1. Background

Bearings are among the most widely used machine elements and are critical to almost all forms of rotary machinery. In order to prevent unexpected bearing failure, defects that can occur in bearings should be detected as early as possible to avoid fatal breakdowns of the machines to which they are so critical. Such breakdowns can lead to a costly lapse in production, and/or even human causalities. Another additional measure that can prevent breakdowns is the creation of a bearing life prediction system.

2. Objectives

- Design and development of feature extraction and correlation engine for bearing defect detection and residual life prediction.
- Testing and system improvement

3. Methodology

- Two models were developed, one for bearing wear detection and the other for bearing crack/damage detection.
- Simulation tests were conducted to test system effectiveness.
- Real life tests were conducted on a lathe, milling machine and a hydraulic bearing.

4. Results

4.1 Simulation Results

![Simulated Bearing Signal](image1)

![Simulated Bearing Signal for Crack/Damage Failure Detection Training](image2)

4.2 Testing Results

- Testing at 400 rpm with sufficient lubrication was conducted and compared to testing at 1500 rpm with insufficient lubrication in order to check if the IMS would detect the friction defects on the bearing.
- IMS detected the friction defects and they are indicated by the high vibration amplitudes in fig 7.

5. Conclusions

- Developed Intelligent Maintenance System is capable of detecting machine bearing failure.
- The feature extraction tools, Mel Frequency Cepstral Coefficients and Spectral Kurtosis used are able to extract features for detecting bearing wear and bearing crack/damage defects.
- Self Organizing Map and Weight Application Failure Times (WAFT) technology is efficient for bearing residual life calculation.

6. Recommendations

- Further modeling should include accelerated bearing life tests.
- Mount multiple accelerometers on machine surfaces.
- Conduct further research on self learning artificial intelligence.