



# High dynamics MMC control

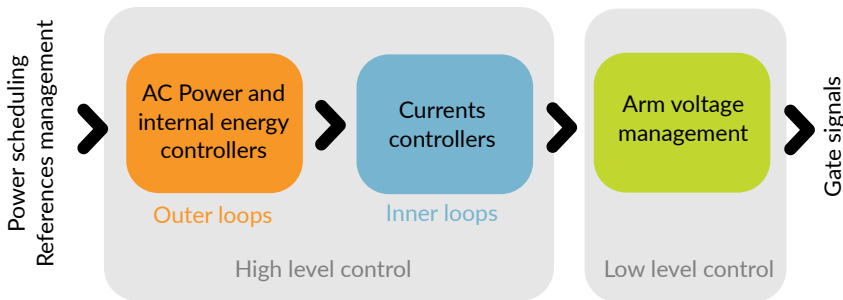
Fast, precise and robust arm currents control

## CONTEXT

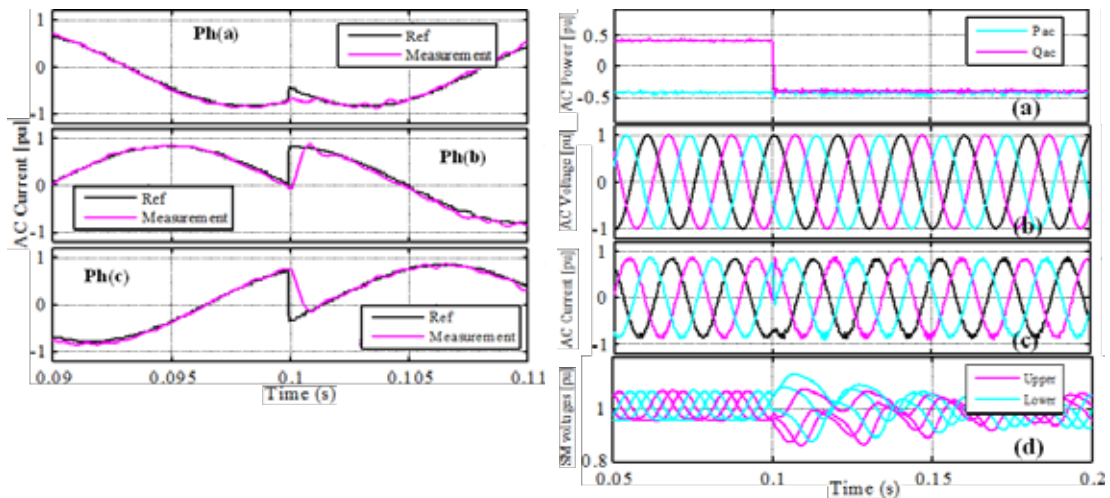
Due to its complexity, the control of Modular Multilevel Converters (MMC) constitutes an intensive research activity. The stored energy inside the MMC presents a new degree of freedom which can be exploited to provide ancillary services (oscillation damping for example). In order to do so, the response time of the energy loop has to be as low as possible. However, when a cascaded approach is used to control the structure, this purpose cannot be achieved without fast inner loops.

## TECHNOLOGY DESCRIPTION

A novel inner loops controller is proposed in order to get a high response dynamic. These controllers have been developed based on exact discrete-time models obtained from an analytic calculation of exponential of matrices. A pole placement method using feedback control is chosen to derive their control laws. For stability matters, a pole location analysis have been performed to set appropriately the controller parameters which are the sampling period and the controller gains.



EXPERIMENTAL RESULTS:  
STEP OF AC REACTIVE  
POWER SET-POINT



## APPLICATION DOMAIN

- MMC converter control
- AC/DC current control (dq reference frame)
- Arm current control (natural reference frame)

## ADVANTAGES



Fast reaction



Easy tuning



Efficient ancillary services enabler

## TRL SCALE



After validation with offline simulations, experimental tests using a real small scale MMC.

## DELIVERABLES

- Patent FR3053494 (A1) WO2018024977 (A1)
- Control software implementations
- Virtual mock-ups
- Technical reports
- Training, technical support

## SCIENTIFIC REFERENCE

A. Zama, A. Benchaib, S. Bacha, D. Frey, and S. Silvant, "High Dynamics Control for MMC Based on Exact Discrete-Time Model with Experimental Validation". IEEE Transactions on Power Delivery.