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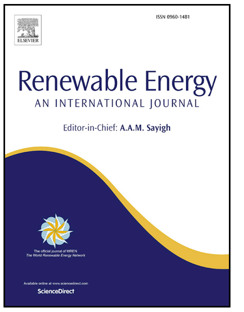

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Detection of Natural Crack in Wind Turbine Gearbox

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Abstract

One of the most challenging scenarios in bearing diagnosis is the extraction of fault signatures from within other strong components which mask the vibration signal. Usually, the bearing vibration signals are dominated by those of other components such as gears and shafts. A good example of this scenario is the wind turbine gearbox which presents one of the most difficult bearing detection tasks. The non-stationary signal analysis is considered one of the main topics in the field of machinery fault diagnosis. In this paper, a set of signal processing techniques has been studied to investigate their feasibility for bearing fault detection in wind turbine gearbox. These techniques include statistical condition indicators, spectral kurtosis, and envelope analysis. The results of vibration analysis showed the possibility of bearing fault detection in wind turbine high-speed shafts using multiple signal processing techniques. However, among these signal processing techniques, spectral kurtosis followed by envelope analysis provides early fault detection compared to the other techniques employed. In addition, outer race bearing fault indicator provides clear indication of the crack severity and progress.

1. Introduction

Wind energy is one of the growing renewable energy industries. In recent years, hundreds of wind farms, frequently in unmanned and remote areas, have been built. As the size of wind power projects keeps increasing, the need for reducing the downtime and making the best use of availability is essential. Wind turbines are becoming more established as an economically viable alternative to fossil-fueled power generation. The potential of the wind turbine could meet the demand in two times over in many places around the word (Nie & Wang 2013). The continuous monitoring and fault diagnosis of wind turbine systems (generators, blades, and drive trains) can be the most effective way to reduce the operational and maintenance costs of these systems and increase their reliability. With good data acquisition and appropriate signal processing, faults can thus be detected while components are operational and appropriate actions can be planned in time to prevent damage or failure of components. Maintenance tasks can be planned and scheduled more efficiently, resulting in increased reliability, availability, maintainability and safety (RAMS) whilst downtime, maintenance and operational costs are reduced (Wenxian et al. 2010). The gearbox steps up the speed from the input shaft (approx. 20 rpm.) to the high-speed shaft (approx. 1500+ rpm.). The high-speed bearings, which support both radial and thrust loads, are highly susceptible to failure, being subjected to continue variable speed, load and misalignment, see Figure 1. The high-speed