



**Master project, 2018-2019**

**Control Strategy of MMC under Unbalanced AC Grid: HIL Simulation Study**

**Supervisors :** Moez BELHAOUANE, [mohamed-moez.belhaouane@centralelille.fr](mailto:mohamed-moez.belhaouane@centralelille.fr) L2EP – Centrale Lille  
 Frederic COLAS, [Frederic.COLAS@ensam.eu](mailto:Frederic.COLAS@ensam.eu), L2EP – ENSAM  
 Xavier GUILLAUD, [xavier.guillaud@centralelille.fr](mailto:xavier.guillaud@centralelille.fr), L2EP – Centrale Lille

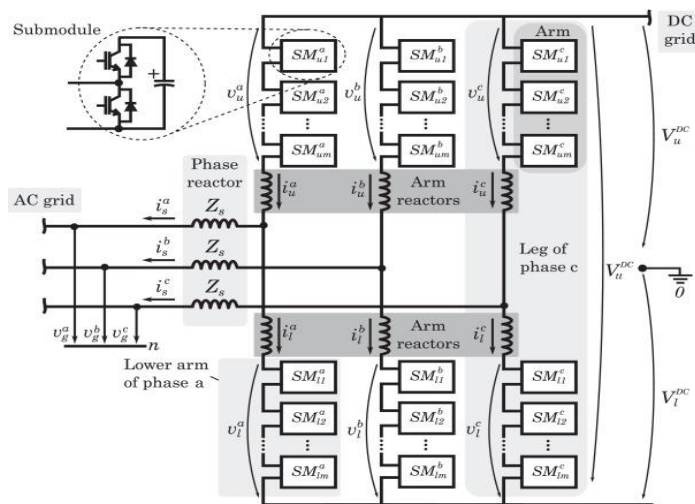
**Context**

This research project deals with analysis and control of MMC (Modular Multilevel Converter) under unbalanced AC grid. Through this study, the robustness of the high-level control of MMC connected to unbalanced AC grid will require a wide consideration. Moreover, the synchronization problem draws some attentions, for the converter operating under unbalanced grid voltage conditions. This project is in collaboration with UPC (Universitat Politècnica de Catalunya. BarcelonaTech) and related to our research activities with the French’s TSO, RTE.

**Objectives**

The main purposes of the proposed project are summarized as follows:

- Control design of MMC for High Voltage Direct Current (HVDC) application during unbalanced AC grid conditions;
- Validation on Real time simulation using RTLab and OPAL-RT tools;
- Hardware In the Loop (HIL) simulation for the validation of the proposed/studied control strategy using the DSP (Digital Signal Processor) development kit as reference DSP TMS320F28377D (Dual Core Delfino Micro Controller).



**Figure:** Overview of Modular Multilevel Converter (MMC)

## Work steps

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In order to ensure the requested work on schedule, a step-by-step methodology is proposed given by the following steps:

- Bibliographic study and consolidation based on recent published works around the considered issue;
- Steady-state and dynamics analysis of the MMC are required to identify the degrees of freedom of the studied MMC;
- Step-by-step MMC control design which enables full control of the internal dynamics of converter during unbalanced grid voltage conditions;
- Offline simulation study under Matlab/SimPowerSystem environment;
- Model development for Real time simulation and comparative study with offline simulation elaborated in the previous step;
- HIL validation of the studied/proposed control strategy.

## Keywords

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Modular Multilevel Converter (MMC), Unbalanced AC Grid, Control design, Real-time simulation, Hardware In the Loop (HIL) simulation.

## References

- [1] *Control of Modular Multilevel Converters under Singular Unbalanced Voltage Conditions with Equal Positive and Negative Sequence Components.*, E Prieto-Araujo, A Junyent-Ferré, G Clariana-Colet, O Gomis-Bellmunt. *IEEE Transactions on Power Systems*. Vol. 32 (3), 2131-2141.
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