LABORATOIRE D'ELECTROTECHNIQUE ET D'ELECTRONIQUE DE PUISSANCE DE LILLE

Master project, 2023 – 2024

Deep learning-based digital twin for power converters

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Context

The Transmission System Operator (TSO) ensures efficient electrical energy transmission within the vast electrical grid, negotiating rules and conditions among stakeholders to maintain operation and service quality [1]. Recent years have seen a shift toward decarbonization in electricity production, integrating carbon-neutral sources like photovoltaic and wind power through power converters. This transition from synchronous machines to converters presents network stability challenges [2]. To provide a high-quality service, network operators must understand converter dynamics, often relying on external measurements at the connection point [3].

Objective

The objective of the internship is to develop a digital twin based on deep learning for power converters connected to the power grid. The development of this digital twin will be based on data collected from various control algorithm models for power converters.

Work steps

1 Bibliography on the subject (Power converter control, Digital twin for power converters).
2 Evaluate the control algorithms for power converters developed at the L2EP laboratory.
3 Develop new converter control algorithms using MATLAB / Simulink.
4 Generate datasets based on the developed control algorithms.
5 Utilize deep learning to develop the digital twin.

Keyword

Power grid , Power electronic converters , Power converter control , Deep learning , digital twin

References

[1] https://www.entsoe.eu/network_codes/

[2] Grid-Forming Capabilities: Ensuring system stability with a high share of renewables https://www.entsoe.eu/news/2021/04/01/grid-forming-capabilities-ensuring-system-stability-with-a-high-share-of-renewables/ - March 2021

[3] X. Wang, F. Blaabjerg and W. Wu, "Modeling and Analysis of Harmonic Stability in an AC Power-Electronics-Based Power System," in IEEE Transactions on Power Electronics, vol. 29, no. 12, pp. 6421-6432, Dec. 2014, doi: 10.1109/TPEL.2014.2306432