Semester project at EPFL

CFD analysis of boundary conditions on tilting pad gas bearings

General information

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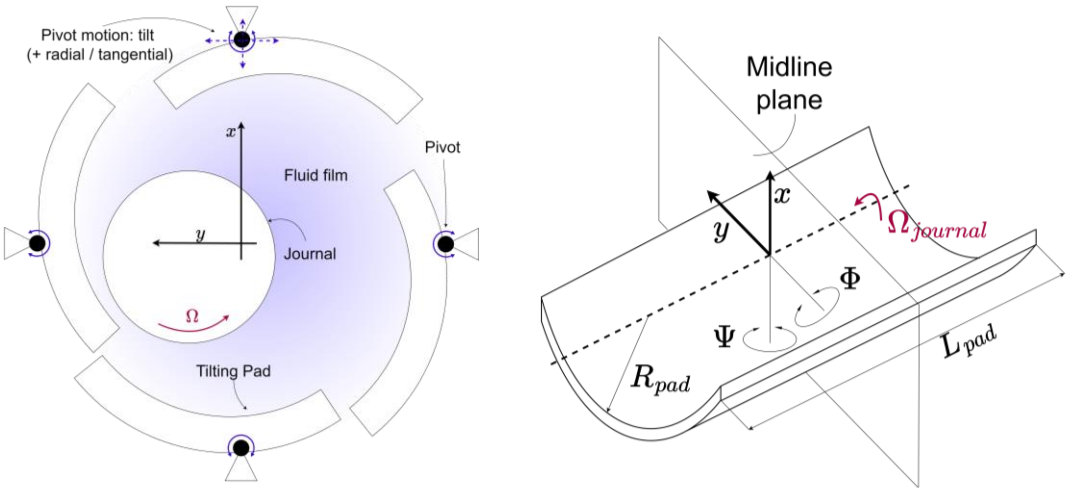
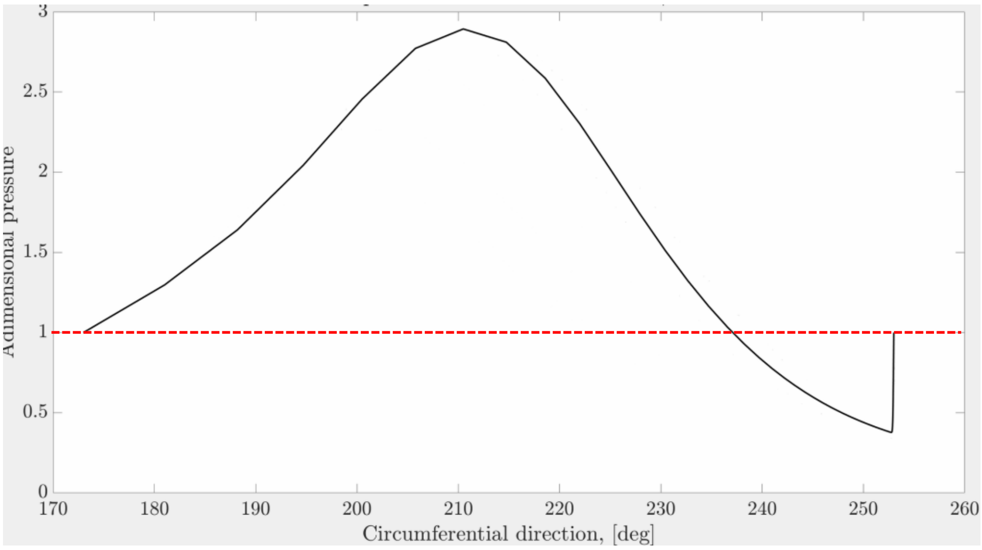
Background and objectives

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. Essentially, the Reynolds equation models the thin fluid film inside a bearing as a fluid inside a channel of variable height, with boundary conditions of atmospheric pressures at the open boundaries of the channel. This includes the “ends” of the bearing, but also the edge between one pads and the successive pad (see left diagram). This is called the *feedline*, because indeed it is a line that runs (axially) from one end to the other end of the bearing, and supplies air.



Despite the boundary condition on the feedline being of atmospheric pressure, there is indications (see graph below) that this might be wrong. In fact, referring to the diagram of the pressure profile on one pad, one can see that the pressure goes below the atmospheric pressure at the trailing edge of the pad. This is a potential indicator that the boundary condition of ambient pressure might be wrong, and backflow and recirculation might happen.



Objectives:

1. Carry out a CFD study to investigate how the flow behaves around the feedline and the leading and trailing edges of two adjacent pads. Intentify relevant flow patterns.
2. Carry out a parametric study with the two pads in different relative positions and for different journal speeds. Assess regions of operating conditions in which certain flow patterns emerge or disappear.
3. Assess the validity of the Reynolds equation in the proximity of the boundary layer.

Recommended prerequisites

- Operating knowledge of CFD – being able to successfully mesh different geometry, and handle a moving solid boundary condition.
- Good familiarity with fluid dynamics, boundary layer equations, and able to handle theoretical calculations.
- Numerical methods.