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Predictions of Dynamic Behaviors for Gas Foil Bearings Operating at Steady-State Based on Multi-Physics Coupling Computer Aided Engineering Simulations

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Abstract : A simulation scheme of rotational motions for predictions of bump-type gas foil bearings operating at steady-state is proposed; and, the scheme is based on multi-physics coupling computer aided engineering packages modularized with computational fluid dynamic model and structure elasticity model to numerically solve the dynamic equation of motions of a hydrodynamic loaded shaft supported by an elastic bump foil. The bump foil is assumed to be modelled as infinite number of Hookean springs mounted on stiff wall. Hence, the top foil stiffness is constant on the periphery of the bearing housing. The hydrodynamic pressure generated by the air film lubrication transfers to the top foil and induces elastic deformation needed to be solved by a finite element method program, whereas the pressure profile applied on the top foil must be solved by a finite element method program based on Reynolds Equation in lubrication theory. As a result, the equation of motions for the bearing shaft are iteratively solved via coupling of the two finite element method programs simultaneously. In conclusion, the two-dimensional center trajectory of the shaft plus the deformation map on top foil at constant rotational speed are calculated for comparisons with the experimental results.

Keywords : computational fluid dynamics, fluid structure interaction multi-physics simulations, gas foil bearing, load capacity
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