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Evaluation of hydrodynamic forces in journal bearings under dynamic conditions

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Abstract

This work shows the influence of the squeeze effect on hydrodynamic forces acting in journal bearings. The analysis is performed from the integrating of pressure distribution, which is obtained by solving the Reynolds equation from finite volume method. A computational code is developed in FORTRAN in order to perform these analyses. The results obtained show the pressure distributions and the hydrodynamic forces for different values of the squeeze effect acting in the journal bearing.

Key words: Hydrodynamic Lubrication, Journal Bearing, Squeeze Effect

Introduction

In general, hydrodynamic lubrication is used in machines to avoid the wear and to transfer the heat of the components. Thus, the calculation of the forces on bearings is fundamental to determine dynamic behavior of machines and components and to check if the film of lubricant fluid is able to provide load-carrying capacity for the geometry designed.

Results and Discussion

The theoretical base of the hydrodynamic lubrication is the classical Reynolds equation[1].

$$\frac{\partial}{\partial x}\left(h^3\frac{\partial p}{\partial x}\right)+\frac{\partial}{\partial z}\left(h^3\frac{\partial p}{\partial z}\right)=6\mu U\frac{dh}{dx}+12\mu\frac{dh}{dt}$$

From this equation, the pressure distribution in the bearing can be obtained through of the numerical solution by finite volume method. This work investigates the influence of the squeeze effect (dh/dt) on the radial and tangent forces acting in a bearing. For this, different values of the squeeze effect are applied in the Reynolds equation to obtain pressure distribution.

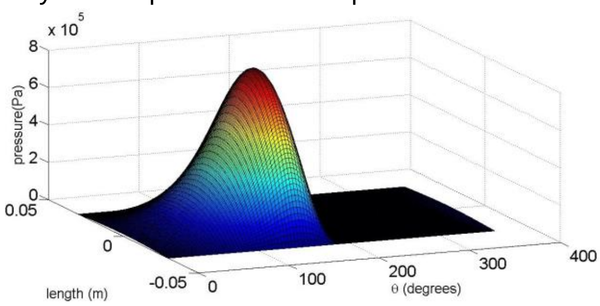

Image 1. Pressure distribution without squeeze effect (dε/dt=0μm/s).

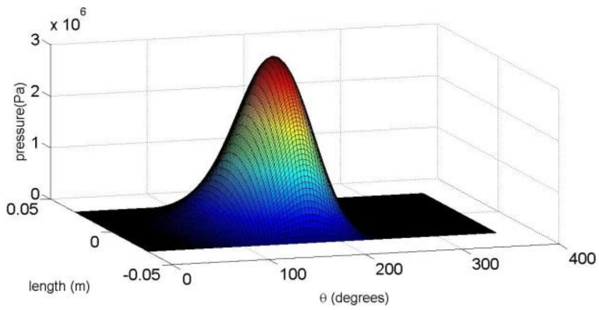

Image 2. Pressure distribution with a high squeeze effect (dƐ/dt = 500μm/s).

In following, the hydrodynamic forces can be evaluated from the integrating of the pressure distribution in the bearing. Table 1 shows the changes of the forces magnitude for different values of the squeeze effects in the bearing.

Table 1. Forces for oscillation

dε/dt (μm/s)	0.0	50.0	500.0
Radial force (N)	-22.6	-30.2	-134.4
Tangential force (N)	28.2	30.7	42.7

Conclusions

The results obtained in this work show the influence of the squeeze effect on the hydrodynamic forces in bearings. As observed, the increase of the squeeze effect can increase significantly the forces.

Acknowledgement

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[2]Norton, R.L. Projeto de Máquinas. Bookman, 2004. 4 ed. Vol. 1.