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Using Envelope Analysis and Compressive Sensing Method for Intelligent Fault Diagnosis of Ball Bearing

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Abstract

Bearings are the key components of many rotating machines, in which serious failure or even major breakdown may occur due to their abnormal operation and defects. Thus, accurate fault diagnoses of bearing elements are essential for proactive predictive maintenance. However, the using of multiple sensors with high sampling rate reveal considerable shortages in the analysis of big data acquisition. Therefore, compressive sensing (CS) proposes in this study to overcome the aforementioned problems and support the fault diagnostic approach of ball bearing defects. The amount of data processed by CS technique can be significantly reduced to be more reliable for backup data. It can be a collaborative reconstruction method to compress the sampling data size and reliably exploiting similar sparsity structure of the acquired signal. Little attention has been paid for practically used sparseness of the CS converted signal in early fault detection of defects in ball bearing. Envelope analysis and CS technique are employed on experimental vibration data for fault detection in inner race and outer race of ball bearing. The results show that the reconstructed CS signal can characterize reliable features for bearing fault detection with some limitations in the range of compression ratio (up to 40%) and the selection of reconstructed sparse bandwidth. Hence, envelope analysis can provide optimal bandwidth to reconstruct the sparse modulated signal of ball bearing to overcome the limitation of the CS method.

Keywords

Ball bearing, Fault diagnosis, Vibration signal, Big data acquisition, Compressive sensing

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