1.3.60. BEARING RACEWAY SURFACE INSPECTION VIA ULTRASONIC SPECTROSCOPY

Riahi M., Farahpour H., Ghadirian A.,
School of Mechanical engineering, Iran University of science and technology, Iran

Abstract. Roller bearings have been among highly inspected industrial products in recent years. Both condition monitoring as well as periodic inspection have been utilized to determine the status of bearings. Vibration analysis and acoustic emission have both been widely investigated in their applicability for the testing of bearings (Yoshioka 1991, Choy, Wang, et. al. 2007).

These approaches are useful in case of bearing investigation during its life service and could help the user in implementing predictive maintenance. On the other hand, visual inspection is commonly used for periodic inspection and maintenance. Although, this approach could help in failure analysis and qualitative inspection of roller bearing, however, there are parameters such as surface roughness and surface waviness which would not be detected by this method, nor they would be quantified.

There are different approaches for surface parameters quantification. A recent one is Ultrasonic Spectroscopy(Lu Chao 2007). In this paper bearing surface geometry is investigated through Ultrasonic Spectroscopy. Three types of spherical bearings with healthy, somehow faulty, and absolutely faulty status are investigated. Practical aspects of this approach are discussed herein and comments about future works are outlined.

Scope and Method. Reflection wave through abnormal surface could be estimated from the following relation:

$$F(\omega) = G(\omega)X(\omega). \quad (1)$$

In which $G(\omega)$ is the reflection from normal surface, and $X(\omega)$ is the abnormality function which evolves with $G(\omega)$ in time domain. Three spherical roller bearings with different level of healthiness were investigated through ultrasonic spectroscopy. Ultrasonic probes with 4 MHz natural frequency were used. Reflection wave were gathered and analyzed through 100 MHz digital oscilloscope. Time domain data was exported to MATLAB software and Fourier transformation was performed.

Results and discussion. Figure 1 illustrates time domain results of healthy surface and damaged surface. Figure 2 shows the abnormality function in frequency domain. For each of the results, 5 experiments were preformed and reliability of the method around natural frequency of the probe was proven. Figure 3 shows the statistical analysis for absolutely faulty surface case.

Conclusion. Surface inspection of a roller bearing raceway was performed using ultrasonic spectroscopy. Function of abnormity due to relation in frequency domain was estimated. The applicability of the method and its reliability were shown in different experiments. Reliability of the method around probe's natural frequency was proven. This approach is a useful method for automatic and quantitative analysis of bearing surface defects and parameters. Although, there are some limitations which could be addressed in future works, nevertheless, the resolution of this method is a major topic of interest that is in need of attention in upcoming investigations.

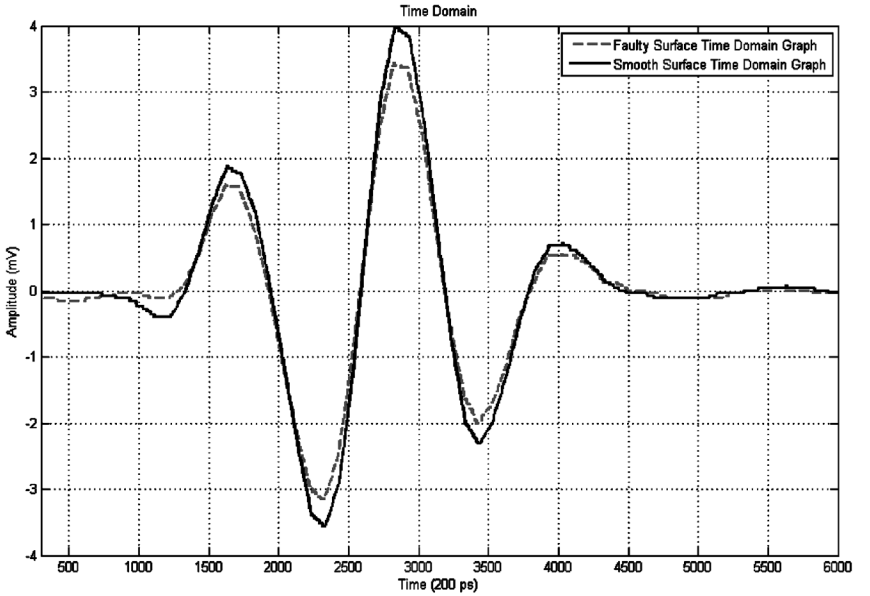

Fig. 1. Time Domain Presentation of Surface Reflection

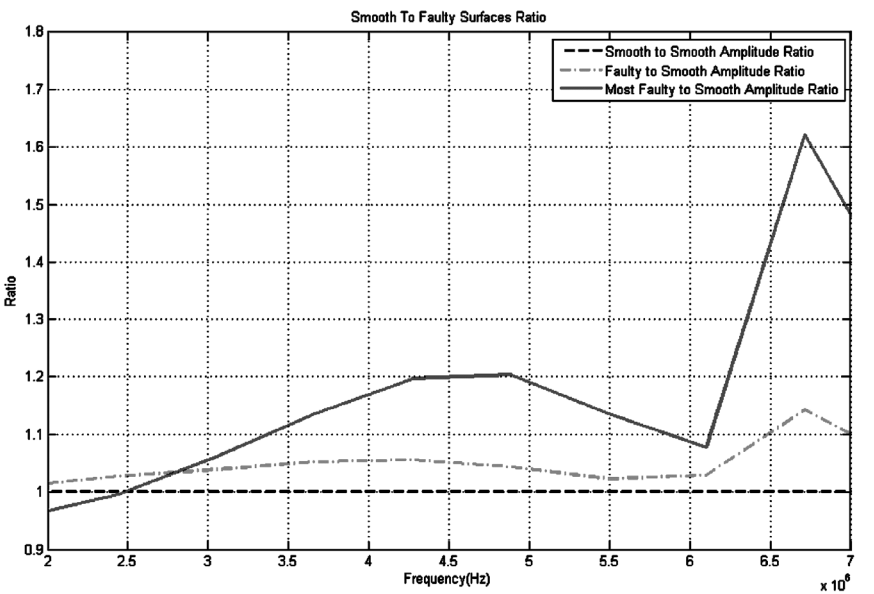

Fig. 2. Abnormality Function in Frequency Domain

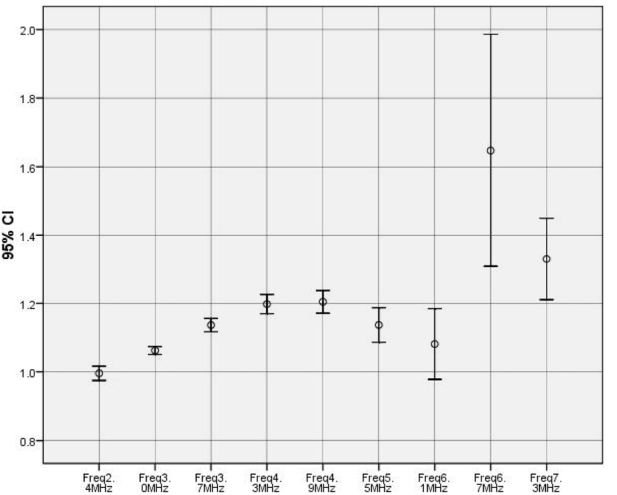

Fig. 3. Statistical Analysis for Abnormality Function in Absolutely Faulty Surface Case

References:

1. **Choy, F. K., Wang L., et al.** Online vibration monitoring of ball bearing damage using an experimental test rig // Journal of Propulsion and Power. – 2007. – № 23(3). – p. 629 – 636.

2. **Lu Chao, C. J.** Surface Roughness Measurements of Titanium Alloy Plates Using Improved Ultrasonic Spectroscopy. – 2007.

3. **Yoshioka, T.** (). Acoustic-Emission and Vibration in the Process of Rolling-Contact Fatigue (3rd Report) – Diagnosis of Rolling Bearing by Time Interval of Abnormal Signals // Journal of Japanese Society of Tribologists. – 1991. – № 36(6). – p. 444 – 451.