Computationally Efficient State Estimation of a Wind Turbine Model

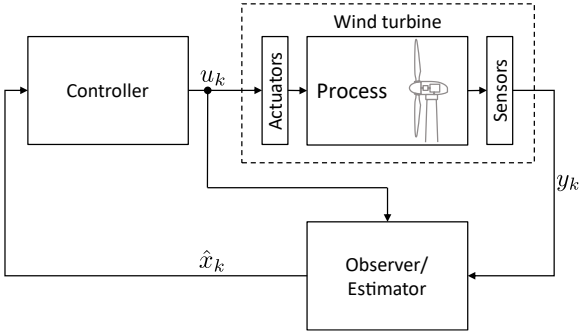
TECHNISCHE UNIVERSITÄT DARMSTADT

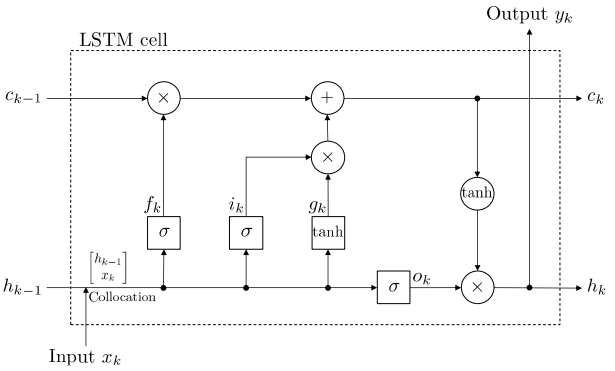
Master's Thesis

Wind turbines are highly nonlinear, dynamical systems with complex disturbances, such as varying wind speeds. In order to efficiently control such a system, modern wind turbine controllers, such as Model Predictive Controllers, need precise knowledge of the wind turbine system states. Since not all states can be measured directly, the use of state estimation techniques becomes necessary.

Within the scope of this master thesis, you will investigate the performance of different state estimation techniques for a wind turbine model [1]. The task of these estimation techniques is to reconstruct the system states of the wind turbine based on a stream of measurement data. Hereby, both classical estimator approaches, such as Kalman Filters and Moving Horizon Estimation, should be tested as well as the idea of using recurrent neural networks (e.g. LSTMs) for state estimation. The latter is a continuation of [2], where this concept was initially formulated. To compare computational efficiency of the considered estimators we employ *acados* toolbox for the MHE implementation as well as TorchScript for the inference of the trained LSTM/RNN based estimator. Additionally, pruning or quantization techniques should be investigated to determine the accuracy-performance tradeoff. If time allows, the state estimator approaches can be implemented on a microcontroller with limited computational power.

Background knowledge in the field of state estimation and neural networks is required. Experience in programming in Python/PyTorch, Matlab and C are beneficial. If you have any questions, feel free to contact us.





[1] https://github.com/jgeisler0303/CADynTurb

[2] F. Häusser. Real-time capable State Estimation for a Wind Turbine Model. Master thesis, Institute for Automation Engineering, University of Magdeburg. 2020.

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