# On the Steady-State Behavior of Porous Journal Bearings - Bridging the Gap Between Simulation and Experiments

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## 1. INTRODUCTION

Porous journal bearings are a common and economic solution for lubrication applications where maintenance and access to the system are restricted or difficult. This work aims to provide the engineer with a validation of the theoretical model and simulation results put forward in an earlier study [1] with those obtained by recent experiments performed with industrially used bearings [2]. Adopting rather small "real-life" industrial rather than specifically designed bearings in tests represents a novelty with definite appeal to the practitioner. This fills a gap in the existing literature, all the more as it provides an intricate challenge caused by the increase of relative errors that are still difficult to properly cope with, given the more pronounced and unavoidable geometrical imperfections stemming from the manufacturing process and their variations due to different samples. These are still not easily quantified.

## 2. THEORY VS. EXPERIMENT

We compare new experiments on the frictional behaviour of porous journal bearings, lubricated with polyalphaolefin-based oils of distinct viscosities, referred to as "PAO 18", "PAO 46", "PAO 100", and "PAO 460", with results predicted by numerical simulations. The underlying theoretical model includes the effects of cavitation by vaporization and accounts for the sinter flow as described by Darcy's law. Using a sizeable database and an accurate numerical interpolation scheme, we estimate the effective eccentricity ratio corresponding to the experimentally imposed load. The validation of our results focuses on the hydrodynamic branches of the Stribeck curve via dimensional analysis, in particular the variations of the lubricant viscosity with temperature.

## 3. EVALUATION AND RESULTS

We are interested in determining which type of correlation exists between experimental friction coefficients $\mu_{exp}$ and the simulated ones $\mu_{sim}$. For this reason, for each set of data we extract five values of $\mu$ taken at distinct rotational speeds ($\omega$=1000, 1500, 2000, 2500, and 3000 min$^{-1}$) for all the bearing samples and two loads (50 N, 100 N). In this way we obtain 90 points, which are represented in Fig. 1. The majority of points rests on a band-type cluster that marks a definite correlation of the two data sets. The large experimental values of PAO 460 at 50N are isolated from all the other points. We find that the correlation coefficient is 0.9239. The data points are thus strongly correlated, yet there exists a discrepancy between the two data sets, namely a bias towards higher experimental coefficients of friction and a slope that is closer to 0.5 than to 1.

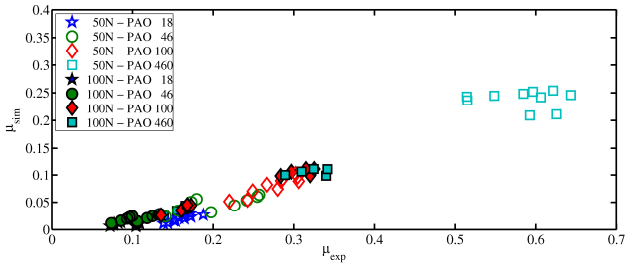


Figure 1: Correlation between measured ($\mu_{exp}$) and calculated values ($\mu_{sim}$) for the coefficients of friction at $T$=25°C.

## 4. CONCLUSIONS

Our numerically calculated values for the coefficient of friction reproduce the experimentally obtained ones satisfactorily in terms of overall trends, resulting in a low-positive correlation between the two.

## REFERENCES

[1] Scheichl, B., Neacşu, I.A., Kluwick, A., *Tribol. Int.*, **88**, 189–208, 2015.

[2] Neacşu, I.A., Scheichl, B., Vorlaufer, G., Eder, S.J., Franek, F., Ramonat, L., *J. Tribol.–T. ASME*, **138**(3), 031703, 2016.