HEIBRIDS
Helmholtz Einstein International
Berlin Research School in Data Science

Admission Round 2019

Project Title	**Optimization of solar energy yield and specific load conditions considering electric buses in public transportation**
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Project description

With the progressing deployment of battery electric vehicles (BEV) in public transportation the peak demands of energy for loading batteries will become an essential problem since the BEV have to re-charge their batteries at some charging stations in order to overcome the range limitation. On the one hand, when generating required amounts of energy by photovoltaic systems, an effective tuning regarding the network utilization may open up degrees of freedom and, thus, cost saving and higher efficiency potentials. On the other hand, the scheduling of public transportation networks is already subject of extensive optimization approaches, which still mainly consider only cost savings for vehicle fleet operations and neglect BEV-induced requirements and stochastic aspects. Large amounts of both real-word data and data generated by stochastic simulation need to be incorporated in the new approaches for BEV-scheduling and for charging infrastructure design in order to predict and to control the future energy demand of public transport.

The energy yield of photovoltaic systems does not only depend on the available solar radiation and given outdoor conditions. Such a system is tunable to some extent. One can adapt the materials spectral response as well as the installation conditions to the needed peak loading times. From theoretical simulations and from data acquired outdoors, we aim at identifying suitable module types and mounting conditions to optimize the yield to a required load profile.

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This research topic requires an *interdisciplinary synthesis of theoretical knowledge and methods from energy systems and from information systems & data analytics research*. This dissertation project contains a *strong link to Data Science* since, in order to address the research goals, it deals with large amounts of data, such as historical and simulated data describing the BEV-charging and energy consumption in public transportation depending on different conditions (weather, traffic congestion, load) as well as data for energy yield of photovoltaic systems. Based on this real and simulated data the proposed HEIBRiDS-dissertation project will investigate optimal control strategies of solar energy yield under consideration of the specific load conditions induced by electric buses in public transportation, and otherwise, the optimal scheduling for electric vehicles and strategies for BEV-charging. The control strategies will incorporate models and methods from predictive and prescriptive data analytics. With new integrated approaches, optimizing simultaneously both processes – the energy yield and the BEV-charging/infrastructure – we expect a huge potential for cost-saving and emission reduction.

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