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A COMPUTATIONAL MODEL FOR THE FORCED PERFORMANCE ANALYSIS OF SELF-EQUALIZING TILTING PAD THRUST BEARINGS

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A self-equalizing tilting pad thrust bearing (TPTB) adjusts its pads to account for thrust collar misalignment. Work in 2019 integrates a model for the pads' leveling mechanism into the earlier thermo-elasto-hydrodynamic (TEHD) analysis tool to deliver static and dynamic load performance predictions for self-equaling TPTBs. The analysis offers an option to implement the leveling plates geometry model from a commercial solid modeling software. The model performs analysis using the exact geometry of the leveling plates and eliminates geometric simplification. The analysis, however, only accounts for the circumferential tilting of the leveling plates (around the radial axis), and assumes the contact between the leveling plates extends over their entire radial length, i.e., a line contact. A static load analysis further determines the forces acting at the contact points of the leveling plates as well as the moments acting on them as a function of the applied load on the bearing pads. Since thrust collar misalignment rearranges the load among the pads to generate a moment on the lower leveling plates, the analysis finds tilt angles for the leveling plates to balance of moments on them. A simple Coulomb friction model further estimates the sliding friction forces acting at the contact points of the leveling plates and the rolling friction at the leveling plates pivot to be integrated into the solution. Friction forces limit the performance of the pad leveling mechanism to keep a degree of uneven loading among the pads. In addition, a Hertz contact analysis model uses the predicted forces to deliver a peak pressure for the contact area on the leveling plates. Further, this report presents predictions from XL ThrustBearing® for an example self-equalizing TPTB operating with a 0.01°thrust collar static misalignment. The bearing has six pads with 126 mm in OD, operates at 4krpm (maximum surface speed = 26 m/s) and a specific load/pad ranging from 0.5 to 3.5 MPa. Compared to a regular TPTB, a self-equalizing TPTB operates with up to 50% larger minimum film thickness. The peak mechanical deformation of a regular TPTB is roughly twice that in the self-equaling TPTB. Variations of the pads peak temperature are insignificant (max of 8.6 °C) even for the regular TPTB.