DYNAMIC CHARACTERISTIC STUDY OF A NONLINEAR ROTOR THRUST BEARING SYSTEM

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ABSTRACT

The dynamic parameters estimation and response analysis of a nonlinear rotor thrust bearing system was investigated in this study. The rotor system is equipped with journal and thrust bearings. And the rotor system is also subjected to an unbalance force and parametric excitations. The parametric excitations include thrust bearing hydrodynamic forces and moments. This is under the condition when the rotor is subjected to an applied axial load. The rotor axial displacement can be calculated by solving the Reynolds equation when bearing misalignment is determined. In the meantime, the parametric excitations are also calculated by solving the perturbations of the Reynolds equation. By using above information, the system equation of the motion can be derived. By applying for time collocation method, the coupled lateral and axial motion of the system can be obtained under the consideration of the nonlinear journal bearing forces and parametric excitations. The results show that the lateral angular velocities of the thrust bearing can hardly affect the hydrodynamic loads. The lateral angular displacements of the thrust bearing can hardly affect the axial hydrodynamic loads. The axial translation displacement and velocity of the thrust bearing can hardly affect the hydrodynamic moments. The misalignment and high spin speed can enlarge the magnitudes of damping coefficients and some stiffness coefficients. But the large initial oil film thickness will suppress the magnitudes of damping and stiffness coefficients. The misalignment and an increase of spin speed will suppress the axial translation motion. The variation magnitudes of lateral rotation displacements have their maximums in the period of low spin speed.

Keywords: Parametric excitation, misalignment, coupled lateral and axial motion, time collocation method.