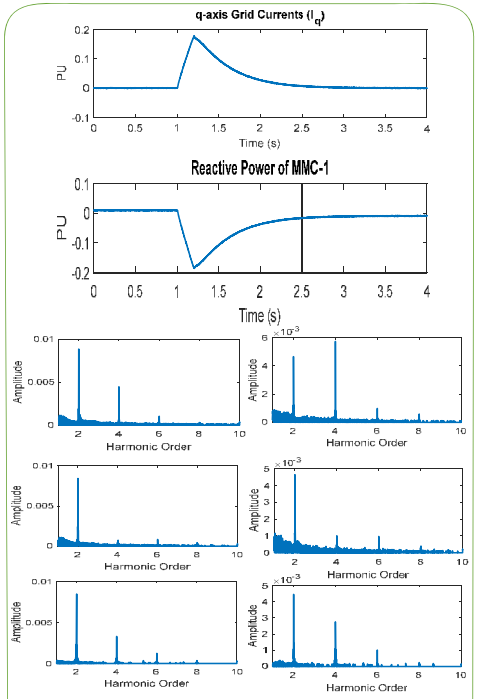
$$v_{m,d} = v_{s,q} + wL(i_{d.dc} - i_{d,ac)} + e$$



Results

- Active power reversal is applied at t=0.15s from -500 MW to 500 MW
- Reactive power remains unchanged





Conclusion

- Dynamic response of the system improves
- Proposed method reduces disturbances
- Less dependence on PI controllers
- More efficient in tracking

References

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2. Flourentzou, N., Agelidis, V. G., & Demetriades, G. D. (2009). VSC-Based HVDC Power Transmission Systems: An Overview. *IEEE Transactions on Power Electronics*, *24*(3), 592–602.