FORECAST OF HIGH FREQUENCY ENERGY DATA BASED ON MACHINE LEARING APPLICATIONS

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Overview

Forecasts are a fundamental element of the energy system. In the past, the planning of the long term energy production capacity, as well as the short term use of energy production resources, was based on consumption forecasts. In the future, the interaction between consumption and production will increase in complexity due to the growing number of renewable energy resources as well as sector coupling technologies such as electric vehicles and heat pumps. Established procedures like the short term balancing of the energy system will get more critical. On the other hand, there will be new use cases such as regional energy markets and the necessity to monitor the network status in order to avoid congestions, even in lower network areas. For these use cases, a new type of forecast is essential, which delivers the information with an increased spatial and temporal resolution.

Reviewing state-of-the-art forecast techniques in academic literature we find a gap between economically and technically oriented works (see e.g. Voyant et al. 2017; Ahmed und Khalid 2019; Mullainathan und Spiess 2017; Athey 2019; Carvallo et al. 2018; Hahn et al. 2009). While economic literature often focuses on the long term development of energy consumption on a national level, there is a broad technical literature base of detailed forecast methods for renewable energies in different time horizons. In consequence, the application of machine learning approaches is underrepresented in economic literature.

Methods

We apply different approaches for the short term forecast of local energy consumption and focus on the comparison of classical time-series analysis with machine learning approaches.

In the first step, we give an overview of machine learning forecast methods and bring these in connection with other forecast techniques

Then we apply three different forecast methods, namely sARIMAX, artificial neural networks (ANN), and deep learning methods.

We build our models based on one year of hourly energy consumption data (8760 data points) of industrial consumers located in one mid-voltage network area in the middle of Germany. As exogenous data, we use 27 different weather parameters of the region with the same timestamp.

Results

We compare the models based on their accuracy, complexity, and limitations during application. First results suggest that with the growing complexity of a model, the accuracy increases. On the other hand, more complex models do not explain the correlations between input and output parameters in all terms. In every case, a large amount of data is necessary to learn robust forecast models.

Conclusions

Energy forecasts for the production of renewable energy, as well as the consumption of energy, will gain importance in the future. There are different use cases for energy forecast, but in general, a higher spatial and temporal resolution as today is necessary. We show that the application of machine learning techniques can handle a big amount of data and leads to good forecast results.

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