

Research Field And Department	PREDICTIVE MAINTENANCE ORIENTED TO ROTATING MACHINERY, MECHANICAL ENGINEERING DEPARTMENT
Supervisor	MARÍA JESÚS GÓMEZ GARCÍA & CRISTINA CASTEJÓN SISAMÓN
Title of the Work	BEARING FAULT DIAGNOSIS BASED ON VIBRATION SIGNALS ACQUIRED EXPERIMENTALLY

Abstract:

This research project aims to investigate and implement techniques for bearing fault diagnosis based on experimentally acquired vibration signals. The study will focus on the collection, analysis, and interpretation of vibration data from rotating machinery under various operating conditions. The main objective is to identify characteristic signal patterns associated with different bearing defects and to evaluate the effectiveness of signal processing and feature extraction methods such as Fast Fourier Transform (FFT), Wavelet Transform, and Envelope Analysis. Experimental measurements will be performed using accelerometers mounted on test bearings, and the obtained data will be analyzed using MATLAB tools. The project will provide hands-on experience in experimental vibration analysis, signal processing, and fault classification. Expected outcomes include the identification of optimal diagnostic parameters and the establishment of a preliminary framework for automated bearing fault detection. This short-term research is particularly suited for students interested in condition monitoring, mechanical systems diagnostics, and data-driven reliability engineering.

Main Tasks to Carry Out:

- **Literature Review:**
Conduct a brief review of existing methods and recent advances in bearing fault diagnosis based on vibration analysis, emphasizing both time-domain and frequency-domain techniques.
- **Experimental Setup Preparation:**
Configure the test rig for vibration data acquisition, including the installation of accelerometers, data acquisition systems, and the selection of suitable bearing samples with controlled defects.
- **Data Acquisition:**
Perform experimental measurements under different operational conditions (e.g., varying load and rotational speed) to obtain representative vibration signals from healthy and faulty bearings.
- **Signal Processing and Feature Extraction:**
Apply analytical techniques such as Fast Fourier Transform (FFT), Wavelet Transform, and Envelope Analysis to extract relevant features that characterize different fault types.
- **Fault Identification and Classification:**
Analyze extracted features to identify fault signatures and evaluate diagnostic indicators. Implement simple classification methods to distinguish between normal and defective bearing conditions.

- **Results Interpretation and Discussion:**

Compare experimental findings with existing literature, assess the effectiveness of the chosen analysis methods, and identify potential improvements or future research directions.

- **Documentation and Reporting:**

Summarize the procedures, results, and conclusions in a structured technical report and prepare a brief presentation outlining the main outcomes of the two-week research project.

References/Bibliography if required

- Randall, R. B. (2011). *Vibration-based Condition Monitoring: Industrial, Aerospace and Automotive Applications*. Wiley.
- [2] McFadden, P. D., & Smith, J. D. (1984). *Model for the vibration produced by a single point defect in a rolling element bearing*. *Journal of Sound and Vibration*, 96(1), 69–82.
- González D., Diagnóstico de maquinaria rotativa mediante aprendizaje automático, (2021), Trabajo Fin de Master, UC3M
- Gomez, M.J., Castejón, C., Garcia-Prada, J.C., Crack detection in rotating shafts based on 3X energy: Analytical and experimental analyses”, *Mechanism and Machine Theory* 96 (2016) 94-106.[2] Braun, S. *Discover Signal Processing: An Interactive Guide for Engineers*, (2008) Wiley-Interscience.
- Gómez, M.J. et al. Btool: a friendly teaching tool to acquire and process vibration signals, *The 14th IFToMM World Congress* (2015)
- Harris, T. A., & Kotzalas, M. N. (2006). *Rolling Bearing Analysis*. CRC Press.
- Randall, R. B., & Antoni, J. (2011). *Rolling element bearing diagnostics—A tutorial*. *Mechanical Systems and Signal Processing*, 25(2), 485–520.

MATLAB Vibration Analysis Toolbox Documentation:

<https://www.mathworks.com/help/signal/>