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Detection of Natural Crack in Wind Turbine Gearbox

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15 Abstract

One of the most challenging scenarios in bearing diagnosis is the extraction of fault 16 signatures from within other strong components which mask the vibration signal. Usually, 17 the bearing vibration signals are dominated by those of other components such as gears and 18 shafts. A good example of this scenario is the wind turbine gearbox which presents one of 19 the most difficult bearing detection tasks. The non-stationary signal analysis is considered 20 one of the main topics in the field of machinery fault diagnosis. In this paper, a set of signal 21 processing techniques has been studied to investigate their feasibility for bearing fault 22 detection in wind turbine gearbox. These techniques include statistical condition indicators, 23 spectral kurtosis, and envelope analysis. The results of vibration analysis showed the 24 possibility of bearing fault detection in wind turbine high-speed shafts using multiple signal 25 processing techniques. However, among these signal processing techniques, spectral kurtosis 26 followed by envelope analysis provides early fault detection compared to the other 27 techniques employed. In addition, outer race bearing fault indicator provides clear indication 28 of the crack severity and progress. 29

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31 **1. Introduction**

Wind energy is one of the growing renewable energy industries. In recent years, hundreds of 32 wind farms, frequently in unmanned and remote areas, have been built. As the size of wind 33 34 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 35 viable alternative to fossil-fueled power generation. The potential of the wind turbine could 36 meet the demand in two times over in many places around the word (Nie & Wang 2013). The 37 continuous monitoring and fault diagnosis of wind turbine systems (generators, blades, and 38 drive trains) can be the most effective way to reduce the operational and maintenance costs of 39 these systems and increase their reliability. With good data acquisition and appropriate signal 40 processing, faults can thus be detected while components are operational and appropriate 41 actions can be planned in time to prevent damage or failure of components. Maintenance 42 43 tasks can be planned and scheduled more efficiently, resulting in increased reliability, availability, maintainability and safety (RAMS) whilst downtime, maintenance and 44 operational costs are reduced (Wenxian et al. 2010). The gearbox steps up the speed from the 45 input shaft (approx. 20 rpm.) to the high-speed shaft (approx. 1500+ rpm.). The high-speed 46 bearings, which support both radial and thrust loads, are highly susceptible to failure, being 47 subjected to continue variable speed, load and misalignment, see Figure 1. The high-speed 48

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