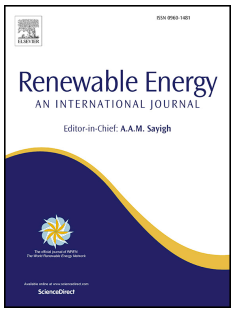
Accepted Manuscript



Analysing wind turbine fatigue load prediction: The impact of wind farm flow conditions

Luis Vera-Tudela, Martin Kühn

PII: S0960-1481(17)30075-7

DOI: 10.1016/j.renene.2017.01.065

Reference: RENE 8504

To appear in: *Renewable Energy*

Received Date: 22 January 2016

Revised Date: 16 January 2017

Accepted Date: 30 January 2017

Please cite this article as: Vera-Tudela L, Kühn M, Analysing wind turbine fatigue load prediction: The impact of wind farm flow conditions, *Renewable Energy* (2017), doi: 10.1016/j.renene.2017.01.065.

Analysing wind turbine fatigue load prediction: The impact of wind farm flow conditions

Luis Vera-Tudela[a,*], Martin Kühn[a]

[a]*ForWind - Carl von Ossietzky University of Oldenburg, Küpkersweg 70, 26129 Oldenburg, Germany*

Abstract

Lifetime evaluation with fatigue loads is commonly used in the design phase of wind turbines, but rarely during operation due to the cost of extra measurements. Fatigue load prediction with neural networks, using existing SCADA signals, is a potential cost-effective alternative to continuously monitor lifetime consumption. However, although assessments for turbines in wind farm flow have been pointed out as deficient, the evaluations were limited to single cases and the implication for the design of a monitoring system was not discussed. Hence, we proposed metrics to evaluate prediction quality and, using one year of measurements at two wind turbines, we evaluated predictions in six different flow conditions. The quality of fatigue load predictions were evaluated for bending moments of two blades, in edgewise and flapwise directions. Results, based on 48 analyses, demonstrated that prediction quality varies marginally with varying flow conditions. Predictions were accurate in all cases and had an average error below 1.5 %, but their precision slightly deteriorated in wake flow conditions. In general, results demonstrated that a reasonable monitoring system can be based on a neural network model without the need to distinguish between inflow conditions.

Keywords: wind turbine, wake effects, fatigue damage, lifetime extension, condition monitoring, neural networks

*Corresponding author
Email address: luis.vera.tudela@forwind.de (Luis Vera-Tudela)