Master Thesis

Determining an optimal VPP pool composition based on profit maximization using Reinforcement learning

There is a significant increase in renewable generation from the distribution grid on medium and low voltage levels. The potential from these DERs for the power system is still not fully exploited, for example in the provision of ancillary services. In order to use the potential of such technologies, aggregation of multiple resources is necessary to participate in energy or balancing markets as individual participation from the DERs does not meet the minimum bidding size for these markets. Virtual power plants are one of the trending technologies for aggregating and controlling the generation of DERs (Hydro power plant, PV, Wind, etc.). However, there are many challenges to aggregate the DER power generation profiles, especially while considering simultaneous participation in multiple markets adding to the weather-dependant generation and volatility of market prices.

The aim of this thesis work is to find an optimal pool composition for a Virtual Power Plant to ensure secure provision of services by maximizing the profits from a pool composition (aggregation of DERs). A VPP pool composition is a selection problem, which involves decision-making. Machine learning methods, such as reinforcement learning, have proven to be a solution for tackling such problems. This master thesis aims at optimally combining generation from different DER technologies from different locations and of different sizes by maximizing the profit of a pool through simultaneous participation in multiple markets.

The thesis tasks should be structured as follows:

- Literature research on related topics
- Conceptual development of VPP pool composition techniques
- Problem formulation, Reinforcement learning model generation, training and validation
- Qualitative analysis of the developed concept and obtained results
- Documentation of thesis work, program codes, etc.

At the end of this thesis work, the results achieved should be presented to wider audience along with open discussions.

The thesis is available immediately to students of electrical engineering/information technology, software engineering, industrial engineering or computer science as a master thesis. Basic knowledge in the field of Artificial Intelligence, in particular machine/deep/reinforcement learning and energy systems would be an advantage, in addition to beginners experience in any programming language.

For further details and discussions, please contact:

Supervisor(s) @ie3: Kiran Nivrutti Borse, M.Sc.
kiran.borse@tu-dortmund.de
Bharathwajanprabu Ravisankar, M.Sc.
bharathwajanprabu.ravisankar@tu-dortmund.de