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Fault Features Extraction for Bearing Prognostics*

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Abstract

This paper describes a newly developed fault feature extraction method for bearing prognostics. The effectiveness of the method is demonstrated with real bearing run-to-failure test data. Experimental results show that with the growth of the bearing defective area, the method is able to indicate clearer trends than the traditional condition indicators, such as RMS, the peak value, the amplitude of the Fourier spectrum at the bearing fault characteristic frequencies.

Key words: Bearing prognostic; Fault feature extraction; Run-to-Failure test

1 Introduction

Bearings are the critical components in the rotating machine. The degradation of the bearing over time is one of the most reasons that caused a machine to breakdown. Effective methods are needed to monitor the degradation process of the bearing and to make an earlier prediction of the failure time before the failure takes place. The condition-based maintenance (CBM) technique has been widely used in many industries for years. The goal of CBM is to monitor the real time condition of the bearing and to make an estimation of the remaining useful life (RUL) based on the current condition information [5]. The use of CBM strategies for mechanical machinery can produce significant saving through more efficient maintenance scheduling. In order to apply CBM techniques effectively, the fault features, which can be treated as the condition indicators should be extracted properly to keep track of the changing in the system [4]. Among all the methods for detection of the bearing faults, vibration-based techniques are the most widely used since it is easy to obtain the acceleration signals and the abundant information contain in the vibration signal. Many fault feature extraction methods have been investigated. Paper [2] uses certain statistical parameters, such as root mean square (RMS), Crest Factor and Kurtosis as the fault indicators of the bearing. While in [1], the authors use the average of the amplitudes on the bearing fault characteristic frequency and its first six harmonics as the degradation index. In [9] wavelet coefficients are treated as the fault features of the ball bearing with race fault. As mentioned in [3], these fault features may either have a low sensitivity to the bearing incipient defect or do not suitable for the deep groove ball bearing under highly accelerated test.

This paper presents a new method of extracting the bearing fault feature. An autoregressive model is applied to separate the original vibration signal of the bearing into the random parts and the deterministic parts and then the energy ratio between the random parts and the original signal is calculated as the fault indicator. Compared with the traditional condition indicators, the newly developed condition indicator is more effective. The remainder of the paper is organized as follows. In Section 2, the theoretical background of autoregressive model method

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