Reproducibility Report:
"Wavelet Decomposition and Neural Networks—A Potent Combination for Short Term Wind Speed and Power Forecasting"

Version 1: March 4. 2023

1. Computer and software environment

Hardware and Operating System:
Any operating system capable of installing R software and Python (Windows/MacOS/Ubuntu etc.) with a recommended RAM of 16 GB or above.

Software used:
R version 4.1 (https://www.R-project.org/)
Python version 3.7 (https://www.python.org/)

Required R package:
DSWE version 1.5 or above available on CRAN and GitHub
(https://github.com/TAMU-AML/DSWE-Package)

Required Python packages:
PyWavelets version 1.1 (https://pywavelets.readthedocs.io/en/latest/)
TensorFlow version 2.1 (https://www.tensorflow.org)
PyTorch version 1.8 (https://www.pytorch.org)

2. Data files

Dataset	File names	Description
#1	dataset_1.csv	Dataset-1 containing wind speed, wind direction, first and second derivatives of wind speed, wind power, first and second derivatives of wind power for 36 wind turbines.
#2	dataset_2.csv	Dataset-2 containing wind speed, first and second derivatives of wind speed, wind power, first and second derivatives of wind power for 160 wind turbines.
#3	dataset_3.csv	Dataset-3 containing wind speed, first and second derivatives of wind speed for 100 wind turbines.
#4	dataset_3_meta.csv	Dataset-3 meta data containing turbine number, site ID, latitude, and longitude for 100 wind turbines.

3. Explanation of the headers of the data files

Header name	Meaning
Time	Timestamp of the data collection.
Turbine[t]_Speed	10-min average of wind speed observed, in units of m/s.
Turbine[t]_Direction	10-min average of wind direction observed, in units of degrees.
Turbine[t]_D1Speed	10-min average of the first derivative of wind speed observed, in units of m/s.
Turbine[t]_D2Speed	10-min average of the second derivative of wind speed observed, in units of m/s.
Turbine[t]_Power	10-min average of active power output.
Turbine[t]_D1Power	10-min average of the first derivative of active power output.
Turbine[t]_D2Power	10-min average of the second derivative of active power output.

Where [t] is the number of the turbine. For instance, Turbine5_Speed is the wind speed measured at Turbine 5.

4. Reproducing the results in the paper

Code File	Results to Reproduce	Required Data	Output
table1.py	Table 1	dataset_2.csv	table1a.csv (MAEs) table1b.csv (wavelet averages) table1c.csv (k averages) These files are combined in a spreadsheet to produces Table 1.
wdnn_1_s_ffnn.py wdnn_1_s_rnn.py wdnn_1_s_lstm.py table2.py	Table 2	dataset_1.csv	table2.csv Averages are computed on a spreadsheet.
wdnn_[d]_s_ffnn.py wdnn_[d]_s_rnn.py wdnn_[d]_s_lstm.py table3.py	Table 3	dataset_1.csv dataset_2.csv dataset_3.csv	table3.csv
wdnn_[d]_p_ffnn.py wdnn_[d]_p_rnn.py wdnn_[d]_p_lstm.py table4.py	Table 4	dataset_1.csv dataset_2.csv	table4.csv
table5.py	Table 5	All files generated while obtaining Tables 3 and 4.	table5.csv
per.R df_s.py stan_[d]_s.py wdnn_[d]_s_ffnn.py pstn_s.py table6.py	Table 6	dataset_1.csv dataset_2.csv dataset_3.csv dataset_3_meta.csv	table6.csv

table7.py	Table 7	All files generated while obtaining Table 6.	table7.csv
table8.py	Table 8	All files generated while obtaining Table 6.	table8.csv
df_p.R stan_p.R wdnn_p.R wdnn_1_p_ffnn.py wdnn_2_p_ffnn.py table9.py	Table 9	dataset_1.csv dataset_2.csv All files generated while obtaining Table 6.	table9.csv
table10.py	Table 10	All files generated while obtaining Table 9.	table10.csv

For dataset_1.csv, [t] range: 1 to 36
For dataset_2.csv, [t] range: 1 to 160
For dataset_3.csv, [t] range: 1 to 100
[d] (dataset) range: 1 to 2 for speed and 1 to 3 for power.
[h] (time horizon) range: 1 to 12 unless otherwise specified.

Note:
It is strongly advised to execute the code files in the order in which they are presented in the table above.

Other than the files named *table[x].py* or *table[x].R*, most of the code files require intensive computation (time and resource). In our research, we executed these files using the computing resources of Texas A&M University High Performance Research Computing (HPRC). Some required at least 48 hours to run in the HPRC using 24G memory.