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

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

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