Moving from Traditional SCADA Monitoring to Algorithm Monitoring

Chris Dømgaard
KK Wind Solutions

Abstract

Even well-running turbines experience problems once in a while. The question therefore is how turbine owners can predict turbine errors and avoid consequential production loss and costly unplanned service visits.

By moving from traditional SCADA monitoring to algorithm monitoring based on real-time turbine data, turbine errors can be detected before they result in wind turbine stop so predictive maintenance can be performed which in turn increases availability and lower costs.

Traditional SCADA:
- Human interpretation of data
- Reactive approach
- Individual sensors
- Threshold-based monitoring
- No utilization of system knowledge

Algorithm Monitoring:
- Algorithm monitoring based on data
- Proactive approach
- Combining sensors
- Condition-based monitoring
- Utilizing statistics and mathematical models including system knowledge

Methods

The work is divided into two main topics the one is the software platform which is an extension to a traditional SCADA system and the other part is the algorithms used to predict wind turbine stops to monitor main components based on existing sensors or add-on sensors for specific purposes.

The mathematical method used is data driven, since in most cases the component parameters are not available from the supplier or the OEM. Several methods from machine learning and statistics, has been used to predict failures. This includes autoregressive models, static models, etc.

Results

The algorithms has been designed and tuned on 1-2 years of operational data and verified on 3-4 years of historic data. It has been found that data driven models can obtain sufficient accuracy to detect main component failures.

Health monitoring

From a predicted e.g. temperature of the component a residual is calculated and based on that a component health value and alarm trigger is handled.

After the prediction algorithms has been applied for more than ½ a year the results show that a number of fast evolving failures could be detected in due time for the service crew to repair the wind turbine components before it result in an unwanted wind turbine stop.

Moreover, slower evolving failures/wear could be detected well before wind turbine stop enabling shifting from unplanned service to planned service.

Case: Transformer cooling failure

A comparison of measured and modelled transformer temperature revealed a component failure approx. 12 hours before a wind turbine stop. Not until the temperature limit was reached 12 hours later it was detected by the wind turbine controller. The below figure shows an algorithm detecting the failure.

Conclusions

It has been found that predictive algorithms based on statistical methods and simple static models as well as machine learning methods are applicable for designing robust prediction and detection algorithms on wind turbines.

Also it has been found that existing 10 min values existing on most wind turbines are valuable for monitoring and predicting failures on a large part of the wind turbine sub systems and components and especially for system with medium to large time constants.

The work has also shown that using a platform solution consisting of a basic layer dealing with all software and database complexity and an algorithm layer with focus on modelling combined with wind turbine knowledge enables fast implementation of robust and working algorithms.

Meet us at booth 1D74

windEurope.org/confex2017
#windEurope2017