Karlsruhe Institute of Technology

Stochastic Optimization
Institute of Operations Research

Prof. Dr. Steffen Rebennack
Head of Stochastic Optimization

KIT-Campus Süd, 76131 Karlsruhe, Germany

Kaiserstr. 12, Building 09.21
76131 Karlsruhe

Phone: +49 721-608-44397
Fax: +49 721-608-46057
Email: steffen.rebennack@kit.edu
Web: www.sop.ior.kit.edu

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Masterthesis: Development of decentral DSM algorithms – applied stochastic optimization in cooperation with "Easy Smart Grid"

Easy Smart Grid (ESG) is a start-up in Karlsruhe developing disruptive technology to coordinate supply and demand in electric grids with a local energy market (LEM). By massively cutting the cost of information and communication technology, it allows full use of Demand Side Management (DSM) potential. By integrating flexibility of even the smallest decentral generators, consumers and storage devices, a maximum amount of volatile energy (photovoltaic, wind) can be integrated at minimum storage cost. ESG technology allows market balancing within seconds, thus creates a real time market that can complement or replace previously existing trading and flexibility segments (such as Day Ahead/Intra Day or Control Power markets).

Dynamic prices:
In our LEM, energy prices vary every second (dynamic tariffs) reflecting the balance of generation and consumption: any imbalance leads to a price update that reflects the instantaneous balance price. The benefit of such a system is twofold:

- For energy end-customers: reduced electricity bill for flexible customers.
- For the energy system: more RE can be integrated as demand adapts to generation.

The Algorithm:
An algorithm defines the operation of (e.g. household) appliances that have an inexact energy consumption cycle. The algorithms optimize the consumption behaviour of different devices (e.g. water heaters, washing machines, freezers, electric vehicles) in an environment with uncertainties (both on future energy prices and to owner behaviour impact on energy consumption). As the algorithm must be implemented in hardware with limited capacity (e.g. micro controllers of a washing machine), there should be a focus on implementation efficiency.

Scope of Master Thesis:
The student should implement the algorithm described, analysing different optimisation strategies and compare them with respect to expected performance and implementation effort. The algorithm will be implemented for selected devices in a simulation already available. If desired, the master thesis can be complemented by (paid) working student activities on further development for concrete controllers as part of an ongoing R&E project.

Please contact Professor Rebennack (steffen.rebennack@kit.edu) if you are interested or have any questions.