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A hybrid model based on LSTM neural networks with attention mechanism for short-term wind power forecasting

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Abstract-

Wind power plants have gained prominence in recent decades owing to their positive environmental and economic impact. However, the unpredictability of wind resources poses significant challenges to the secure and stable operation of the power grid. To address this challenge, numerous computational and statistical methods have been proposed in the literature to forecast short-term wind power generation. However, the demand for more accurate and reliable methodologies to tackle this problem remains. In this context, this paper proposes a new hybrid framework that combines a statistical pre-processing stage with an attention-based deep learning approach to overcome the shortcomings of existing forecasting strategies in accurately predicting multi-seasonal wind power time series. The proposed ensemble model involves a data transformation stage that normalizes the data distribution, along with modeling and removing multiple seasonal patterns from the historical time-series. Considering these results, the proposed model further incorporates an LSTM Recurrent Neural Network (RNN) model with an attention mechanism, for each month of the year, to better capture the relevant temporal dependencies in the input residuals sequence. The model was trained and evaluated on hourly wind power data obtained from the Spanish electricity market, spanning the period from 2008 to 2019. Experimental results show that the proposed model outperforms well-established DL-based models, achieving lower error metrics. These findings have potential applications in energy trading, grid planning, and renewable energy management.

Index Terms- Long short term memory, deep learning, wind power forecasting, attention mechanisms, time series decomposition

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