Manufacturing defect size estimation of tapered roller bearings from the vibration signal using discrete wavelet transform with Symlet wavelets and image processing*

Krisztián Deák

University of Debrecen Faculty of Engineering
deak.krisztian@eng.unideb.hu

Abstract

Tapered roller bearings are important parts of all rotary machines. Defects of bearings can be derived from either manufacturing or operation. This paper focuses on diagnosis of real manufacturing defects from vibration signal which is still an important challenge in bearing manufacturing industry. Here, grinding marks on the outer rings are analyzed to determine their width. Wavelet method is more efficient for detecting sharp edges and fast changes in signal than conventional frequency domain method. Symlet-5 wavelet has linear phase nature therefore sudden changes in the vibration signal can be detected efficiently. Experiments were carried out on a test-rig which is capable of measuring tapered roller bearings under different conditions. The proposed method has been succesfully implemented to reveal manufacturing problems. Defect width has been detected with maximal deviation of 2.41% from the defect width which was verified using visual techniques and image analysis methods.

Keywords: condition monitoring, bearing vibration analysis, wavelet

MSC: AMS classification number(s)

References

[1] Patel, V. N., Tandon, N., and Pandey, R., K., 2012. Defect Detection in Deep Groove Ball Bearing in Presence of External Vibration Using Envelope Analysis and Duffing Oscillator, Measurement 45, pp. 960.

[2] Khanam, S., Tandon, N., Dutt, J. K., 2012. Fault Identification of Rolling Element Bearings from Vibration Signals: An Application of Kalman and H Filters. LOWHUV 10th International Conference on Vibrations in Rotating Machinery (VIRM10), IMechE London, UK, Woodhead Publishing Limited, Institution of Mechanical Engineers (IMechE), pp. 703-713.

[3] Al-Ghamd, A.M., Mba, D., 2006. A Comparative Experimental Study on the Use of Acoustic Emission and Vibration Analysis for Bearing Defect Identification and Estimation of Defect Size, Mechanical Systems and Signal Processing 20, pp. 1537.

[4] Elforjani, M., Mba, D., 2010. Accelerated Natural Fault Diagnosis in Slow Speed Bearings with Acoustic Emission, Engineering Fracture Mechanics 77, pp. 112.
[5] Sawalhi, N., Randall, R.B., 2011. Vibration Response of Spalled Rolling Element Bearings: Observations, Simulations and Signal Processing Techniques to Track the Spall Size, Mechanical Systems and Signal Processing 25, pp. 846.