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# THERMO- ELASTO-HYDRODYNAMIC (TEHD) COMPUTATIONAL ANALYSIS OF TILTING PAD THRUST BEARINGS: ANALYTICAL AND FE PAD STRUCTURE MODELS

Luis San Andrés, Rasool Koosha

Work in 2018 extends an earlier (2017) single-pad, laminar flow thermohydrodynamic (THD) model, into a multiple-pad, turbulent flow thermoelastohydrodynamic (TEHD) model for the prediction of the static and dynamic force performance of tilting pad thrust bearings (TPTBs). The updated XLTHRUSTBEARING$^{R}$ software offers three ways, simple to complex, to account for mechanical and thermal pad deformations in the analysis. The first way relies on an approximate solution, based on a generalization of the Euler–Bernoulli beam theory, and outputs the axial deformation field on a pad top surface. The second method is an in-house three dimensional (3D) Finite Element (FE) model that accounts for all modes of elastic deformations, both pressure and temperature induced, and delivers a complete 3D pad deformation field. The third method, specific for pads with a complex geometry, provides a user with the option to model the pad in a commercial FE software and to import the (reduced) stiffness matrix into the code. This method only accounts for pad mechanical deformations and produces axial deformations of the pad top surface.

Unlike single pad models, the multiple-pad predictive tool extends the analysis to include (possible) thrust collar misalignment to deliver more realistic predictions. A small amplitude perturbation of the thrust collar (axial displacement and tilting) is followed by small amplitude motions of the pads and pivots, hence resulting in first-order pressured fields to calculate (frequency reduced) stiffness ($K$) and damping ($C$) coefficients. This model may output (bending) moment coefficients that couple rotor axial motions to lateral displacements.

Predictions of pad sub-surface temperature are benchmarked against published test data for an eight-pad TPTB, 267 mm in OD, operating from 4 krpm to 13 krpm (maximum surface speed = 54 to 181 m/s) and under a specific load/pad ranging from 0.69 to 3.44 MPa. The test data covers operation in the laminar flow, turbulent flow and transition flow regimes. Predictions agree with measured temperatures for most test conditions, including the transition flow regime.

TRC users have in XLTHRUSTBEARING$^{R}$ a state of the art tool to design, engineer and troubleshoot TPTBs operating under heavy loads and at high surface speeds.