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THERMOHYDRODYNAMIC ANALYSIS OF COMPRESSIBLE GAS FLOW IN COMPLIANT FOIL BEARINGS

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ABSTRACT

My master's thesis work deals with the development of mathematical models and numerical schemes for simulating the hydrodynamic pressure and temperature rise of compliant foil bearings lubricated by a thin gas film in between its compliant bearing surface and the rotating shaft. The model accounts for the compressibility of gas, the compliance of the bearing surface, and the interaction between the pressure field and temperature field of the gas film. Numerical solutions obtained over a fairly large range of operating speeds show excellent agreement with existing experimental data from both load performance test and bearing temperature measurement.

A series of parametric study is presented to illustrate the utility of the developed algorithms for characterization of foil bearing performance, such as the bearing load-carrying capacity, the operational stability of bearing at high speeds, and the thermal effect of the compressible fluid due to pressure work. The numerical algorithm can handle high speeds and high eccentricity ratios, which allows the prediction of realistic performance and characteristics of foil bearings under extreme operating conditions.

FIGURES AND TABLES

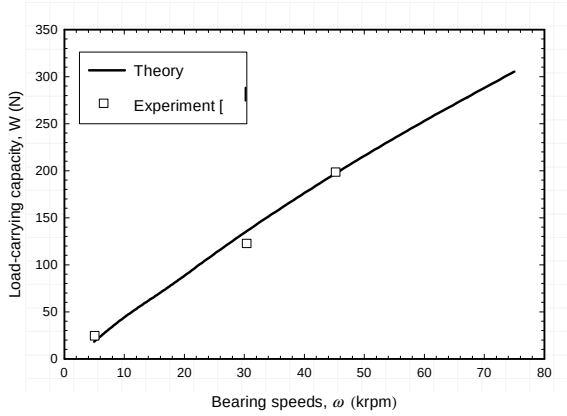

Fig. 1 Simulated load performance compared with experimental data

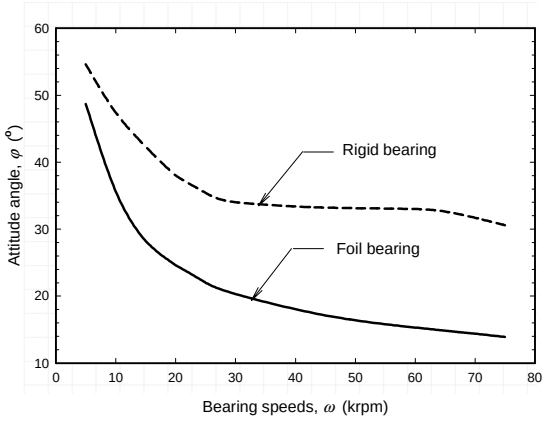

Fig. 2 The attitude angles of a rigid bearing and a foil bearing over a range of speeds

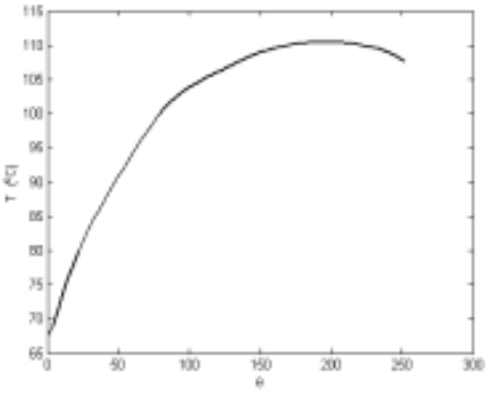

Fig. 3 Temperature rise of a foil bearing at 20,000 rpm

ACKNOWLEDGMENTS

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REFERENCES

1. Advanced Gas Turbine (AGT) Technology Development Project-Final Report, NASA CR-180891, December 1987. T. Strom Program Manager.