Abstract

To reduce the carbon emissions of the building sector, renewable energy resources should be used in the future. One example of an electricity-only supply is the FUBIC district in Berlin. To reduce the operating costs, former studies implemented a model predictive controller to optimize the charging and discharging power of a battery. A special form of model predictive control is approximate control. An approximate model predictive controller uses data-driven methods like machine learning to predict the control variable based on measured data and disturbances like the weather or the energy price.

The challenge for the approximate control is to use machine learning algorithms that are real-time capable. Consequently, algorithms with low computing times and complexity, which still achieve high accuracies are preferable. In scientific literature, accuracy is commonly used as a key performance indicator for the training of machine learning methods. These models often have a high computational complexity and computing time. This bachelor thesis aims to find key performance indicators to create models that are real-time capable for approximate model predictive control applications.

In this framework, machine learning algorithms like artificial neural networks (ANN), support vector regressions (SVR), and random forests (RF) are trained and compared based on their accuracy, complexity, and computing time. To reduce the complexity and computation time, the information criteria AIC and BIC are used in the training process. In order to apply the information criteria to machine learning algorithms, the complexity parameters, which represent the complexity of the algorithm, have to be defined. In literature, no consistent definition of complexity parameters exists. That is why the definition of the complexity parameters of ANN, SVR and RF are part of this thesis' method. To measure the influence of information criteria in the training process, different training objectives are used like the regression metric R^2, AIC , BIC, and combinations of the indicators mentioned above.

In summary, the results show that the use of information criteria results in models with lower complexity and computational capacity. In addition, AIC and the combined objectives accomplish the same accuracy as a model optimized by a solely accuracy-based metric. The resulting complexity parameters and prediction times decrease by 10 % to 90 %. The transferability of the results is confirmed with a second data set of the E.ON ERC main building.

Keywords: Approximate model predictive control, Machine Learning, Model selection, Information Criterion, Complexity Reduction