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Detection of Nacelle Anemometers Faults in a Wind Farm

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Extended Abstract. Control of wind farms requires the acquisition of accurate wind speed data. Nevertheless there is no system able to control the small, long-term degradation of data registered by anemometers installed in wind turbines. In this report we have developed a method to evaluate the quality of the wind speed measurements with the minimum uncertainty. This evaluation is made comparing the data from anemometers of the whole wind farm to detect its degradation and other anemometer faults.

The main idea is to estimate the wind speed data in the target wind turbine using the wind speed data of other wind turbines and, with these estimations, use the data range with the lowest wind speed deviation uncertainty to control the anemometer performance.

To carry out the selection of the reference wind turbines we have calculated the correlation between every wind turbine based in historic filtered data. This election is due to the more correlation coefficient between anemometers there is, the less wind speed deviation exist [1].
To estimate the wind speed deviations a linear regression model is considered for each direction sector, in a similar way to the Measure-Correlate-Predict (MCP) algorithm that is usually used in the wind industry to predict mean wind speed characteristics [2]. However a new factor has been introduced since an underestimation exists in the uncertainty determination because consecutive data cannot be considered independent [3] [4]. In order to evaluate the global deviation a factor, which accumulates the speed deviation for a period of time, is computed. It allows the detection of problems in the anemometer performance, including long-term deviations, and even if they are small.

However, some speed ranges must be eliminated due to its low quality. The deviation value has different uncertainty depending on the wind speed data range used for the calculation process. On the other hand the less data are used, the more uncertainty we have.
In this paper, the uncertainty of the method is computed in function of the data range, finding the speed ranges that introduce the minimum uncertainty in the deviation factor. The study shows that the deviation has lower uncertainties when we works with wind speed data greater than 4 or 5 m/s.

In this way if the target anemometer has a high deviation from the closest reference anemometers a problem with his performance is considered. To control the deviation an acceptable maximum value of deviation to determine if the anemometer performance is correct has been introduced.

With this information it is possible to make a new calibration or a substitution if it's necessary, allowing a better control of maintenance faults of wind turbines. The method has been tested using real data from 53 turbines in a wind farm and the results are promising.

Key words
wind speed estimation, anemometer degradation, wind power systems, uncertainty propagation, wind farm maintenance.

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