Spectrally Multiplexed Fiber Optic Sensors for Bearing Condition Monitoring

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The use of spectrally multiplexed Bragg gratings are investigated to condition monitor ball bearings. Fiber Bragg gratings are attached to a ball bearing housing and monitored in order to monitor fault conditions.

Keywords: fiber Bragg grating (FBG), optical fiber sensors, ball bearings, fiber segment interferometry (FSI), condition monitoring.

1. Introduction

Bearings and gears are used in a variety of complex machinery. Defects in these components can reduce machine efficiency and compromise safety. For this reason, Condition Monitoring is used to assess operational components and predict faults before they occur.

Condition monitoring requires high quality data to be collected. As of now electronic based sensors have largely formed the basis of condition monitoring systems. As the components to be monitored are often situated in hard to reach harsh environments there is opportunity to explore new monitoring capability, of which optics is one with notable advantages.

Fiber optic sensing can provide higher accuracy and precision for condition monitoring. Furthermore, due to their small size, chemical inertness, immunity to electromagnetic fields and their multiplexing ability they enable multiple sensing points within a harsh environment [1].

Existing studies into using optical sensors to monitor bearings have been limited to only examining the spectral response from a small number of Fiber Bragg Grating (FBG) sensors. This study investigates new advances in fiber segment interferometry (FSI) that allows integrated strain measurements along fiber segments without sensing gaps. This can potentially provide more sensitive and precise strain measurements within a defined measurement region [2] and through using FBGs this interferometry technique can harness spectral and spatial multiplexing.

2. Method

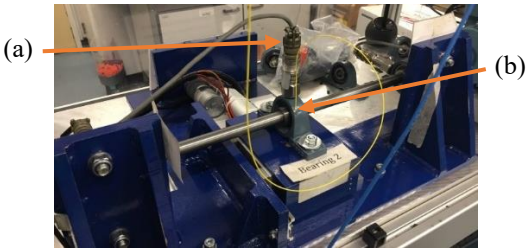

Figure 1: Test rig containing a conventional electronic accelerometer (a) and an FBG sensor (b).

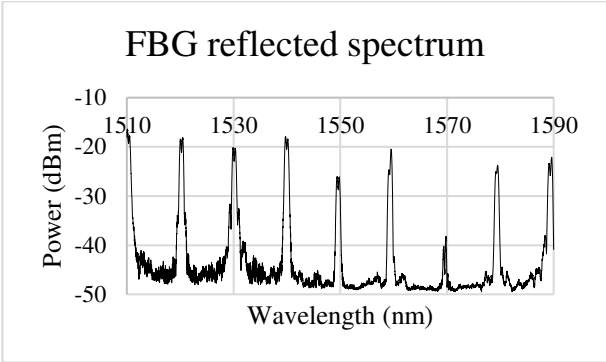

Figure 2: Reflectivity spectrum from 1510 to 1590 nm showing the multiplexed Bragg grating sensors positioned onto the bearing housing.

Experiments are conducted on a bearing test rig (shown in Fig. 1), where fiber optic sensors are wrapped around the bearing housing and a conventional accelerometer is installed for referencing. The FBGs used in this study were fabricated with a small spot direct UV writing technique [3], allowing for computer controlled grating synthesis. The reflectivity spectrum is shown in Fig. 2.

The presented work will focus on tailored FBG designs and use of emerging concepts interferometric measurements (i.e. FSI) to enhance the condition monitoring capability for bearings.

3. References

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