

Identification of Dynamic Stiffness of Squeeze Film Damper using Active Magnetic Bearing System as an Exciter

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ABSTRACT

Squeeze Film Dampers (SFDs) are commonly used to effectively enhance the damping force to the rotating shaft supported by rolling element bearings. Thus, the dynamic behavior of such a rotor system depends strongly upon the dynamic characteristics of the SFD in service. In the past, many researchers put much effort in either experimental determination or analytical prediction of the dynamic properties of SFD in service. However, few research results are found completely satisfactory yet, due to the complexity of the SFD analysis and the difficulty in experimentations.

In this work, the dynamic characteristics of an oil-lubricated, short squeeze film damper (SFD) with a central feeding groove are derived based on a theoretical analysis considering the effect of the groove, and identified experimentally using an Active Magnetic Bearing (AMB) system as an exciter. In order to get the theoretical solution, the fluid film forces of the grooved SFD are analytically derived so that the dynamic coefficients of the SFD are expressed in terms of its design parameters. For the experimental validation of the analysis, a test rig using AMB as an exciter is proposed. Using this test rig, experiments are extensively conducted with different values of clearance, in order to investigate its effect on the dynamic characteristics and the performance of the SFD. Damping and inertia coefficients of the SFD that are experimentally identified are compared with the analytical results to demonstrate the effectiveness of the analysis. It is also shown that the AMB is an ideal device for tests of SFDs.