COMSOL CONFERENCE
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ASML

Fluid-structure interaction modeling of Air bearing

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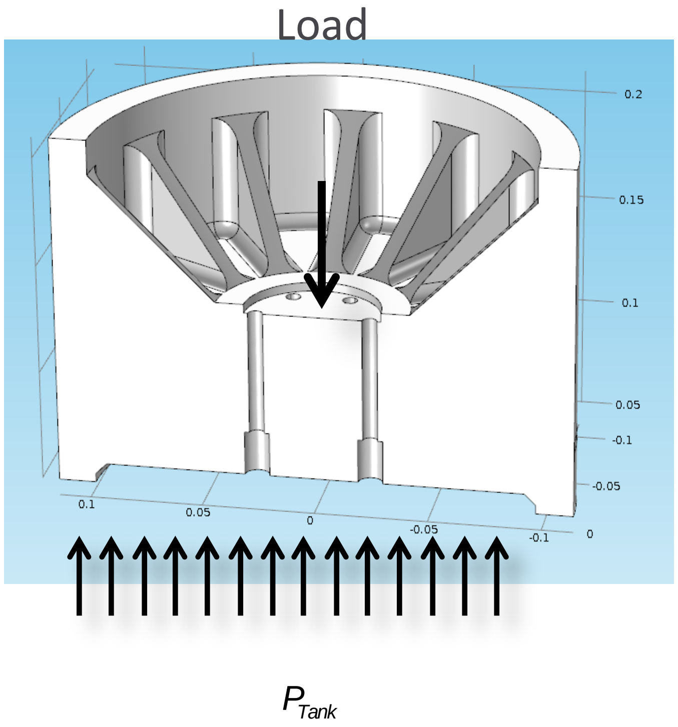
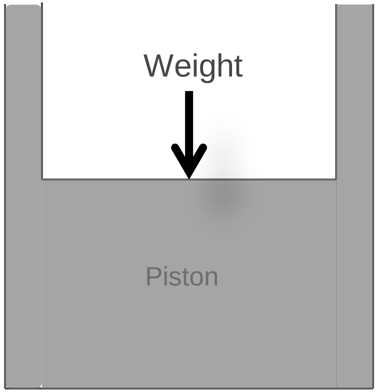
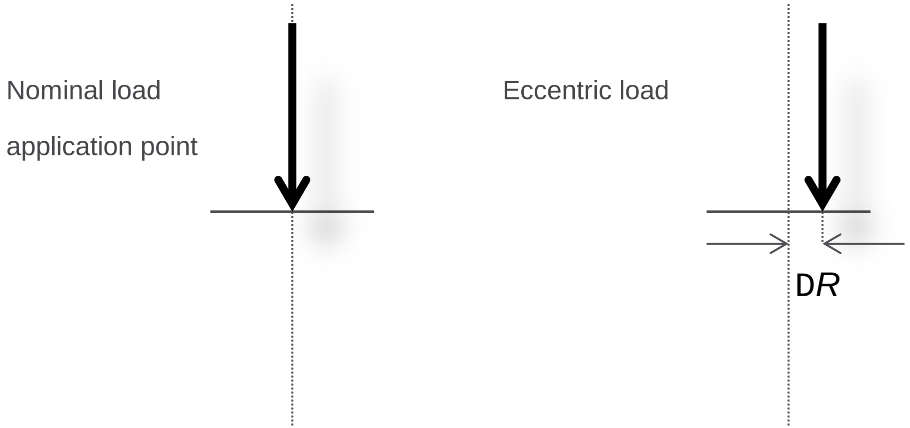
Balance of load with pressure



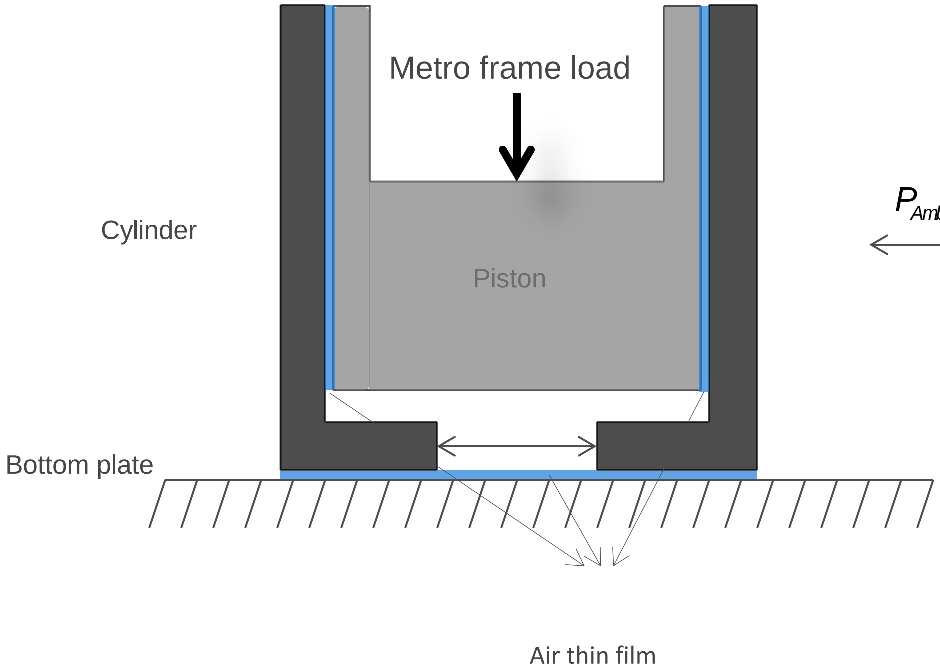
Tilt stiffness

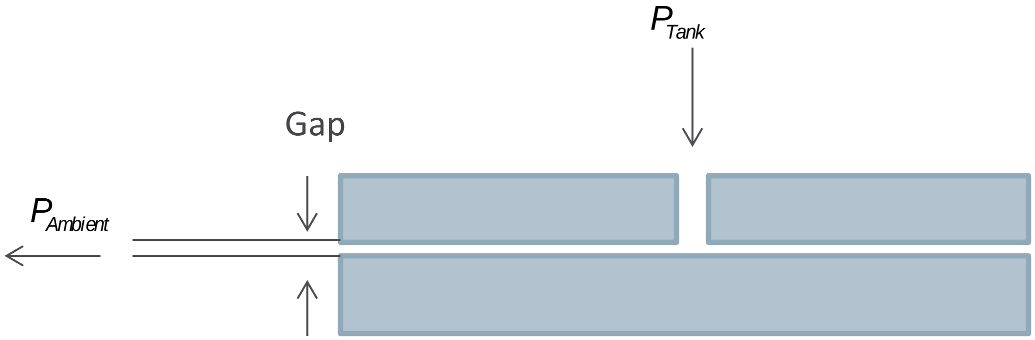
An eccentric load will cause moment which the Air mount should have necessary rotational stiffness to avoid contact and consequently friction.





Introduction



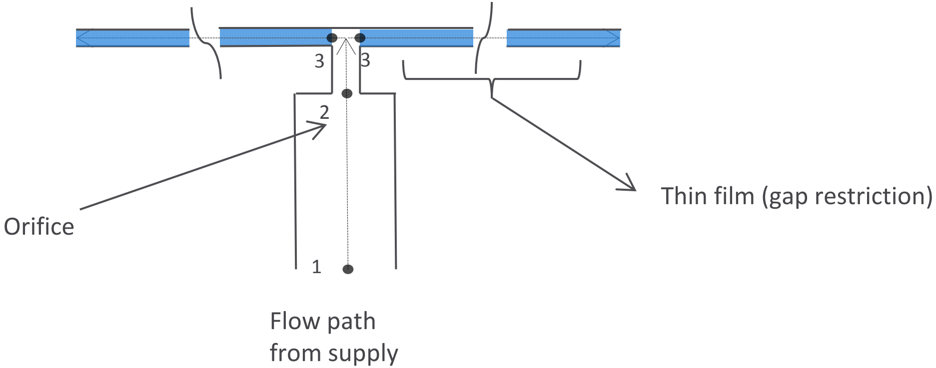


Physics:

1. Flow in the thin film: “Thin-Film Flow, Shell(tffs)”

$$\frac{\partial(\rho h)}{\partial t}+\nabla.(h\rho v)-\rho(v_w.\nabla h_w+v_b.\nabla h_b)=0$$

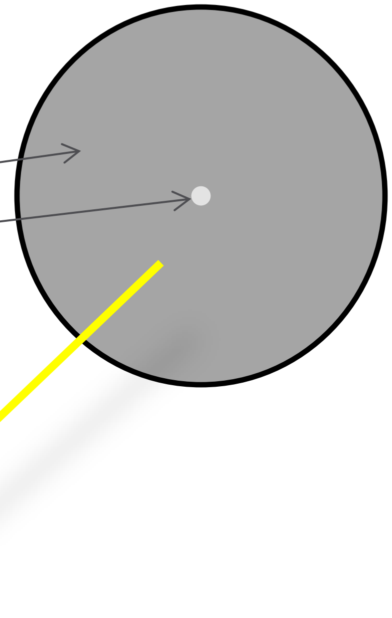
1. Flow in the Nozzle: “Edge-ODEs”

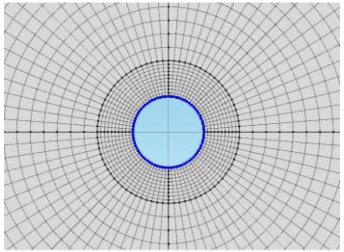


2. Structural deformation: “Solid Mechanics”

Solving physics 1 & 2

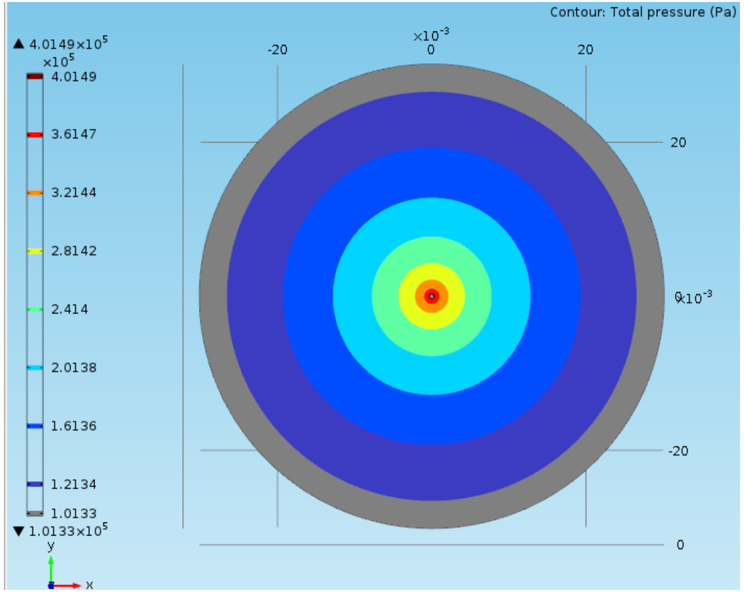
Name	Entity level
Thin film	Boundary
Inlets	Edge



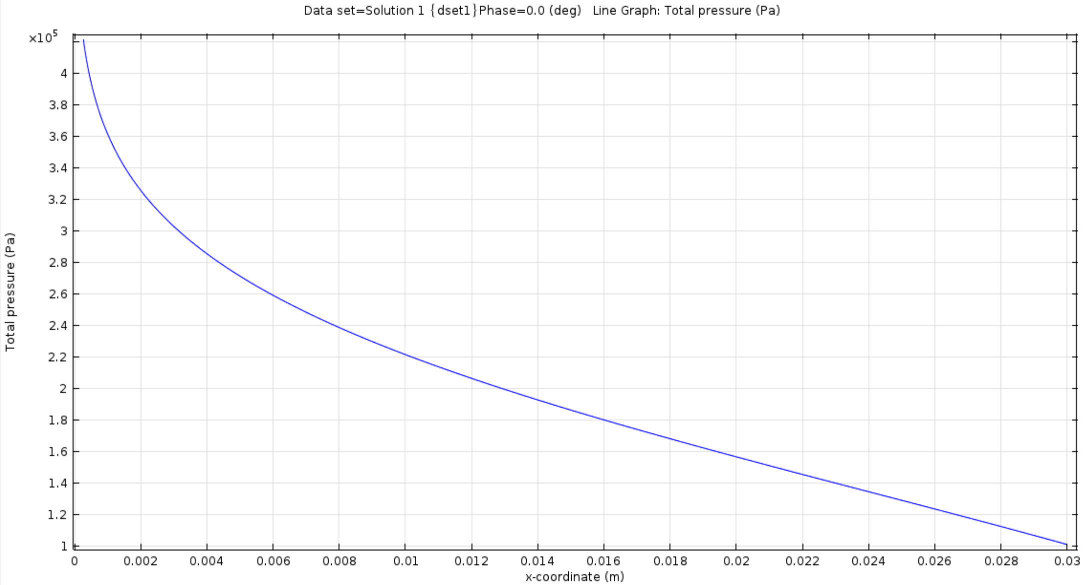


Solving physics 1 & 2

Air consumption = $1.647\ nl/\text{min}$

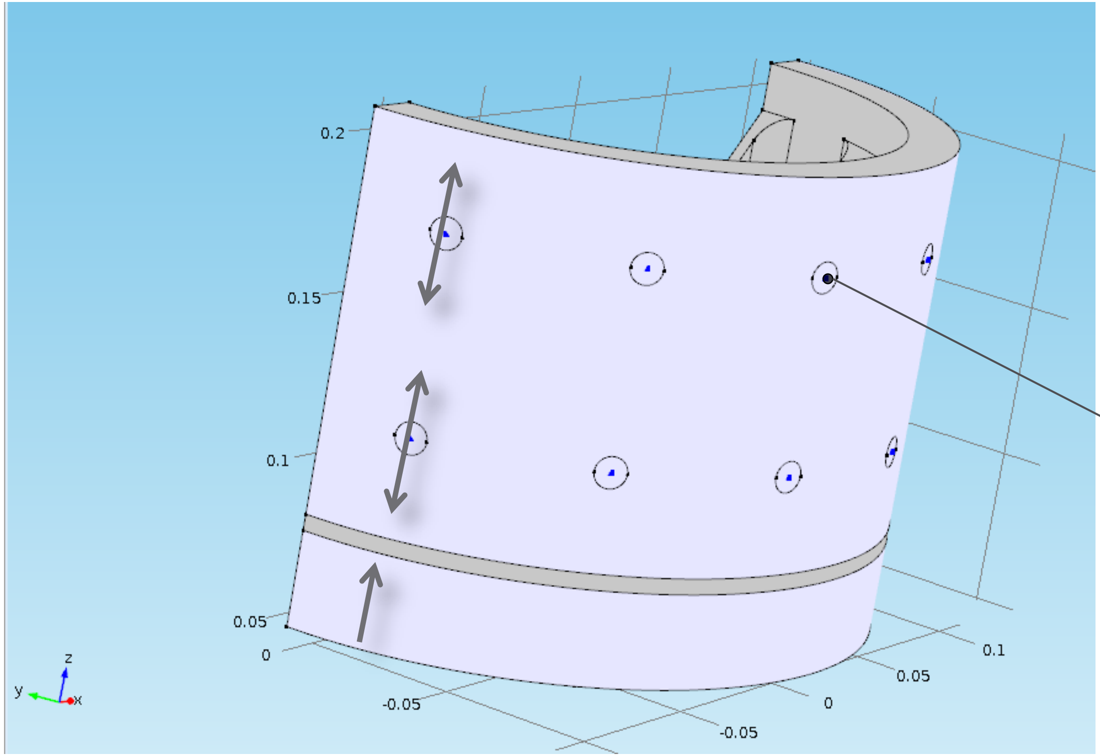


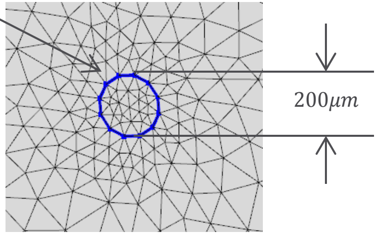
Pressure contour



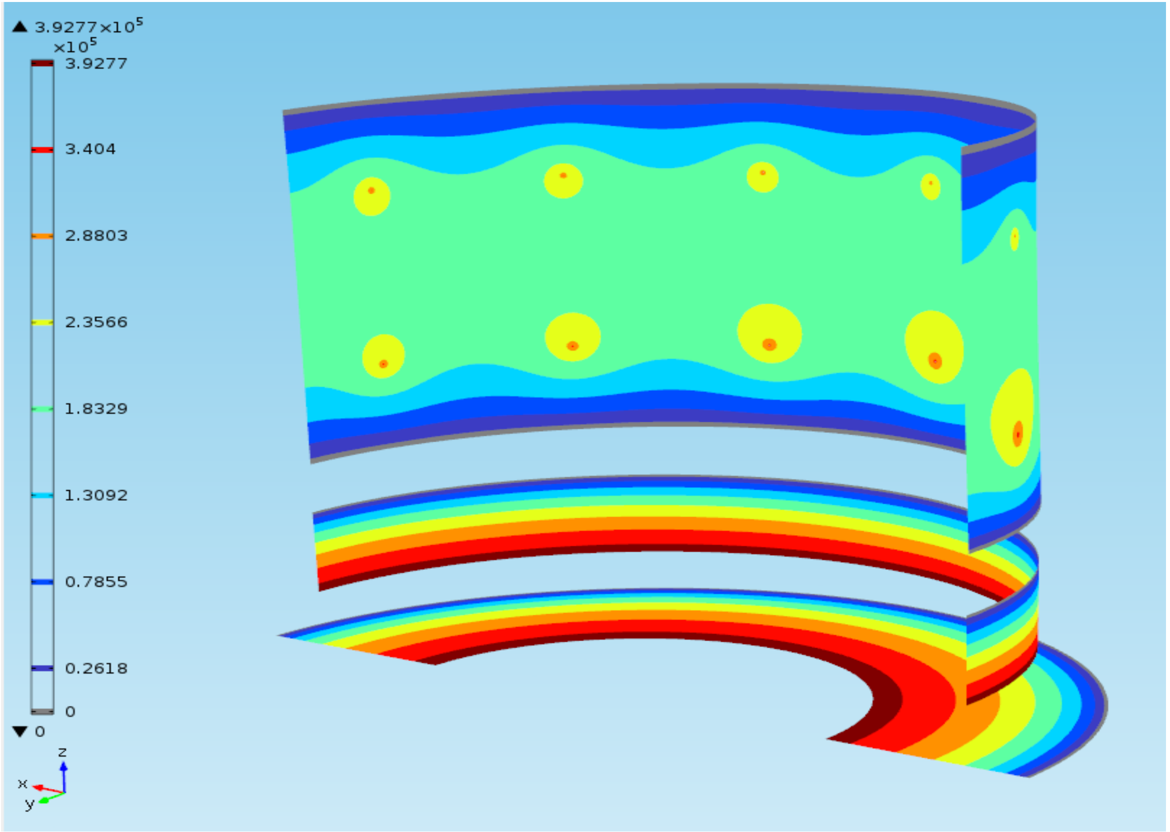
Pressure on axisymmetric line

Air bearing FSI in COMSOL (Nozzles)

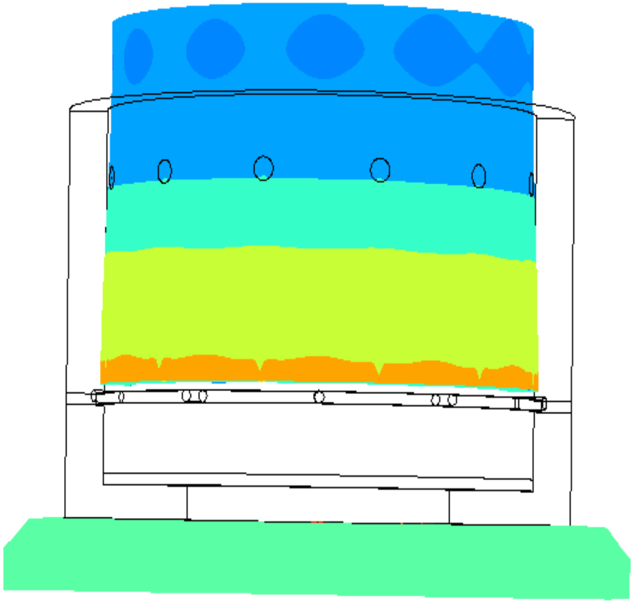




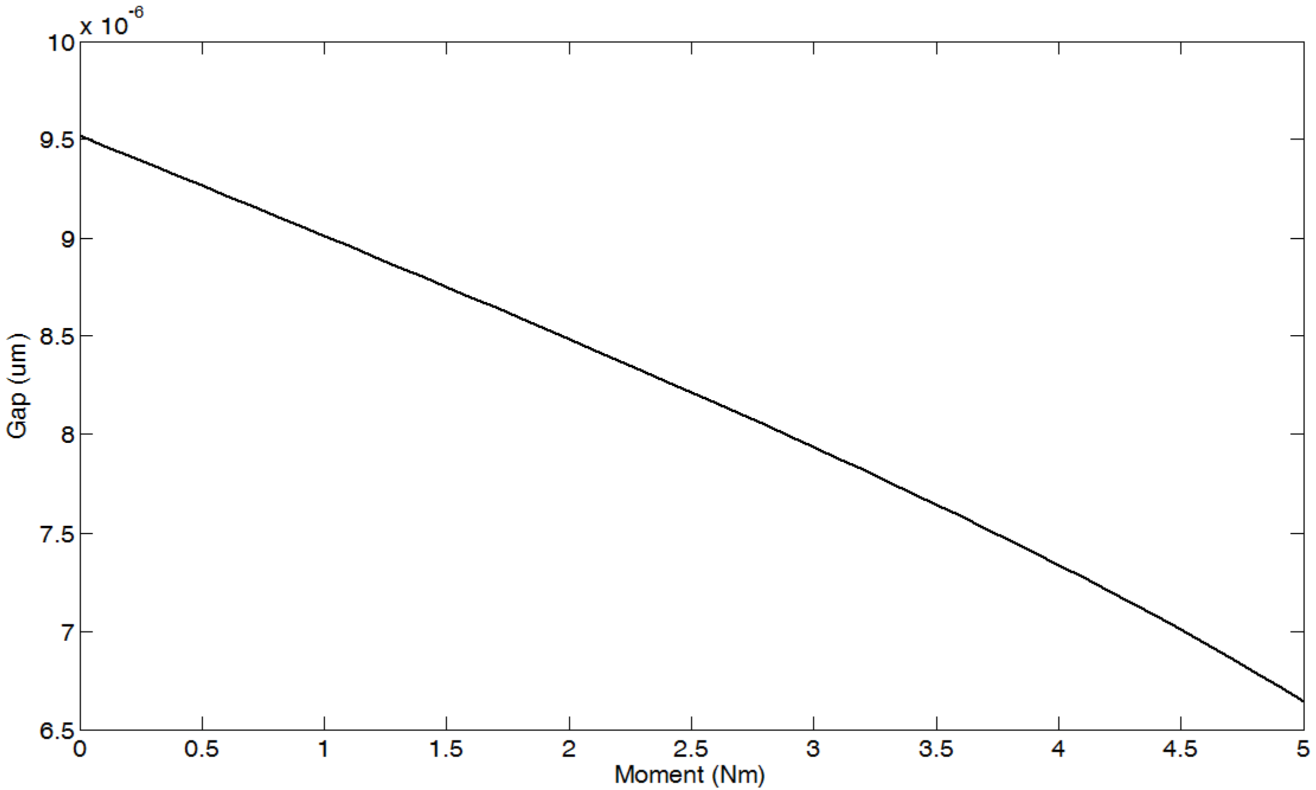
Results (thin film pressure and flow consumption)



Results (Animated deformation)



Results (minimum gap as a function of moment)



Conclusions

- COMSOL is relatively more flexible than Ansys in modeling Air bearing.
- The computational time is significantly reduced due to the coupled approach.
- Air bearing model is a highly compressible flows which interact with very stiff structures. These types of problems are difficult to solve using the Iterative FSI Coupling.