

# Reproducibility Report:

## “Analysis of Leading-Edge Protection Application on Wind Turbine Performance Through Energy and Power Decomposition Approaches”

### 1. Computer and software environment

Hardware and Operating System:

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

Software used:

R (<https://www.R-project.org/>)

Required R package:

DSWE version 1. 5 or above available on CRAN as well as at the Github site at:

<https://github.com/TAMU-AML/DSWE-Package>

### 2. The data files (these data files are under an NDA and cannot be made public at this moment)

Data set explanation	Data names
T1 SCADA data	Data_T1_Part1.csv; Data_T1_Part2.csv; Data_T1_Part3.csv
T2 SCADA data	Data_T2_Part1.csv; Data_T2_Part2.csv; Data_T2_Part3.csv
T3 SCADA data	Data_T3_Part1.csv; Data_T3_Part2.csv; Data_T3_Part3.csv
T4 SCADA data	Data_T4_Part1.csv; Data_T4_Part2.csv; Data_T4_Part3.csv
T5 SCADA data	Data_T5_Part1.csv; Data_T5_Part2.csv; Data_T5_Part3.csv

### 3. Explanation of the header of the data files

Header name	Meaning
Timestamp	Time stamp of the data collection.
ActivePower	10-min average of active power output, in unit of kW.
Windspeed	10-min average wind speed, in unit of m/s.
Windspeed_dev	10-min standard deviation of wind speed, in unit of m/s.
PtAngle	10-min average of blade pitch angle, in degrees.
Temp	10-min average ambient temperature, in unit of °C.
WD	10-min average of wind direction, in degrees.
WD_dev	10-min standard deviation of wind direction, in degrees.
Rotorspeed	10-min average of rotor speed, in rotation per minute (RPM)
TI	Calculated turbulence intensity; the ratio of wind speed deviation and wind speed average.
Impower	The active output (in kW) after imputation. Under this header, invalid power values (negative) were replaced with predicted values.

#### 4. Reproducing the results in the paper

Code File	Which results to reproduce	Required Data	Output
01 Table III.R	Table III	T1 – T5 SCADA data	Table III (in csv file named <i>Table_III.csv</i> )
N/A	Figure 5	Take the values from the right side of Table III, under the header “Weighted statistical power difference”	Manually plot Figure 5 using MS Excel
02 Figure 6_the numbers.R	Figure 6 (in numbers)	T2 SCADA data <i>Binning.R</i>	The numbers for constructing Figure 6 (in csv file named <i>Table_Figure6.csv</i> ) It also provides an extended table for all turbines if one wishes to see the patterns for all.
03 Table IV.R	Table IV	T1 – T5 SCADA data	Table IV (in csv file named <i>Table_IV.csv</i> )
04 Data Imputation and Synchronization.R	Intermediate result	T1 – T4 SCADA data	<i>Imputed.RData</i> It provides imputed values for invalid power and it is used for generating Table V – Table VIII.
05 GP Power Curve Model.R	Intermediate result	<i>Imputed.RData</i>	<i>Rep_GP5.RData</i> It provides tempGP models for T1 – T4 data (Period 3 and Period 4). This RData file is used for generating Table V, Table VII, Table VIII.
06 Table V.R	Table V	<i>Imputed.RData</i> <i>Rep_GP5.RData</i>	Table V (in csv file named <i>Table_V.csv</i> )
07 Table VI.R	Table VI	<i>Imputed.RData</i>	Table VI (in csv file named <i>Table_VI.csv</i> )
08 Table VII and VIII.R	Table VII, Table VIII	<i>Imputed.RData</i> <i>Rep_GP5.RData</i>	Table VII and Table VIII (in csv file named <i>Table_VII.csv</i> and <i>Table_VIII.csv</i> )
09 Table IX.R	Table IX	<i>Imputed.RData</i>	Table IX (in csv file named <i>Table_VI.csv</i> )
Figure 7.R	Figure 7	<i>Imputed.RData</i>	<i>Figure7.pdf</i>
Figure 8.R	Figure 8	<i>Imputed.RData</i>	<i>Figure8.pdf</i>
N/A	Figure 10	<i>Table VI</i> and <i>Table VII</i>	Figure 10 in spreadsheet
Figure 11.R	Figure 11	<i>Imputed.RData</i>	<i>Figure11.pdf</i>

Note:

Code “04 Data Imputation and Synchronization.R” and “05 GP Power Curve Model.R” require intensive computations (time and resource). In our research, we executed these two using a high performance computing of Texas A&M University (HPRC). Each required at least 50 hours to run in the HPRC using 48G memory.