# Rotating gear supported by a plain journal bearing: an experimental and numerical study

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In the present work an experimental and numerical analysis of a plain journal bearing test bench is presented. The analyzed journal bearing is composed of a fixed shaft and a rotating bushing with a gear, which is loaded through a simple pulley-spring system. During the first two runs of the test bench two journal bearing seizures occurred between the rotating gear and the fixed shaft at high rotational speeds. This paper presents the numerical simulations (TEHD and dynamics) of the journal bearing and the validation of the results through a third verification run.

**Keywords:** Plain journal bearing, TEHD, Dynamical analysis

## 1. Introduction

In the present work an experimental and numerical analysis of a plain journal bearing test bench is presented. The analyzed journal bearing is composed of a fixed shaft and a rotating bushing with a gear, which is loaded through a simple pulley-spring system. During the first two runs of the test bench two journal bearing seizures occurred between the rotating gear and the fixed shaft at high rotational speeds. The simplicity of this configuration facilitates a dynamic analysis and the validation of a novel computational method.

Later on, a verification run was realized with a modified spring system as well as a modified journal bearing geometry in order to avoid future seizures. Further on, a numerical analysis of a plain journal bearing is presented.

Then, a detailed dynamical analysis is presented based on the above-described simple system: the system response to unit force perturbations with the classic and the proposed approach are compared while taking into account the gear meshing and spring stiffness. Finally, the model is compared to the experimental results.

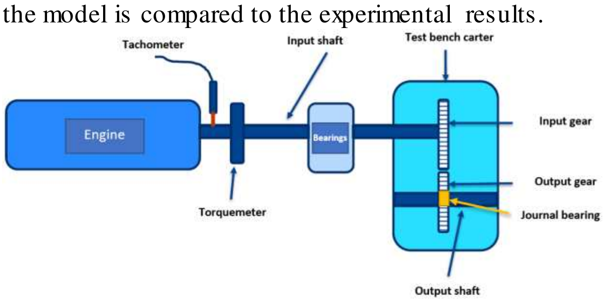


Figure 1: The test bench schema.

## 2. Test bench

The test bench consists of an electric motor connected to the input gear, which drives the output gear. The output gear is supported by a plain journal bearing (see Figure 1).

The output (driven) gear is then loaded by a pulley-spring system in the vertical direction. The journal bearing of the driven gear supports the load generated by this pulley-spring system. After the first seizures, several accelerometers and thermocouples were mounted on the test bench and close proximity to the journal bearing.

## 3. Numerical study

In our study, a thermoelasto-hydrodynamic (TEHD) model of the fluid film bearing is presented. This model is capable of simulating the quasi-static thermos-mechanical deformations of the journal bearing [3].

A small perturbations-based dynamics model is applied to the journal bearing to calculate its dynamic coefficients (stiffness and damping matrix) [2]. A classical 4-point and a more sophisticated 8-points model are compared in terms of resulting stiffness and damping coefficients. Both of these methods are applied on the undeformed (HD) and deformed (TEHD) journal bearing [1].

## 4. Results

The numerical and experimental results were compared for the verification run. An oil whip phenomenon can be observed at the high speed regime, which was aggravated by the journal bearing characteristics (L/D ratio) during the first two test runs – resulting in the seizures.

## 5. References

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