ESR5 Activities InnoDC 2020 Autumn Meeting(Cinergia)

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Outline of the presentation



- 2 Research progress
- **3** Secondments
- **4** Covid-19 impacts

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Initial proposal (InnoDC Handbook)

- The project focuses on the design of the converter controllers required to completely balance the converter energy also considering unbalanced conditions both in the DC and AC sides. The project will develop tools to optimize the controller design and to optimize the converter passive components for different grid requirements both in the DC and AC sides.
- Tasks to be developed
 - Modelling and control of the MMC
 - Control strategies for fault conditions
 - Experimental validations
- 2 secondments (CITCEA-UPC and L2EP-Lille)

Expectations

- The PhD activities are performed both in Cinergia and UPC
- Develop tools for MMC control design for given scenarios
- Tool for converter components sizing depending on system dynamic requirements
- Experimental results to validate the models and controllers developed
- Reports and publications

Research progress

Outline of the presentation









Research progress

VSC-MMC

- The MMC has three legs (1 per phase)
- The legs have two arms (named upper and lower arms)
- Each arm consists of N sub-modules that are connected in series and can be turned on and off to synthesize a desired voltage level
- The arms can be controlled independently



Publications

Journals

 D. W. Spier, E. Prieto-Araujo, J. López-Mestre and O. Gomis-Bellmunt, "Optimal current reference calculation for MMCs considering converter limitations," in *IEEE Transactions on Power Delivery*, doi: 10.1109/TPWRD.2020.3020420.

Conferences

- D. W. Spier, J. López-Mestre, E. Prieto-Araujo and O. Gomis-Bellmunt, "Steady-State Analysis of the Modular Multilevel Converter," *IECON 2019* - 45th Annual Conference of the IEEE Industrial Electronics Society, Lisbon, Portugal, 2019, pp. 4861-4866, doi: 10.1109/IECON.2019.8927796.
- D. W. Spier, J. López-Mestre, E. Prieto-Araujo and O. Gomis-Bellmunt, "Analytic estimation of the MMC sub-module capacitor voltage ripple for balanced and unbalanced AC grid conditions", 3° Simpósio Ibero-americano em Microrredes Inteligentes com Integração de Energias Renováveis, Foz do Iguaçú, Brazil, 2019.

Current Research

Comprehensive analysis of the MMC quantities

- Exploiting novel degrees of freedom of the MMC
- Improvements in the internal power reference calculations
- Improvements in the internal energy balancing during singular AC voltage sags

Implementation of the optimal reference calculations

• Finding computationally efficient implementations of the proposed optimization problem



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Secondments

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Secondments

CITCEA-UPC

• During the secondment in CITCEA-UPC, the current research topics (presented in the previous slide) will be addressed

L2EP-Lille

- The topics to be developed are still being discussed
- The studies performed during this secondment will be validated experimentally

Covid-19 impacts

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Impacts due to the pandemic and possible mitigation

Impacts

- Limited resources are available to conduct the studies
- Reduced concentration level as the pandemic extends
- Personally attending the secondment in L2EP-Lille might be unfeasible or too risky
- Lack of personal interactions have proved to be more challenging than anticipated

Mitigation

- CITCEA-UPC and CINERGIA have provided efficient online communication platforms
- Possibility of performing the L2EP-Lille secondment virtually

Thank you for your attention