Energy Forecasting in a Pharmaceutical Manufacturing Plant

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Abstract

Several considerations are driving a need for improved energy forecasts for large scale industrial manufacturing, which include a requirement to develop more sustainable practices. Recent developments have exploited production data gathered from a large number of sensors available in most modern facilities. This study presents a case study of a pharmaceutical fed-batch fermentation production facility. The fermentation process is energy-intensive and variations in production inputs can have a significant impact on the energy demands of the facility. Process inputs include feed sugar, compressed air, chemicals and cooling water. This work presents a comparison of tree-based machine learning modelling techniques to forecast the energy demand of the facility. The methods used were a gradient boosting machine (GBM), random forest (RF) and Bagging. The models were developed using historical site production data gathered over two years. Initial work required the use of a feature selection method to reduce a large number of features available. To forecast energy demand and move beyond just fitting the historical data, the selected features future values were simulated. The simulated values were estimated from the historical sensor data and the expected process profiles. The GBM provided the best results with a MAPE of 6.49% and an error of 0.76 % between the forecast and actual energy demand.