Effect of possible rotor deformation on the probability of face contact for a liquid film bearing

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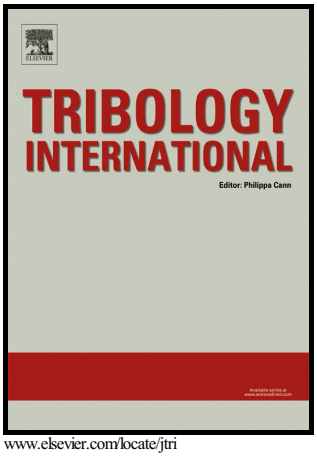

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Effect of possible rotor deformation on the probability of face contact for a liquid film bearing

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Abstract

The possibility of face contact is examined for a coaxial rotor-stator bearing in dynamic motion constrained by a highly rotating very thin liquid film. A modified Reynolds equation for pressurised flow is coupled to the bearing structure leading to determination of the bearing gap from solving a nonlinear second-order non-autonomous ordinary differential equation. Periodic solutions are found via a mapping solver. Rotor deformation is parametrised by a coning angle and considered a random variable. The method of derived distributions is used to quantify variation in coning angle and examine the probability of rotor-stator contact. Additionally, effects of possible destabilising random aspects on the axial rotor oscillations are investigated. Exact solutions for probability of contact are obtained for various bearing configurations.

Keywords: Reynolds equation, method of derived distribution, probability density function, face contact

1. Introduction

Liquid film bearings typically comprise a coaxial axisymmetric rotor and stator pair with a thin liquid film used to maintain a clearance between the faces when the bearing experiences external loading. The local film pressure may be enhanced through normal motion of the plates and flow dynamics associated with the bearings rotational motion. Commonly industrial applications of this type of bearing are required to operate with increasing rotor speed; correspondingly inertia effects which are typically neglected in classical lubrication theory need to be considered. In this high speed scenario, comprehensive and

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