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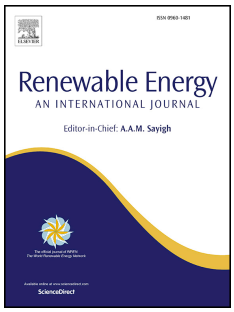

An integrated approach for wind turbine gearbox fatigue life prediction considering instantaneously varying load conditions

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An integrated approach for wind turbine gearbox fatigue life prediction considering instantaneously varying load conditions

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Abstract

Wind power is a significant clean energy source. Operation & maintenance (O&M) costs account for about 25% of the cost of wind power, and it is critical to improve the reliability of wind power generators to reduce the overall cost and increase wind power competitiveness comparing to other power sources. Wind turbines are subject to instantaneously varying load due to wind turbulence, which challenges the prognostic study for predicting equipment future health conditions and remaining useful lives. With existing prognostics methods, the average constant load is typically used to approximate the varying external load. In this paper, an integrated varying-load approach is proposed for predicting wind turbine gearbox remaining useful life by specifically considering instantaneously varying external load, which is more realistic. Fatigue crack damage is focused on. The method integrates gear physical models and available health condition data, and the distribution of uncertain material parameter modeled in crack degradation process is updated via Bayesian inference once new health condition data become available. Examples are provided to demonstrate the effectiveness of the proposed varying-load approach. A comparative study is conducted between the proposed approach and existing constant-load approximation method, and the results show that the proposed varying-load approach can provide more accurate prediction.

Keywords*: wind power, integrated prognostics, time-varying load, gear tooth crack propagation*

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