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Parallel Thrust Bearings - A Comparison between Experiments and CFD Thermoelastohydrodynamic Simulations

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INTRODUCTION: Experimental studies have demonstrated that parallel surface thrust bearings are capable of supporting thrust loads, a phenomena that cannot be predicted with the use of the classic hydrodynamic lubrication theory [1]. The literature gives various explanations of the load carrying capacity of parallel thrust bearings [2]. Recent studies concluded that the main pressure build-up mechanism is the temperature deformation of the bearing pad geometry [3], but other phenomena also contribute to the load carrying capacity. On the current work the effect of the "imperfect" parallel surface will be studied, in means of comparison of experimental results with 3D CFD ThemoElastoHydroDynamic computational models.

METHODOLOGY: A ThemoElastoHydroDynamic (TEHD) model has been generated using the commercial codes Ansys CFX and Ansys Mechanical. A two-way FSI has been set in the fluid-slider interface, by exchanging temperature and pressure field data between the CFD and the FE models. The slider geometry is able to deform due to (a) the temperature gradient, and (b) the pressure generated within the lubricant. In the simulations, lubricant properties, operating parameters and boundary conditions are considered to be the same as those in [3].

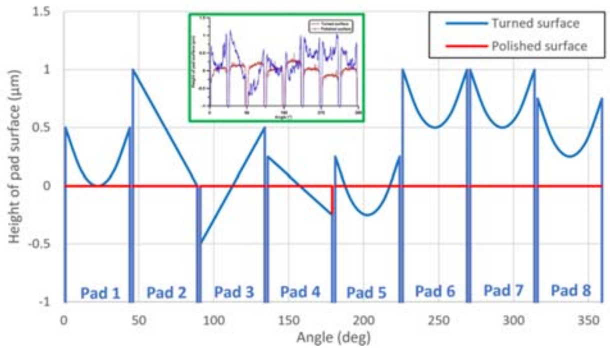

Figure 1. *Approximation of the measured geometry by Henry [4] (Flatness of the active surface of the parallel surfaces thrust bearings at medium radius).*

In order to compare the real geometry measured by Henry [4], the defect of the each pad has been modeled and evaluated separately Fig.1. There are three basic defect categories, (a) converging, (b) diverging and (c) convex, with amplitudes varying from 0.5 micron to 1 micron (see Table 1). For each defect a parametric analysis has been done for different values of H_{min} in a range near the values measured in the experiments [2]. After evaluation of each defect the load is summed and a curve of average film thickness versus Load carrying capacity is produced, and compared with the experimental results.

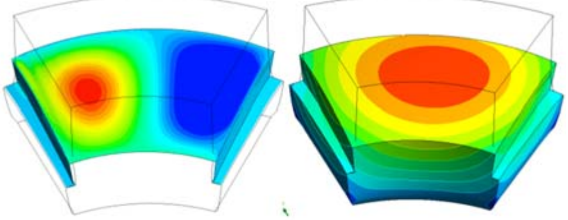

Figure 2. *TEHD model: Calculated pressure and mesh displacement fields of a parallel surface thrust bearing.*

Table 1. *Pad defects*

Pad	*Defect*	*Amplitude (microns)*	*Average film thickness (microns)*
1	*convex*	*0.5*	*+0.25*
2	*diverging*	*1*	*+0.5*
3	*converging*	*1*	*0*
4	*diverging*	*0.5*	*0*
5	*convex*	*0.5*	*0*
6	*convex*	*0.5*	*+0.75*
7	*convex*	*0.5*	*+0.75*
8	*convex*	*0.5*	*+0.5*

Moreover a perfect parallel surface sector pad thrust bearing TEHD model has been generated in order to compare the modeling results with the polished surface.

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