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中小型風力發電機軸承損壞訊號分析
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摘要

本文探討以快速峰度譜(Fast Kurtogram)、總體經驗模態分解法(EEMD)等訊號處理方法分析風力發電機之動態訊號，以及診斷軸承的損壞狀況。計算快速峰度譜過程中使用小波包拆解與峰度值計算，找出最有可能出現破壞特徵的頻率區間，再將此頻率區間的訊號提出並做包絡線分析，最後將頻譜圖特徵與理論軸承破壞頻率做比對以判斷損壞狀況。另一方法 EEMD 中對原始訊號加入雜訊並配合多次的迴圈計算經驗模態，將訊號分離成本質模態函數(IMF)，再將 IMF 的各階展開做包絡線分析，最後將頻譜圖與軸承之破壞頻率做比對來判斷元件是否損壞。

在使用快速峰度譜分析軸承損壞訊號時，有時峰度最大的頻率區間會缺少軸承破壞頻率。而使用 EEMD 分析軸承損壞訊號時，不同階層的 IMF 包絡線頻譜圖與軸承破壞頻率的變異性較大，不易選取較佳判斷運轉缺陷的準則。本文中討論使用以上二種方法分析風力機之動態訊號的優、缺點，以及其適用狀況。

關鍵詞：Fast Kurtogram、EEMD、包絡線分析、軸承損壞。

Abstract

This research studied the use of two signal processing methods, fast kurtogram method and Ensemble Empirical Mode Decomposition (EEMD), to analyze the dynamic responses of a wind turbine for diagnosing any existing fault of bearings. In fast kurtogram method, wave packet decomposition and kurtosis are applied to detect the frequency region, which most likely contains the bearing defect frequency. Then, the envelope spectrum is calculated from the data, in the particular frequency region. The frequency associated with the apparent peak in the envelope spectrum will be compared to theoretical bearing defect frequencies to detect faults. In EEMD method, additional random white noise is introduced into the original signal. Then, the modified signal is analyzed by repeating empirical mode decomposition (EMD) method many times. Several intrinsic mode functions (IMFs) are obtained for conducting the envelope spectrum. Specific peaks, found in the spectrum, should correspond to theoretical bearing defect frequencies if any bearing fault exists. This paper discusses the usage of two signal processing methods.

Keywords: Fast Kurtogram、EEMD、envelope analysis、bearing faults.