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

Master project, 2020-2021

Optimization of interconnected micro-grids using decomposition methods

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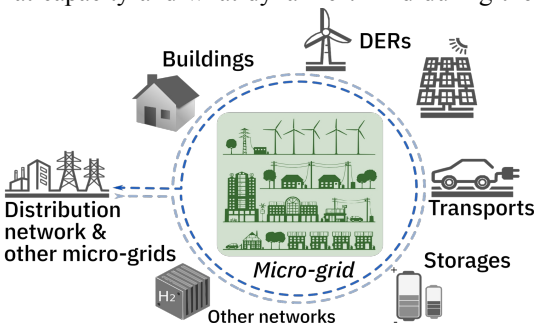
Context

Distributed energy resources (DERs) offer a useful and sustainable technology to meet the IPCC recommendations on minimizing greenhouse gas emission [1]. In order to be able to introduce DERs on the distribution network and ensure physical restrictions of the grid, such as equality between consumption and production, energy storage (ES) components are usually required, therefore, introducing more degrees of freedom in the system. As a result, two problems arise, during the initial phase: where should the storages be placed, with what capacity and what dynamic ? And during the utilisation phase: how should the storages be managed ?

The literature already proposes some responses on the local level [2], *i.e.* for one micro-grid with DER and ES for a relatively short period of time. However, we do not yet fully understand the possible interaction between micro-grids on a bigger scale.

Decomposition methods, like the Bender decomposition [3], could be useful in this context. By turning a relatively complex problem into smaller ones, which are easier and quicker to solve, these methods could ensure the global convergence of the master problem.



Objective

The project aims at optimizing the sizing and the energy management of a set of interconnected micro-grids [4] with storage (electro-chemical or thermal). It will therefore allow to better understand collaboration and competition effects between micro-grids and their effect on the performances of the whole distribution system, in terms of viability, reliability and sustainability.

Work steps

- ✔ Review the literature on decomposition methods, for linear and non-linear problems,
- ✔ Collect economic, ecological and lifespan data on a set of DERs (PV panels, wind turbines, heat-pumps, etc.) and ES (battery, thermal storage, etc.),
- ✔ Model a set of interconnected micro-grids,
- ✔ Implement and perform energy management optimization using a decomposition over a given time horizon. Compare the results with a classical approach considering independent micro-grids, and characterize the importance or inutility of collaboration and competition effects between micro-grids. Increased attention should be paid to the scalability of the proposed method.

Key words

optimisation, distribution grid, micro-grids, energy storage, sustainable development,

References

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