American Journal Of Applied Science And Technology
(ISSN – 2771-2745)
VOLUME 03 ISSUE 06 Pages: 22-25
SJIF IMPACT FACTOR (2021: 5. 705) (2022: 5. 705) (2023: 7.063)
OCLC – 1121105677
Publisher: Oscar Publishing Services

Journal Website: https://theusajournals.com/index.php/ajast

Research Article

FAILURE THRESHOLD DETERMINATION OF ROLLING ELEMENT BEARINGS: VIBRATION FLUCTUATION ANALYSIS AND FAILURE MODES INVESTIGATION

Submission Date: June 02, 2023, Accepted Date: June 07, 2023,
Published Date: June 12, 2023
Crossref doi: https://doi.org/10.37547/ajast/Volume03Issue06-05

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ABSTRACT

Rolling element bearings are critical components in many industrial applications, and their failure can lead to significant downtime and maintenance costs. Therefore, predicting the remaining useful life of bearings is essential for effective maintenance scheduling and avoiding unplanned downtime. In this study, vibration fluctuation analysis and failure modes investigation were employed to determine the failure threshold of rolling element bearings. Results showed that the vibration fluctuation of bearings increased significantly when the bearing was close to failure. The failure modes of bearings were also identified, and the corresponding vibration signals were analyzed. Based on these findings, a failure threshold was determined, which can be used to predict the remaining useful life of bearings.

KEYWORDS

Rolling element bearings, vibration fluctuation analysis, failure modes investigation, failure threshold, remaining useful life.

INTRODUCTION

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Rolling element bearings are widely used in various industrial applications, such as electric motors, turbines, and gearboxes. These bearings play a critical role in the proper functioning of machines and equipment. However, the failure of bearings can lead to significant downtime and maintenance costs. Therefore, predicting the remaining useful life of bearings is essential for effective maintenance scheduling and avoiding unplanned downtime. Many techniques have been developed to predict the remaining useful life of bearings, including vibration analysis, acoustic emission, and temperature monitoring. Among these techniques, vibration analysis is one of the most commonly used methods due to its effectiveness and ease of implementation. In this study, vibration fluctuation analysis and failure modes investigation were employed to determine the failure threshold of rolling element bearings.

METHOD

The study involved the following steps:

Selection of rolling element bearings: Several rolling element bearings were selected from different industrial applications, including electric motors, turbines, and gearboxes.

Experimental setup:

The experimental setup involved mounting the bearings on a test rig and subjecting them to various loads and speeds. The vibration signals were recorded using an accelerometer attached to the bearing housing.

Vibration fluctuation analysis:

The vibration signals were analyzed using the vibration fluctuation method to determine the failure threshold of the bearings. The vibration fluctuation is a measure of the deviation of the vibration signal from its mean value.

Failure modes investigation:

The bearings were inspected after the tests to identify the failure modes. The corresponding vibration signals were analyzed to determine the relationship between the vibration signals and failure modes.

Failure threshold determination:

Based on the results of the vibration fluctuation analysis and failure modes investigation, a failure threshold was determined for each type of bearing.

RESULTS

The results showed that the vibration fluctuation of bearings increased significantly when the bearing was close to failure. The failure modes of bearings were also identified, including fatigue spalling, plastic deformation, and wear. The corresponding vibration signals were analyzed, and the relationship between the vibration signals and failure modes was determined. Based on these findings, a failure threshold was determined for each type of bearing, which can be used to predict the remaining useful life of bearings.

DISCUSSION

The vibration fluctuation analysis and failure modes investigation proved to be effective in determining the failure threshold of rolling element bearings. The identified failure modes can be used to develop strategies for preventing bearing failure, such as improving lubrication and reducing loads. The failure threshold can also be used to predict the remaining useful life of bearings and schedule maintenance activities accordingly.

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CONCLUSION

In conclusion, this study demonstrated that vibration fluctuation analysis and failure modes investigation can be employed to determine the failure threshold of rolling element bearings. The identified failure modes and failure threshold can be used to develop strategies for preventing bearing failure and predicting the remaining useful life of bearings. This approach can lead to improved machine reliability, reduced maintenance.

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