The International Journal of Advanced Manufacturing Technology

Volume 97, Issue 5, 2018, Pages 3099-3117

Enhancement of rolling bearing fault diagnosis based on improvement of empirical mode decomposition denoising method

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Abstract: Signal processing is a widely used tool in the field of monitoring and diagnosis of rolling bearing faults. The vibration signals of rolling bearing contain important information which can be used for early detection and diagnosis of faults. These signals are usually noisy and masked by other sources and therefore the information about the fault can be lost. In this work, we propose an enhancement of rolling bearing fault diagnosis based on the improvement of empirical mode decomposition (EMD) denoising method. This method is made to extract the useful fault signal in order to use the detection indicators such as the kurtosis and the envelope spectrum. Firstly, EMD is applied to the vibration signals to obtain a series of functions called the intrinsic mode functions (IMFs). Secondly, we present an approach based on the energy content of each mode to determine the trip point which allows selecting the relevant modes. The singular selected IMFs are determined by comparing the average energy of all the unselected IMFs with the energy of each selected IMFs; then, an optimized thresholding operation is performed to denoise these IMFs. Finally, the kurtosis and spectral envelope analysis were investigated for early detection and localization of the fault position. Different experimental data are used to validate the effectiveness of the proposed method. The obtained results showed that the proposed method is more efficient and more sensitive to the early detection and diagnosis of rolling bearing faults than the conventional denoising method.

Keywords : Vibration analysis, bearing Fault diagnosis, EMD, threshold Denoising, energy, Relevant mode selection, envelope, Kurtosis