SEMESTER/MSC PROJECT PROPOSAL
Development of Matlab Program for Parameterized Linear Equations Derived from 2D Gas Films

General Information
Laboratory: Laboratory for Applied Mechanical Design (LAMD)
Supervisor: Lili Gu; Prof. Jürg Schiffmann
Location: Neuchâtel (travel and lunch allowance offered)
Duration: 5 months
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Background and Objective
Gas-film bearings (GFTBs) are widely employed in high-speed micro turbomachinery. In fluid dynamics, turbulent and inertia effects become non-negligible for Reynolds numbers much larger than 2,000. Moreover, the small-clearance makes the gas lubricating performance sensitive to temperature rise that is induced by the frictional heating effect of the viscous fluid film. As a result, an accurate prediction and reliable design of gas bearings require the analysis to account for the turbulence, fluid inertia, as well as thermal effects.

The computational algorithms developed by Dr. Lili Gu for 2D fluid domains represent general thin gas film and consider factors above. This algorithm gives a set of linear equations for solving the zero-order and first-order fluid field at discretized grids. The iterative computation involves pressure correction and the TDMA solver for algebraic equations of the following form:

\[
\begin{bmatrix}
\vec{h}_j & \vec{c}_j & \cdots & \vec{n}_j \\
\vec{a}_j & \vec{b}_j & \cdots & \vec{r}_j
\end{bmatrix}
\begin{bmatrix}
\theta_{1,j} \\
\theta_{2,j} \\
\theta_{n,j}
\end{bmatrix}
= 
\begin{bmatrix}
\vec{r}_j \\
\vec{r}_j \\
\vec{r}_n
\end{bmatrix}
\]

The proposed project will translate the computational algorithms into Matlab program, which will serve as a cross-benchmarking tool for the under-developing optimized tool for gas bearings.

Requisites:
Matlab skills and CFD experience.

Tasks and Deliverables:
1. Comprehend the algorithms used to solve the 2D fluid domains.
2. Generate staggered grids (explained in the Fig. 1) and translate the given algorithm into user-friendly Matlab program.
3. Compare the program with ANSYS CFD for a gas film encompassed in two parallel plates with a cylinder orifice.
4. Deliver report and presentation along with a verified Matlab program.

Fig. 1 Staggered grids and control volumes for 2D gas domains