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Experimental Investigation of the Excitation Forcing Function in Rotating Machinery

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Abstract

Bearing fault is one of the major faults in the crystallographic failure of the rotating machine. Due to these faults induced in the rotating machine will lead to the excitation force i.e. the dynamic unbalance force is called excitation forcing functions. And the magnitude of these excitation forcing functions induced in the rolling element bearings varies based on many factors. And the factors are bearing faults, damage by belts, misalignments, leakages etc. The unbalance excitation forcing function due to the bearing faults has the major impact of the failure of rotating machinery. Vibration spectrum analysis for all these faults and particular to excitation forcing function can be studied extensively. In this paper, a new method of the experimental investigation of the excitation forcing function in the rolling element ball bearing is studied. And the excitation forcing function is formulated from the vibration spectrum obtained based on the frequency domain. And these are done with respect to two types of defeats in the ball bearing that is on the outer race and inner race defects in comparison with healthy bearings. And this experimental investigation will lead to the accurate assessment of the failure of rotating machinery; unbalance excitation force which leads to the failure of rolling bearing faults.

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*Keywords:*Excitation forcing functions, Rotating machinery, Bearing faults

1. Introduction

Many methods and theories are analysis by the various researches, which will discuss and determine the excitation forcing function induced in the rolling element bearings due to the bearing faults. The unbalance excitation force generated due to the bearing faults in the rotating machinery is very common type of problem.

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And to ascertain this problem of unbalance force, the vibration condition monitoring technique is widely used, can accurately determine the root cause of the bearing faults in the rotating machinery. Based on the vibration condition monitoring application in the industry, the maintenance cost can be reducing. A vital part of the maintenance program is to prevent and management of the premature failure of rotating machinery based on the faults in bearings is very critical and important. Recent years various wavelets theory like continuous, discrete wavelet transform, wavelet packet transform, and its application for bearing faults studied is carried by two approaches analytical and experimentally [1-7]. And these critical frequency domains will exhibit the different speed range and modes of deformation with respect to the time domain. This time-frequency vibration spectrum not only magnifies the signal obtained for the machine. The magnification of the signal from time to frequency domain will enable to extract the various unbalance excitation force and their effect on the machine health condition. An accurate of the machine health can be determined. And also the frequency-time spectrum decomposition can be carried by both numerical and finite element method also. A non-linear dynamic mathematical investigation of rolling bearing element for the various localized defects that is outer, inner race studied subject to stability of the bearing element and the rotating machinery for layout a framework of monitoring the health of the machine [9-10]. In this work, experimental approach for investigation of the impulse excitation forcing functions in ball bearings subjected to the defects for the case of outer and inner race. This is done with effect radial load on the faults for amplitude variations of impulse force over the time span. The impulse force generated due to radial load acting the defect zone will have wide range of frequency spectrum and respective harmonics value. And also the BPFI and BPFO are calculated in this frequency spectrum side band.

2. Experimental test rig

In this experimental test rig as shown in the figure 1, the rotating machinery used in the electric motor with speed range up to 3000rpm.Speed of electric motor coupled shaft between the motor and ball bearings is measured using the laser tachometer to see the effect of speed on the faults in rolling element ball bearings and the vibration spectrum obtained from the machines. The electric motor shaft is connected to the rolling element ball bearings in the bearing housing. And the external load is applied to the rolling element bearing using the dead weights on the other end shaft connected to the electric motor. The bearing housing is provided with option to replace the bearings with the different types of bearing condition sets to analysis the faults in the rotating machinery due to the rolling elements. The bearing conditions sets are three types that are without any defects that are healthy bearing, outer race defect bearing and also inner race defect bearings. For the rolling element ball bearings the defects are created artificial using the electric discharge machine.

Figure 1 Experimental test rig and rolling element ball bearings