Master's thesis project

Finite Element solution of the Reynolds equation for compressible fluids

General information

- Laboratory: Laboratory for Applied Mechanical Design (LAMD)
- Supervisors: Arnau Català, Emanuele Pallaoro, Prof. Jürg Schiffmann
- Location: Neuchâtel (travel allowance offered)
- Starting date: ASAP
- Duration: Semester
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Background and objectives

The accurate and reliable numerical modeling of gas-lubricated bearings is essential for their design in order to predict their performance and assess stability. For this purpose, the Reynolds equation for compressible fluids has proven successful on several occasions. Due to its complexity, it is necessary to resort to numerical methods to solve this Partial Differential Equation (PDE), Finite Difference (FD) being the currently used method in the lab to transform the PDE into an Ordinary Differential Equation (ODE). Nevertheless, the FD method requires a refined regular mesh, and it can lead to numerical issues close to the boundary conditions of the fluid film.

The student will work on using the Finite Element Method (FEM) in order to solve the Reynolds equation PDE, establishing a side-to-side comparison between the FD and FEM solutions of the Reynolds equation for compressible fluids.

Working plan guideline

1. Literature research on current implementations of FEM for the Reynolds Equation
2. Implementation of the FEM solution of the Reynolds equation
3. Integration of the FEM solution into a gas-lubricated bearing code
4. Comparison between FEM and FD solutions
5. Identification of the advantages and disadvantages of these two different approaches
6. Report and presentation

Recommended prerequisites

- Finite Element Methods
- MATLAB
- Numerical methods
- Dynamics