MMC Virtual Capacitor Control

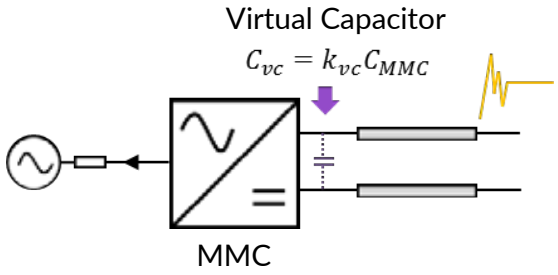
A novel concept for DC Grid Stabilization

CONTEXT

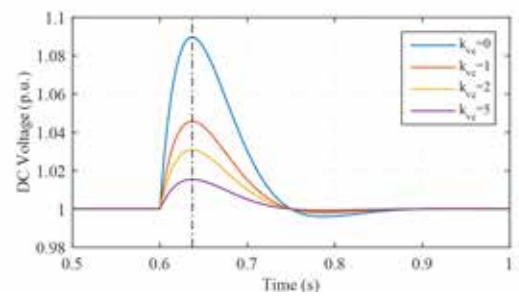
The Modular Multilevel Converters (MMCs) have emerged as the most suitable converter technology for HVDC application. Besides the recognized advantages over conventional VSCs, one of the remarkable features of the MMC is its ability to store energy in the distributed sub-modules.

In DC system, the DC voltage is the indicator of power balance as with the frequency in AC systems. In the similar sense as AC systems, the dynamics of the DC voltage is characterized by the energy stored in the form of electrostatic potential energy in the capacitors. However, compared to the conventional AC system, the system energy level of the DC system is anticipated to be far fewer than that of AC system. This implies that, without explicit control, the DC system voltage can be extremely volatile against power disturbances.

TECHNOLOGY DESCRIPTION



As a solution to this problem, we propose a novel DC voltage stability control for MMC-based HVDC system, named Virtual Capacitor Control. This control enables to virtually enhance the system inertia to mitigate the variation of the DC voltage in case of disturbances without any adverse effect on the AC system. This is achieved by making use of the energy storage capability of the MMC to emulate the dynamic behavior of a physical capacitor.



DISTURBANCE REJECTION BY VIRTUAL CAPACITOR CONTROL

APPLICATION DOMAIN

MMC control
Point to point HVDC connection
MTDC grids

ADVANTAGES

Simple system concept

Fast reaction

Easy tuning

Interoperability

TRL SCALE

1 2 3 **4** 5 6 7 8 9

Control strategy tested on small scale MMC

DELIVERABLES

Patent FR3039940 (B1) WO2017021642 (A1)
Control software implementations
Virtual mock-ups
Technical reports
Training, technical support

SCIENTIFIC REFERENCE

K. Shinoda, A. Benchaib, J. Dai, X. Guillaud, "Virtual Capacitor Control: Mitigation of DC Voltage Fluctuations in MMC-based HVDC Systems", *IEEE Transactions on Power Delivery*, 2018