Wind turbine fault detection by normal behaviour modelling [Poster]

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# Wind Turbine Fault Detection by Normal Behaviour Modelling

## INTRODUCTION
Up-scaling and significant technology improvements have reduced wind energy costs in the last decades. Operational costs, where the fuel is effectively ‘free’, are dominated by maintenance actions. Unscheduled maintenance particularly offshore results in high costs as accessibility is restricted by weather and availability of vessels. Advanced maintenance strategies based on actual condition rather than using corrective or preventive maintenance can reduce these costs. Evaluation of operational data recorded by the Supervisory Control And Data Acquisition (SCADA) system of a wind turbine shows promise for the purposes of condition monitoring as the cost of additional sensors is avoided.

## METHODS
The temperature of drive train components such as bearings or gearbox is proportional to power output. If the relative temperature increases, the performance of the part is altered [1]. Normal Behaviour Modelling can reveal hidden trends in temperature signals by modelling the target value with additional information for normal operating conditions. The residual of measured minus modelled temperature can indicate changes in performance and potentially imminent failures.

Normal Behaviour Modelling of a bearing temperature with Neural Networks is evaluated in a case study with SCADA data from a US wind farm with 1.5 MW turbines. The model is trained and validated with 7,500 samples (52 days) and blind tested with 10,000 additional samples.

## RESULTS
The Neural Network model performs with a root mean square error of 2.14 degrees Celsius for testing under normal conditions. Figure 1-3 shows the performance of the model showing example outputs, residuals and the distribution of the residuals.

## DISCUSSION
Using Neural Networks for Normal Behaviour Modelling of drive train temperatures delivers good accuracy in this case study. Further filtering of the residuals will help to remove outliers and detect underlying trends.

## FUTURE WORK
Different approaches for Normal Behaviour Modelling will be evaluated in this project. After testing the modelling of normal conditions, the focus will be on failure detection with new case studies including failure events.