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FRAUNHOFER-INSTITUTSTEIL ANGEWANDTE SYSTMTECHNIK AST

MASTER THESIS
Online parameter estimation for grid-connected distributed energy resource in a digital twin model

Changing the structure of the energy systems and the high integration of distributed energy resources create a new energy system with high complexity. As a result, the difficulty of monitoring and controlling modern energy systems is highly increased. On the other hand, due to the tremendous progress in computer hardware, it became possible to build very detailed models for modern energy systems.

Such models often employ scenario analysis to investigate different assumptions about the uncertainty of the technical and economic conditions of the energy systems. However, the simulation models are approximate imitations of the physical systems and they never exactly imitate their real outputs. Therefore, it is highly necessary to calibrate the parameters of the implemented model during the system operation in order to build a digital twin of the physical model. A digital twin is a virtual representation that serves as the real-time digital counterpart of a physical object or process. In addition, digital twin is a powerful model that can be used by system designers and operators to run simulations before actual devices are built and deployed.

As a part from a digital twin the online estimation algorithms estimate the parameters of the model when new data is available during the operation of the physical system. The developed algorithms aim to overcome the negative influence of parameter mismatch on the accuracy of the digital twin model.

This work is aiming to develop an online parameter estimation algorithm that can be used to estimate the model parameters for the grid connected distributed energy resources e.g. wind and photovoltaic. The developed algorithms will be able to estimate the model parameters based on the measurement at the point of common coupling. Moreover, the estimated parameters should be updated online to minimize the error between the output of the digital twin model and the studied system.

Work procedures:
- Conduct a detailed literature review about
    - online parameter estimation approaches,
    - distributed energy resources models.
- Build a model of a benchmark grid using Powerfactory software.
- Build the benchmark model using Python.
- Implement the API interface between Powerfactory and python.
- Formulate an optimization problem that aims to minimize the model output error.
- Test the developed algorithm performance under different operation scenarios.

Requirements:
- Basic knowledge in the field of distribution networks and systems modelling.
- Good knowledge of optimization theory.
- Good Knowledge of dealing with specific program languages (Matlab and Python).

Starting time: as soon as possible
External supervisor: Dr. Mansour Alramlawi (Fraunhofer AST Ilmenau)

We would like to point out that the chosen job title also includes the third gender.

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We are particularly pleased to receive applications from motivated students. Please send us your complete and compelling application documents.
In the best case, we will soon get to know each other in person!

Questions about this position will be gladly answered by:
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