Popular Scientific Abstract

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Abstract

Along with the growing energy demand of modern society, the renewable energy generation becomes more important. Wind energy has shown to be an energy source suited for the task. However, as the number and size of wind turbine increase, and siting is moved offshore, the operation and maintenance cost attracts more and more attention to keep wind power competitive to other energy generating sources. In order to increase reliability, availability, and ultimately reduce unnecessary downtime monitoring wind turbine and wind farm performance as well as early fault detection and prediction is highly desirable. As such, research has been focused on condition motoring and maintenance theories. This dissertation focuses on the former, by utilizing historical data in form of Supervisory Control and Data Acquisition (SCADA) data and turbine logs.

As most turbines are equipped with SCADA systems, performance can be evaluated online. Since the condition monitoring is highly data driven the corpus of this dissertation focuses on the statistical analysis. It is shown that performance indicators are able to detect changes in the performance of a wind turbine.This indicators can be associated with the normal operation, down rated operation or failure of a wind turbine. The overall performance of a wind farm can in this way be assessed on both daily, weekly and monthly time scales.

The goal of predicting critical faults is placed in a conditioned statistical framework, where models for both the dependency and independent between different turbine states are developed and evaluated. In general, it has been shown that including dependency between states of a wind turbine yield better predictive results. This approach has shown to be applicable when implemented on wind turbine bearing temperature residuals from a neural network model and was able to predict a critical bearing failure in the order of months before its occurrence

This dissertation is concluded by a remark on dimensionality reduction, especially through the analysis of eigenvalues. Here the focus is paid to the distribution eigenvalues of a correlation matrix build from extensive sensor measurements of a wind turbine.

The developed approaches hold close ties to machine learning. It is further believed that the formulated approaches are general and generic enough to be applied in other fields than wind turbine monitoring.