Wind turbine condition monitoring based on SCADA data using normal behavior models - DTU Orbit (24/06/2018)

**Wind turbine condition monitoring based on SCADA data using normal behavior models: Part 1: System description**

This paper proposes a system for wind turbine condition monitoring using Adaptive Neuro-Fuzzy Interference Systems (ANFIS). For this purpose: (1) ANFIS normal behavior models for common Supervisory Control And Data Acquisition (SCADA) data are developed in order to detect abnormal behavior of the captured signals and indicate component malfunctions or faults using the prediction error. 33 different standard SCADA signals are used and described, for which 45 normal behavior models are developed. The performance of these models is evaluated in terms of the prediction error standard deviations to show the applicability of ANFIS models for monitoring wind turbine SCADA signals. The computational time needed for model training is compared to Neural Network (NN) models showing the strength of ANFIS in training speed. (2) For automation of fault diagnosis Fuzzy Interference Systems (FIS) are used to analyze the prediction errors for fault patterns. The outputs are both the condition of the component and a possible root cause for the anomaly. The output is generated by the aid of rules that capture the existing expert knowledge linking observed prediction error patterns to specific faults. The work is based on continuously measured wind turbine SCADA data from 18 turbines of the 2 MW class covering a period of 30 months.

The system proposed in this paper shows a novelty approach with regard to the usage of ANFIS models in this context and the application of the proposed procedure to a wide range of SCADA signals. The applicability of the set up ANFIS models for anomaly detection is proved by the achieved performance of the models. In combination with the FIS the prediction errors can provide information about the condition of the monitored components.

In this paper the condition monitoring system is described. Part two will entirely focus on application examples and further efficiency evaluation of the system.

**General information**

State: Published
Organisations: Department of Mechanical Engineering, Solid Mechanics, Ecole Polytechnique de Montreal
Authors: Schlechtingen, M. (Intern), Santos, I. (Intern), Achiche, S. (Ekstern)
Pages: 259-270
Publication date: 2013
Main Research Area: Technical/natural sciences

**Publication information**

Volume: 13
ISSN (Print): 1568-4946
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 2.006 SJR 1.199 CiteScore 4.81
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.29 SJR 1.262 SNIP 2.119
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.44 SNIP 2.275 CiteScore 4
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.592 SNIP 2.809 CiteScore 4.29
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.503 SNIP 2.671 CiteScore 4.06
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.129 SNIP 2.371 CiteScore 3.48
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.251 SNIP 3.528 CiteScore 4.65
ISI indexed (2011): ISI indexed yes