Deep Neural Network Regression for Short-Term Load Forecasting of Natural Gas

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Short-term load forecasting is important for the day-to-day operation of natural gas utilities. Traditionally, short-term load forecasting of natural gas is done using linear regression, autoregressive integrated moving average models, and artificial neural networks. Many purchasing and operating decisions are made using these forecasts, and there can be high cost to both natural gas utilities and their customers if the short-term load forecast is inaccurate, so energy analysts continue to explore new ways to make better forecasts.

Recently, deep neural networks (DNN) have emerged as a powerful tool in machine learning problems. DNNs have been shown to greatly outperform traditional methods in many applications, and they have completely revolutionized some fields. Given their success in other machine learning problems, we evaluate DNNs in energy forecasting.

This paper discusses good practices including architecture, input features, and transfer functions in using DNNs for short-term load forecasting of natural gas and forecasting in general. Further, it proposes a network architecture with five hidden layers and evaluates the performance of this architecture on 90 natural gas data sets. The performance of the model is evaluated using weighted MAPE and compared against several traditional forecast strategies, including artificial neural networks and linear regression short-term load forecasting strategies.

The DNN forecaster offers an average 10% decrease in weighted MAPE compared to standard ANNs and a nearly 30% decrease in weighted MAPE compared to linear regression, suggesting that DNNs are a promising option for the short-term energy load forecasting problem.