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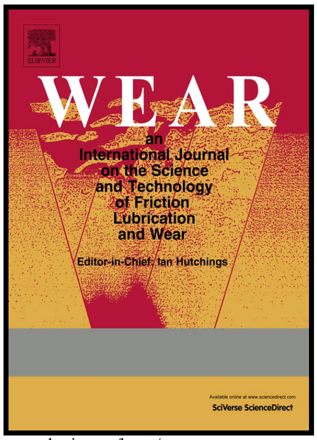


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# Experimental Wear Parameters Identification in Hydrodynamic Bearings via Model Based Methodology

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**Abstract**

When a rotor operates in very low rotating speeds, the fluid-film in hydrodynamic bearings is not completely formed, which allows direct metal to metal contact between the bearing and the journal. Numerous start/stop cycles also may lead to bearing wear. In this context, the present work aims to evaluate a model-based method for identification of hydrodynamic bearing wear parameters: more specifically, wear depth and angular position. The proposed method is based on minimizing an objective function, which compares the directional Frequency Response Function (*dFRF*) of the physical system with the response of the model developed here. It contemplates the numerical model of the rotor and the worn bearings, in this case, represented by linearized coefficients of damping and stiffness. Through experimental results, a deeper evaluation of the identification method is presented, such as the sensitivity to the number of points of the *dFRF* used in the objective function, different meshes of starting points, and the region of the *dFRF* used – around the resonance peak or around the oil-whirl peak. The analyses are conducted for different levels of bearing wear. The precision obtained in the results indicates that the presented method is a promising tool in the identification of bearing wear.
*Keywords: bearings wear, parameters identification, directional frequency response.*

## 1. Introduction

Rotating machines are used in a wide range of industrial processes. To avoid sudden failures during operation that can seriously affect the productivity, early fault detection is essential. It is crucial for effective condition monitoring and to complement the predictive maintenance policies, that are known to reduce the cost considerably. Vibration analysis is widely used as an effective tool for fault monitoring and diagnosis of many ill conditions in rotating machinery, such as misalignment, cracks, shaft bow and bearing faults. In this context, the vibration analysis or modal analysis has always gained attention in the industry and research community.

Rotating machines present very particular characteristics, such as non-symmetric stiffness and damping matrix due to gyroscopic effects and anisotropy of journal bearings and supporting structures. The implication of such peculiarities is that classical modal analysis methods, in most cases, are not suitable for the modal parameters identification of rotating systems.

In 1975, Gasch and Pfützner [1] showed that when a rotating system is represented by the use of complex coordinates, the rotor precession movement can be