ABSTRACT

Accurate prediction of electricity load demand is crucial for adequate power production planning in a region. Short-term load forecasting is essential for efficient electricity generation, avoiding energy waste, and preventing supply failures. However, accurately predicting power load remains a major challenge due to external factors such as weather and consumer industry behavior. Therefore, efficient feature selection and extraction of input data are vital to improve the accuracy of electricity load forecasting. In this paper, we propose a machine learning model, Convolutional Neural Networks (CNN) with Attention Mechanism (AM), in combination with a signal decomposition approach using Empirical Mode Decomposition (EMD). As input for the machine learning models, we propose criteria for selecting features from weather parameters and time features. Weather factors and time features, which are highly correlated with the load, are integrated as additional features in the prediction models. Moreover, we perform feature extraction using EMD to decompose the load signal into Intrinsic Mode Functions (IMFs). We propose a methodology for selecting the best IMFs—IMF-3, IMF-6, and IMF-7—which are then used as features for predicting electricity load. We choose the East Java area, Indonesia, as a study area, given its diverse daily consumer and industrial activities. By combining CNN models with the Attention Mechanism (AM) and signal decomposition EMD, we show that the models achieve high accuracy with an RMSE of 132.375, MAPE of 2.149%, and a Correlation Coefficient (CC) of 0.970. This approach improves prediction accuracy by 46% in terms of RMSE, 45% in terms of MAPE, and enhances correlation strength by 8.5% in terms of CC, compared to CNN models without feature selection and signal decomposition.

Keywords: electricity load, forecasting, weather, convolutional neural networks, attention mechanism, empirical mode decomposition