Paper: *Empirical Mode Decomposition Based Deep Learning for Electricity Demand Forecasting*

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Summary

In the above paper, authors try to forecast the electricity demands in to meet the needs of making reliable and continuous improvements in the energy analytic systems. Since electricity is very difficult to store, forecasting it accurately would help save operational costs as well as avoid financial losses and unmet demands. Out of many machine learning algorithms, neural networks are found to be very promising however, they suffer from slow learning rates, over-fitting etc. Authors propose a hybrid model using Empirical Mode Decomposition and LSTM network to improve the model's accuracy. Statistical models like ANN have gained a lot of popularity in tackling these kind of problems as they do not require any prior physical information like the physical models. They provide the theoretical background of RNNs, LSTM as well as EMD in section 3.

The data they've used is the electricity consumption data of Chandigarh, India. For the preprocessing, they perform data cleaning, aggregation and transformation. They use K-means clustering algorithm to find out the groups of months in the electricity data that follows similar consumption patterns. Elbow method is used to determine the optimal k value. They perform analysis on different trends like monthly, daily and hourly. In order to predict the average and peak electricity demand for the season, day and time intervals they perform load characterization at two different levels: seasonal and daily/time-span. They train the LSTM network models with input_window_size of 16 and out_size of 2. The model provides support for dynamic learning as it shifts both input and output windows by two steps causing a overlap with prior windows.

For evaluation of the models, they have used RMSE and provide further results and discussion in section F. It is observed using the graphs that EMD based LSTM model does more accurate average and peak demand forecasting than other regression models. Hence, EMD based deep learning models are found to outperform other regression based models for electricity demand time series forcasting and it can be utilized to deal efficiently with non-linear features of electricity time series data as well as provide support for dynamic learning.

Strengths

- Paper provides a robust technique of improving electricity consumption prediction through the use of EMD based deep learning models.
- Ample amount of figures and tables are provided for comparison.

Weaknesses

- I think the figures and tables could have been described more in detail.
- Organization could have been made a little better.

Points of Confusion

- I am confused about the interpretation of values in table 1.
- How does increasing the k value in k-means clustering algorithm helps us decrease SSE in this case?

Discussion Questions

- Is EMD technique related to fourier transform which also decomposes a noisy signal into its individual waves?
- How does DWT algorithm work and why is it applicable in this case?
- Why does normalized values exhibit way less RMS error values when compared with un-normalized values?