Fault Diagnosis of ball Bearing through Vibration Analysis

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Abstract-Antifriction bearing failure is a major factor in failure of rotating machinery. As a fatal defect is detected, it is common to shut down the machinery as soon as possible to avoid catastrophic damages. Performing such an action, which usually occurs at inconvenient times, typically results in substantial time and economical losses. It is, therefore, important to monitor the condition of antifriction bearings and to know the details of severity of defects before they cause serious catastrophic consequences. The vibration monitoring technique is suitable to analyze various defects in bearing .This paper describe the suitability vibration monitoring and analysis technique to analyze the vibration behavior in Radial, Axial and Downward direction in Antifriction bearing. It is to analyze the good and defective bearing vibration behavior.

Keywords – MATLAB graph, Vibration amplitude, Vibration in Radial , axial and downward direction.

I. INTRODUCTION

Condition monitoring of antifriction bearings in rotating machinery using vibration analysis is a very well established method. It offers the advantages of reducing down time and improving maintenance efficiency. The machine need not be stopped for diagnosis. Even new or geometrically perfect bearings may generate vibration due to contact forces, which exist between the various components of bearings. Antifriction bearing defects may be categorized as localized and distributed. The localized defects include cracks, pits and spalls caused by fatigue on rolling surfaces1.The other category, i.e. distributed defects include surface roughness, waviness, misaligned races and off size rolling elements. These defects may result from manufacturing error and abrasive wear. Hence, study of vibrations generated by these defects is important for quality inspection as well as for condition monitoring [2]. Antifriction bearing failures result in serious problems, mainly in places where machines are rotating at constant and high speeds. In order to prevent any catastrophic consequences caused by a bearing failure, bearing condition monitoring techniques, such as, temperature monitoring, wear debris analysis, oil analysis, vibration analysis and acoustic emission analysis have been developed to identify existence of flaws in running bearings. Among them vibration analysis is most commonly accepted technique due to its ease of application. Vibration signature monitoring and analysis in one of the main techniques used to predict and diagnose various defects in antifriction bearings3. Vibration signature analysis provides early information about progressing malfunctions and forms the basic reference signature or base line signature for future monitoring purpose. Defective rolling elements in antifriction bearings generate vibration. This vibration is to analysis by the accelerometer this vibration is to analyze by the Matlab graphs and numerical value of the vibration. This vibration 100 readings taken in 38 sec.

II. DESCRIPTION ABOUT EXPERIMENTAL SETUP

An experimental test rig built to predict defects in antifriction bearings is shown in Figure 1.The test rig consists of a shaft with central rotor, which is supported on two bearings. An induction motor coupled by a flexible coupling drives the shaft. Self aligning Pedestal ball bearing is mounted at driver end and another tested pedestal ball bearing is mounted at free end. The cylindrical roller bearing is tested at constant speed of 1420 rpm with radial load of 50 N. pedestal ball bearing type SKF SY 20 WM Healthy Bearing , on tested side mounted Another Faulty pedestal Bearing (with some Wear defects on ball or Case) have been both used for analysis. The details of the bearings used in the present analysis are given in Table 1. Provision is made on the pedestal ball bearing housing to mount accelerometers .Analog to Digital Converter (A&D AD 3525) was used to monitor vibration signals from good and defective bearings. These Digital output interface with the Matlab & use some Commands to draw a graphs For the Healthy & Faulty Bearings. Use of Matlab to evaluate the values of Vibration takes a 100 No. of readings in 38 second. Experimental test carried out on three Directions (Radial, Axial and Downward) For each direction take 4 trials. Experimental tests were carried out on two sets of bearings. Initially new bearing (good bearing) was fixed in the test rig and signals were recorded using Matlab to draw graphs. The good bearing was replaced by defective bearing and signals were recorded for each one of the case separately under the same standard condition.

Table 1 Specifications of Pedestal Bearing

S.No.	PARAMETERS	SPECIFICATION
1.	Material	Cast Iron
2.	Inside Diameter	20 mm
3.	Centre Height	33.3 mm
4.	Overall Height	64 mm
5.	Length	127 mm
6.	Depth	32 mm
7.	Mount Hole Size	10 mm
8.	Mount Hole Centre – to-Centre distance	102 mm
9.	Mass	0.62 kg

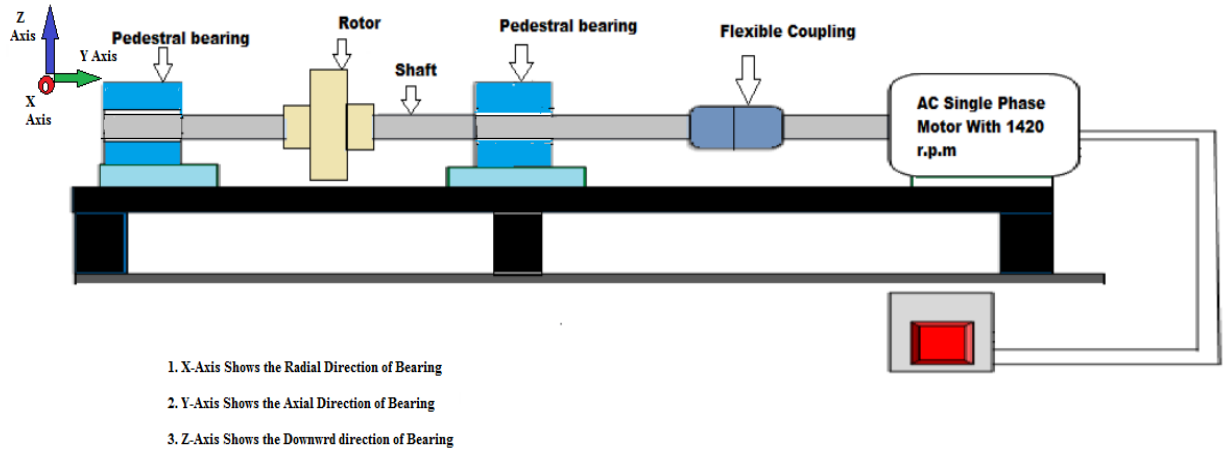


Figure 1 Line Diagram of Experimental Set-Up

III. OBSERVATIONS ON EXPERIMENTAL SET-UP:-

WE OBSERVE ON DIFFERENT CONDITIONS OF BEARING:-

1. Vibration Signature on good bearing.

2. Vibration signature on defective bearing.

We take four observations for every case and each case has three axis graph along (X-Axis) radial, (Y-axis) axial and (Z-Axis) Downward directions.

1 GRAPHS ON GOOD BEARING:-

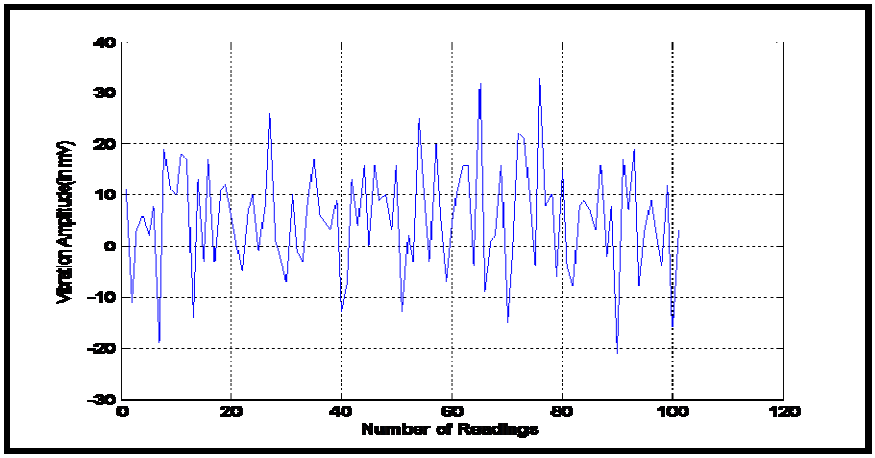


Figure 2 Good Bearing X Axis Trial 1

Similarly takes a reading on good bearing X axis other three trials, Y axis four trials and Z axis four trials.

Table2. Vibration Amplitude on Good Bearing:-

Axis	No. Of trials	Maximum amplitude(in mV)
X-Axis	Trial1	32
	Trial2	34
	Trial3	36
	Trial4	37
Y-Axis	Trial1	45
	Trial2	40
	Trial3	44
	Trial4	42
Z-Axis	Trial1	39
	Trial2	44
	Trial3	40
	Trial4	41

2. GRAPHS ON DEFECTIVE BEARING:-

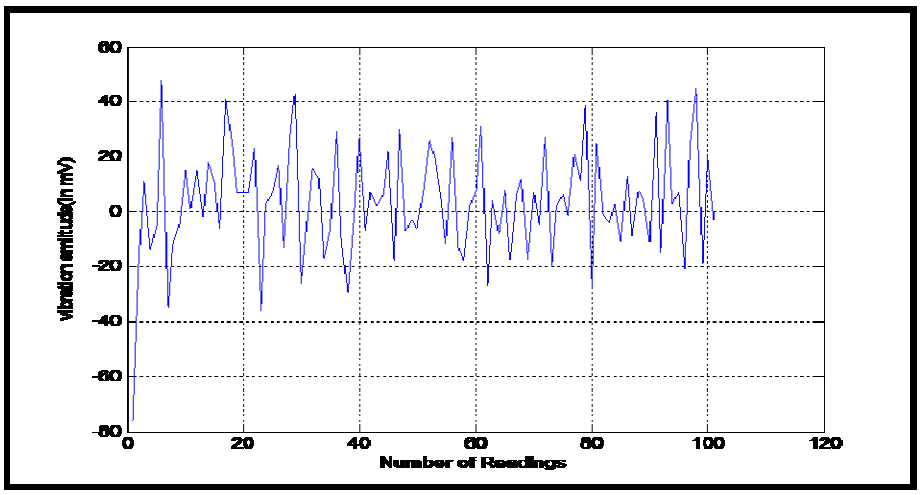


Figure 3 Defective Bearing X Axis Trial 1

Similarly takes a reading on defective bearing X axis other three trials, Y axis four trials and Z axis four trials.

Table3 Vibration Amplitudes on Defective Bearing:-

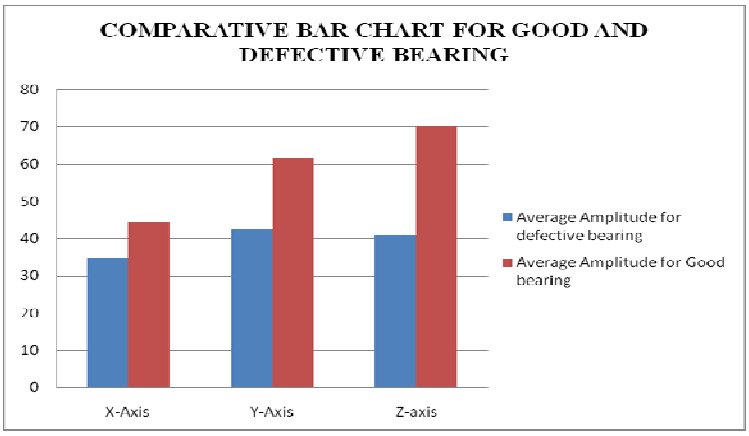
Axis	No. Of trials	Maximum amplitude(in mV)
X-Axis	Trial1	43
	Trial2	47
	Trial3	44
	Trial4	44
Y-Axis	Trial1	64
	Trial2	62
	Trial3	63
	Trial4	58
Z-Axis	Trial1	71
	Trial2	72
	Trial3	69
	Trial4	69

IV. IV Experiment Result

Table.3 Comparison of average amplitude of vibration in good and defective bearing:-

Axis	Good Bearing Amplitude (in mV)	Defective Bearing Amplitude (in mV)
X-Axis	34.75	44.5
Y-Axis	42.75	61.75
Z-Axis	41	70.25

Chart.1 Comparison of good and defective bearing:-



V. CONCLUSION

It concludes that Radial direction has a minimum vibration, axial direction has medium vibration and downward direction has maximum vibrations exist on the bearing either it is good or defective. That Average magnitude of vibration in radial, axial and downward direction for the good and defective bearing is to compare the variation in vibration magnitude. The bar chart shows in minimum variation of vibration magnitude in radial direction medium variation in axial direction and maximum vibration in downward direction .The maximum variation of vibration in downward direction and minimum variation of vibration magnitude in Radial direction. The distinct and different behavior of vibration signals from bearings. The magnitude of vibration is to compare the good and defective bearing vibration in rotary system.

REFERENCES

[1] Dhirendra Nath Thatoi,1 Harish Ch. Das,1 and Dayal R. Parhi "Review of Techniques for Fault Diagnosis in Damaged Structure and Engineering System"Advances in Mechanical Engineering Volume 2012 article ID 327569.

[2] Hocine Bendjama, Salah Bouhouche, and Mohamed Seghir Boucherit "Application of Wavelet Transform for Fault Diagnosis in Rotating Machinery" International Journal of Machine Learning and Computing, Vol. 2, No. 1, February 2012.

[3] Matej Tadina and Miha Boltezar "Improved model of a ball bearing for the simulation of vibration signals due to faults during run-up" Journal of Sound and Vibration (2011), Volume:300, Issue 17, Pages 4287-4301.

[4] Karol Listewnik and Jerzy Zukowski ""Preliminary Evaluation of Effective Vibration Analysis for the Fault Diagnosis of Natural Gas Engine-Driven Compressor" Journal of KONES Power train and Transport, Vol. 18, No. 4 2011.

[5] Manish yadav and Dr. Sulochana wadhwani "Vibration analysis of bearing for fault detection using time domain features and neural network" International Journal of Applied Research in Mechanical Engineering, Volume-1, Issue-1, 2011.

[6] M Amarnath , R Shrinidhi , A Ramachandra and S B Kandangal "Prediction of Defects in Antifriction Bearings using Vibration Signal Analysis" IE(I) Journal-MC 2004.