Aircraft Landing Gear Slider Bearing Thermo-Elastohydrodynamic Concept Model

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1. Introduction

In civil aviation, aircraft are required to operate on a variety of runways. Investigations are necessary for aircraft manoeuvring on rough runways. High loads on the shock absorber bearings and high sliding speeds induced by rough runways lead to heat generation at the slider bearings, causing eventual structural damage.

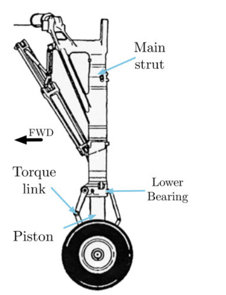

Fig.1 Landing Gear [1].

In a previous study [1], a thermo-tribo-mechanical model of a landing gear (LG) has been developed. Numerical results indicated that the main source of heat generation is at the lower bearing while manoeuvring on rough runways (see Fig. 1).

The objective of this study is to develop a methodology to quantify the heat generation and understand the rheology of the lubricant. For this purpose, a simplified 2D steady-state thermo-elasto-hydro-dynamic (TEHD) concept model of a lubricated slider bearing is presented.

2. Methodology

The proposed 2D slider bearing TEHD fluid-structure interaction (FSI) simulation is performed using a modified version of ANSYS. The thermo-mechanical behavior of the solid components is analyzed using the FE (Finite Elements) mechanical solver. An in-house CFD code, using a FD (Finite Differences) discretized Reynolds equation for Bingham flow and a Multi-Grid solver, is coupled to the FE solver. Heat is generated at the bearing interface by shearing of the viscous lubricant. Under lubricated conditions, the temperature at the sliding interface is determined from the energy equation solved in the fluid domain.

The developed methodology will lead to a 3D TEHD model, which will be used to optimize the current bearing performance.

3. Rheology and Solid Material Properties

The lubricant used in the presented model is common in aerospace applications. Grease, a non-Newtonian fluid, is generally modeled as a Bingham plastic [2]. In the presented model, a linearly varying shear stress with shear rate is adopted. The viscosity of the grease is considered to be pressure and temperature dependent.

4. Model Definition and Verification

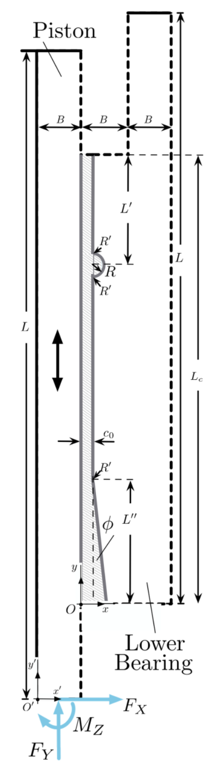

Fig.2 Model Definition.

The 2D model is shown in Fig. 2. The solid domains are linear and isotropic and the stress equilibrium equations are solved together with the energy equations for the solid domains.

The velocity field component along the lubrication gap is calculated from the pressure gradient, which results from the Reynolds equation (modified for Bingham flow). The square of the derivative of the velocity field is proportional to the heat energy, which serves as a source in the energy equation.

The stress, the displacement, the heat flux as well as the temperature fields are continuous at the FSI boundaries, by which the solids and the fluid are interconnected.

The developed model is verified using an analytical steady-state solution for oil [3]. Then, a solution with grease is obtained. Finally, the cases of oil and grease are compared.

5. Acknowledgment

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6. References

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