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Scaling management of distributed energy storage systems.

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Abstract

The management of battery energy storage systems (BESS) in order to provide energy market and / or electricity grid services comes into practice more and more. One of the next research questions is how to apply such a management to a larger number of interdependent BESS.
The study analyses possible concepts for this management as well as their computational complexity. This complexity is important to consider if a large number (e.g. 100'000) of BESS should be managed.
Two different methodologies are compared, both from the perspective of a central optimization problem. The first one models the problem as a mathematical linear optimization problem, which is a typical approach in such a context. This methodology provides quite efficiently optimal control solutions in respect to the model. However, it does e.g. not consider any uncertainty. Further, it is shown that a large number of BESS can get difficult to be optimized with reasonable computational effort.
Complicating the deterministic optimization problem by using concepts from stochastic control would be possible to address some modeling issues. However, such an approach seems to be rather excessive. Therefore, as a second methodology, a heuristic is proposed, which manages the fleet of BESS in an opportunistic way. The behavior of the BESS is represented by a simple but flexible model and the control of the individual BESS is based on a first-fit decreasing heuristic.
The poster will present and compare the methodologies regarding quality of results and computational complexity. Further, they are applied in a realistic case study. As a conclusion, one can state that the heuristics provide a computational speedup of more than 10 with a control performance of 90% of the mathematical linear program. Therefore, such heuristics are interesting candidates such applications where linear programs are not well applicable.