

A new time–frequency method for identification and classification of ball bearing faults

I. Attoui, N. Fergani, N. BOUTASSETA, B. Oudjani, A. Deliou

Abstract: In order to fault diagnosis of ball bearing that is one of the most critical components of rotating machinery, this paper presents a time–frequency procedure incorporating a new feature extraction step that combines the classical wavelet packet decomposition energy distribution technique and a new feature extraction technique based on the selection of the most impulsive frequency bands. In the proposed procedure, firstly, as a pre-processing step, the most impulsive frequency bands are selected at different bearing conditions using a combination between Fast-Fourier-Transform FFT and Short-Frequency Energy SFE algorithms. Secondly, once the most impulsive frequency bands are selected, the measured machinery vibration signals are decomposed into different frequency sub-bands by using discrete Wavelet Packet Decomposition WPD technique to maximize the detection of their frequency contents and subsequently the most useful sub-bands are represented in the time–frequency domain by using Short Time Fourier transform STFT algorithm for knowing exactly what the frequency components presented in those frequency sub-bands are. Once the proposed feature vector is obtained, three feature dimensionality reduction techniques are employed using Linear Discriminant Analysis LDA, a feedback wrapper method and Locality Sensitive Discriminant Analysis LSDA. Lastly, the Adaptive NeuroFuzzy Inference System ANFIS algorithm is used for instantaneous identification and classification of bearing faults. In order to evaluate the performances of the proposed method, different testing data set to the trained ANFIS model by using different conditions of healthy and faulty bearings under various load levels, fault severities and rotating speed. The conclusion resulting from this paper is highlighted by experimental results which prove that the proposed method can serve as an intelligent bearing fault diagnosis system.

Keywords : Vibration signal processing Bearing fault diagnosis Bearing faults LDA, LSDA, ANFIS, WPD