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Predictions of Thermo-Hydrodynamic State for Single and Three Pads Gas Foil Bearings Operating at Steady-State Based on Multi-Physics Coupling Computer Aided Engineering Simulations

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Abstract : Oil-free turbomachinery is considered one of the critical technologies for future green power generation systems as rotor machinery systems. Oil-free technology allows clean, compact, and maintenance-free working, and gas foil bearings, abbreviated as GFBs, are important for the technology. Since the first applications in the auxiliary power units and air cycle machines in the 1970s, obvious improvement has been created to the computational models for dynamic rotor behavior. However, many technical issues are still poorly understood or remain unsolved, and some of those are thermal management and the pattern of how pressure will be distributed in bearing clearance. This paper presents a three-dimensional, abbreviated as 3D, fluid-structure interaction model of single pad foil bearings and three pad foil bearings to predict bearing working behavior that researchers could compare characteristics of those. The coupling analysis model involves dynamic working characteristics applied to all the gas film and mechanical structures. Therefore, the elastic deformation of foil structure and the hydrodynamic pressure of gas film can both be calculated by a finite element method program. As a result, the temperature distribution pattern could also be iteratively solved by coupling analysis. In conclusion, the working fluid state in a gas film of various pad forms of bearings working characteristic at constant rotational speed for both can be solved for comparisons with the experimental results.

Keywords : fluid-structure interaction, multi-physics simulations, gas foil bearing, oil-free, transient thermo-hydrodynamic
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