

Clustering of Frequency Spectrum from Different Bearing Fault using Principle Component Analysis.

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ABSTRACT

In this paper, the application of principle component analysis (PCA) as a pre-processing method for hierarchical clustering analysis on the frequency spectrum of the vibration signal was proposed. To achieve the aim, the vibration signal was acquired from the operating bearings with different condition and speed. In the next stage, the principle component analysis was applied to the frequency spectrums of the acquired signals for pattern recognition purpose. Meanwhile the mahalanobis distance model was used to cluster the result from PCA. According to the results, it was found that the amplitude of vibration at Ball Passing Frequency Outer Race and Ball Passing Frequency Inner Race will increase in align with the presence of outer race defect and inner race defect respectively. Moreover, the overall amplitude of vibration spectrum was found to be uniformly increased for the case of corroded bearing due to the widespread uniform corrosion on the entire bearing. By applying principle component analysis, the change in amplitude at any of these fundamental frequencies can be detected. Meanwhile, the application of mahalanobis distance was found to be suitable for clustering the results from principle component analysis. Uniquely, it was discovered that the spectrums from healthy and inner race defect bearing can be clearly distinguished from each other even though the change in amplitude pattern for inner race defect frequency spectrum was too small compared to the healthy one. In this work, it was demonstrated that the use of principle component analysis could sensitively detect the change in the pattern of the frequency spectrums. Likewise, the implementation of mahalanobis distance model for clustering purpose was found to be significant for bearing defect identification.

Keywords: Rolling Element Bearings, Vibration, Principle Component Analysis.

INTRODUCTION

In any rotating machineries, rolling element bearing is important in which it is functioning as both thrust and radial load bearer. Without bearing, the rotating shaft will be exposed to an excessive vibration which later on led to the fatigue damage. Basically, an abrupt bearing failure will precipitate massive impact to the maintenance and