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Bearing Fault Monitoring Using CWT Based Vibration Signature

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Abstract

This paper introduces a new approach for generating patterns of phenomena associated with vibration of bearing faults using continuous wavelet transform (CWT). These patterns may be used as signatures for identification of bearing faults. There are four types of bearing faults namely inner race fault, outer race fault, ball fault and cage fault. This work is carried out for inner race and outer race faults. The signatures obtained are found to be unique for a particular type of bearing fault and can be used for identification of bearing faults.

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Keywords: Vibration, Bearing; Continuous Wavelet Transform; Signature

1. Introduction

Bearings are widely used in various types of machines ranging from simple induction electric motor to complex manufacturing facilities. Bearing faults, in fact, are a common cause of machinery failures. Rotating machine is a common class of machinery in the industry. The root cause of machinery faults in rotating machinery is faulty rolling element bearing .There are many bearing fault diagnosis techniques available but still the methods that are more effective need to be researched and developed for accurate detection of the fault before machine failure. Several methods have been proposed in the literature for bearing fault detection. To inspect raw vibration signals, a wide variety of techniques have been introduced that mainly includes classical signal processing techniques and intelligent systems. However, an effective bearing fault diagnostic technique is critically needed for a wide array of industries for

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early detection of bearing defects so as to prevent machinery performance degradation and malfunction.With the emergence of new mathematical tools and AI techniques along with progress in signal processing techniques, there is ample opportunity to investigate to meet the precise requirement of bearing fault diagnosis. In this work, an experimental setup is prepared for generating vibration signals for various types of bearing faults. Then, CWT is applied to these vibration signals and a novel algorithm is developed for generating signatures of different types of bearing faults [1].

Nomenclature

τ	time translation
s	dilation (scale)
t	time

2. Experimental Setup

The experimental setup used in this experiment consists of 0.25horse power induction motor, having fixed 1440 RPM, an extended shaft is mounted on the main shaft of the motor so that the seeded fault bearings can be mounted on the shaft for taking vibration data. In this experimental setup ADXL 335 accelerometer is used to capture the vibration data from bearing housing, the faulty bearings are mounted on the shaft and they are covered by the bearing housing and accelerometer is mounted on the top of the housing. In order to collect data from the accelerometer it is coupled with ARDUINO UNO board (microcontroller) which is compatible to MATLAB 2013R where the data can be captured. The Figure 1 shows schematic diagram of the experimental setup and Figure 2 shows actual experimental setup.

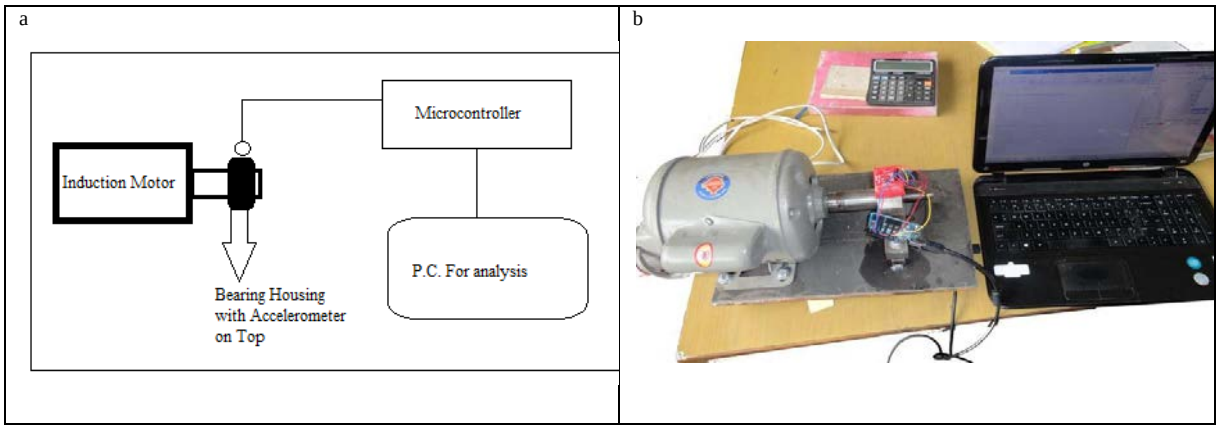

Figure. 1(a) Schematic Diagram for Experimental setup (b) Actual Experimental setup Equations

2.1. Accelerometer

An accelerometer is a device that measures proper acceleration ("g-force"). Proper acceleration is not the same as coordinate acceleration (rate of change of velocity). Accelerometers have multiple applications in industry and science. Highly sensitive accelerometers are components of inertial navigation systems for aircraft and missiles.. Figure 3 shows ADXL 335 accelerometer which is used in the experiment.

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