Turbine erosion analysis

This README describes the data package that you have in front of you.

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Research hypothesis, design and method

The `turbine_erosion_analysis.pdf` file -- a PDF document in which you can see computer code along with its output and documentation -- tries to answer the following question:

Can we see that the turbines are generating less energy in comparable external conditions if time progresses?

To answer this question, the following data sources where used:

1. SCADA data from three turbines (anonimized)
2. Dutch Offshore Wind Atlas
3. Experts from the organization that operates the turbines (anonimized)

The notebook can be read from top to bottom. In summary: the data is read, merged, cleaned and prepared for training of two machine learning models. Those models are then trained and evaluated. Lastly, the conclusions and further avenues of research are expanded upon.

Raw data

Raw data in the strict sense of the words cannot be found in this package: it is too sensitive to share. An anonimized version of the data can be found in the `processed_data` folder.

anonimized_turbine_data.csv

Introduction

CSV file with SCADA data of three turbines in the Netherlands.

Methodological information

The data was gathered using the SCADA system present in the turbines. At set times (in this case: every 10 minutes), the system reports the sensor states if those can be reported.

Data specific information

The file contains 55 columns and 473040 rows. All have headers that indicate the unit of measurement. Most column headers explain themselves well. Together with domain experts it was decided to use the following columns, since those are the only ones capable of giving a true indication of possible erosion. Missing data is denoted by an empty cell.

Column	Explanation
turbineId	The numerical ID of a turbine. Either 1, 2 or 3
DateTime	Date and time of the measurement. Format YYYY-MM-DD HH:MM:SS
Blade angle	The angle of the blade. 0° means that the blade runs perpendicular to the turbine itself. 90° means that the blade is exactly in line with the turbine: it will cause the rotor to stand still
Rotor speed	How many full turns a blade makes in 60 seconds
Energy export	The generated electricity in kWh since the last measurement
Wind direction	The direction in degrees of the wind. 0° is north, 180° is south. Measured by an anemometer on the nacelle so turbulence will affect the measurements
Wind speed	How fast the air moves past the blades in meters per second. Measured by an anemometer on the nacelle so turbulence will affect the measurements

dowa-2008-2018-hourly.csv and dowa-2018-2019-hourly.csv

Introduction

CSV files with data from the Dutch Offshore Wind Atlas for the coordinates of the turbines. All measurements are at 60 meters above sealevel. As can be read from the filenames, the data for 2018 is in a different file than the data for 2017.

Methodological information

Please refer to https://www.dutchoffshorewindatlas.nl/

Data specific information

The files contain 4 columns and 87673 (2008-2018) or 8761 (2018-2019) rows. There are no missing data.

Column	Explanation
DateTime	Date and time of the measurement. Format YYYY-MM-DD HH:MM:SS
Wind speed	How fast the air moves in meters per second
wdir (deg)	The direction in degrees of the wind. 0° is north, 180° is south
air pressure (Pa)	The air pressure in Pascal

Computer code

Can be found in `turbine_erosion_analysis.ipynb`. This is a Jupyter Notebook that can be run on any computer with Python 3.