Comparison of machine learning algorithms for forecasting of residential complex energy consumption

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Abstract. With the advent of building energy production and electrical/heat storage devices, forecasting user consumption patterns on the micro and medium level is becoming more important for optimization of local energy and heat generation and usage. We set up the workflow for automatic data processing in order to train and evaluate a number of prediction models for forecasting of energy consumption. Validation of models has been performed in parallel with the training process using cross-validation and cross-validation with backward feature elimination, in order to reduce the number of features used for training and to optimize the accuracy of the model.

1. Introduction

A major trend in building energy systems is the transition from simply oversizing both production and distribution (Sun, et al., 2014) to flexible and optimized energy systems. The behaviour of the buildings and its tenant then becomes more than just a disturbance variable to be counteracted by a local feedback control. Also, renewable energy production on both building and grid level leads to new business models. The timing of energy consumption becomes important beyond simple off-peak pricing systems. Furthermore, along building integrated energy storages and different approaches to demand response (DR), building energy management systems (BEMS) which balance costs and comfort are deployed increasingly (GlobalData, 2012).

To increase the performance of BEMS, especially when considering the thermal inertia of the building mass, prediction about the behaviour of both energy consumption and production of buildings is a possible option. Therefore, on the one hand, a forecast of renewable energy production is desirable, mostly in the form of solar thermal systems or photovoltaic panels. On the other hand, energy consumption by the heating, cooling and air conditioning (HVAC) as well as by the tenants' usage of electric energy and domestic hot water will help to put this forecast to good use. This is especially important because while the consumption by the tenant does not change much, the ratio increases as building quality increases, making the less predictable part much more important.

On the other hand, although the overall market for DR and BEMS is quite large, the individual benefits for a single user are still quite small (Pinson, et al., 2014). This leads to the need for automating the forecast, reducing the need for manual configuration and optimizations as much as possible, using semantic information alongside recorded data to extract as much knowledge as possible. Thus, this paper explores the various possibilities of clustering building energy consumption data, both thermal and electric, to predict the future of a large residential complex, which in turn could be used to optimize the utilization of various thermal and electric sources and storages.