National Institute of Technology Rourkela

Departmental Seminar

Seminar Title	: Thermo-Hydrodynamic Analysis and Optimization of Oil-Lubricated Straight Micro-Grooved Journal Bearing
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Abstract	: Journal bearings are critical components in high-speed machinery, often prone to failures due to thermal and radial load challenges. Among various designs, grooved oil-lubricated journal bearings demonstrate superior thermo-hydrodynamic (THD) performance compared to conventional ones. This study focuses on evaluating the thermal and hydrodynamic performance of oil-lubricated straight micro-grooved journal bearings (StGJB) under high-speed and radial loading conditions. A THD lubrication model for straight micro-grooved journal bearings is developed by incorporating temperature-dependent viscosity and density into the non-linear Reynolds equation, coupled with the energy equation. The numerical model is discretized using the finite difference method and solved via the successive over-relaxation method to determine key performance metrics such as film thickness, pressure distribution, thermal profile, load-carrying capacity (LCC), frictional torque (FT), coefficient of friction (COF), and side leakage (SL). The performance of straight micro-grooved journal bearing is further improved through the optimization of texture parameters, including groove depth, width, and the number of grooves. An optimization approach is essential to address the need for improving the real-time performance of straight micro-grooved journal bearings. This study employs a grey relational analysis (GRA)-based statistical tool to refine key bearing parameters. The objective is to maximize the load-carrying capacity while minimizing power loss. The GRA-based approach not only optimizes the bearing parameters but also identifies the most influential parameter affecting the real-time performance of StGJB. This ensures a comprehensive understanding of parameter impacts and facilitates enhanced design strategies. The study's findings emphasize the critical role of numerical modeling and optimization in advancing the efficiency and reliability of StGJBs. By integrating advanced statistical tools and optimization techniques, the research provides a robust framework for improving the thermo-hydrodynamic performance of these bearings, making them better suited for high-speed and high-load applications. Keywords: Reynolds equation, Thermo-hydrodynamic journal bearing, StGJB, GRA