Univariable Machine Learning Model for Long-Term Offshore Wind Power Forecasting
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Introduction
For the past decades, there have been an increase in the need for alternative energy sources, and move away from fossil fuel.

Our study seeks to do the following:
- Develop machine learning models to accurately predict offshore wind power production in short and long term.
- Compare the performance of different models on univariable and datasets.
- Select the best performing model from results of the tests and fine-tune the model.
- Use insights gained from the selected model to guide schedule maintenance and repair planning.

Methods
Our study employed the following approach:
- Collect wind turbine data, clean and pre-process.

Results
- Build and train a univariable LSTM and Random Forest models on the processed data.
- Hyperparameter tuning to increase model forecast accuracy.
- Evaluate performance of each model and compare results using 3 evaluation metrics:
- SMAPE: The symmetric mean absolute percentage error.
- RMSE: The root-mean-square error.
- R^2: The coefficient of determination.

Results - 10 min
- Actual vs Predicted for 10 min LSTM Univariable
- Actual vs Predicted for 10 min Random Forest Univariable

Evaluation Metrics

<table>
<thead>
<tr>
<th>Model</th>
<th>SMAPE</th>
<th>RMSE</th>
<th>R^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSTM 10 min 5 epoch</td>
<td>55.23%</td>
<td>51.87</td>
<td>0.999</td>
</tr>
<tr>
<td>LSTM 10 min 15 epoch</td>
<td>60.94</td>
<td>47.97</td>
<td>0.999</td>
</tr>
<tr>
<td>LSTM 10 min 20 epoch</td>
<td>60.94</td>
<td>47.97</td>
<td>0.999</td>
</tr>
<tr>
<td>Random Forest 10 min</td>
<td>56.2</td>
<td>227.696</td>
<td>0.989</td>
</tr>
<tr>
<td>LSTM 30 min 5 epoch</td>
<td>64.46</td>
<td>215.383</td>
<td>0.987</td>
</tr>
<tr>
<td>LSTM 30 min 15 epoch</td>
<td>63.81</td>
<td>215.272</td>
<td>0.989</td>
</tr>
<tr>
<td>LSTM 30 min 20 epoch</td>
<td>64.64</td>
<td>233.43</td>
<td>0.987</td>
</tr>
<tr>
<td>Random Forest 30 min</td>
<td>69.53</td>
<td>525.499</td>
<td>0.929</td>
</tr>
</tbody>
</table>

Results - 30 min
- Actual vs Predicted for 30 min LSTM Univariable
- Actual vs Predicted for 30 min Random Forest Univariable

Discussion
- Built and trained univariable LSTM and Random Forest to predict short and long term.
- Fine tune both models which resulted in an overall increase in forecasting results.
- From results obtained so far, the LSTM model produced the best results for both 10 and 30 min predictions.

Future Work
Build a multivariable models using LSTM and Random Forest and compare the models to univariable using different metric errors.

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