3DTEHD simulations for a bidirectional tilting pad thrust bearing in pump storage units

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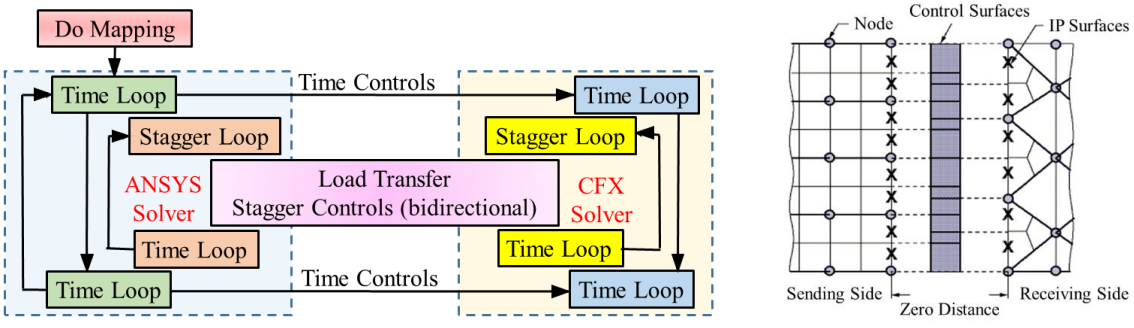
Long Abstract

Introduction

Thrust bearing lubrication involves fluid-thermal-structural interactions between the oil film, the pad and the collar. Conventional TEHD solutions simultaneously solve the Reynolds, energy, film thickness, viscosity-temperature, solid heat conduction and solid deformation equations with many assumptions and simplifications. This study used the MFX technique in ANSYS to conduct a fluid-solid-thermal two-way coupled solution for a bidirectional thrust bearing in a pump storage unit in which a 3D computational fluid dynamics model (CFD) for the oil film and a 3D finite element analysis model (FEA) for the pads are combined. Heat transfer across the pad and the influences of some operating conditions such as the thrust load, rotational speed and supply oil temperature on the pressure, temperature, film thickness and viscous torque on the collar are analyzed. The results show that this technique combining CFD and FEM models can accurately model thrust bearing lubrication problem better than the conventional method.

1. Methods

The thrust bearing TEHD analysis in this study used the direct coupled method for the fluid-thermal field in the oil film and for the solid-thermal field in the pad and mirror plate respectively, and the separately coupled method for the data exchange between the oil and the pads (or collar). The FTSI method in ANSYS uses CFX code for the fluid domain and ANSYS Mechanical for the solid domain as shown in Fig. 1(a). The fluid domain usually needs fine mesh while the solid domain just needs a coarse mesh. ANSYS then interpolates between the two meshes so they do not have to correspond to each other but may have different mesh densities so each can be adjusted to the requirements of the model. The two meshes only need to geometrically complement each other. All quantities (temperature, force, displacement, heat fluxes) are exchanged during the solution process at the matching surfaces. Mapping from one grid to another is performed as presented in Fig. 1(b).



(a) (b)

Figure. 1 Multi physics analysis
(a) Multi-physics solver, (b) Conservative interpolation of the data exchange at the interface

References

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