Master thesis proposal

Reduced order model of a small-scale turbocompressor

General information:

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Background and objective:

The Center for Intelligent Systems of EPFL has recently started a research project to develop the digital twin of a small-scale turbocompressor to detect precursors of dynamical instabilities. In this project, the digital twin consists in a physics-informed surrogate model, built with reduced order modelling techniques, empowered with machine learning algorithms to improve its prediction capabilities. An existing reduced order model (ROM) has already been developed from simplified equations of the rotordynamics system (Narrow Groove Theory - NGT). An alternative would be to develop a ROM directly from the original Reynolds' equation, to better capture the dynamics of the coupled system. The challenge is to incorporate the grooved geometry of the bearings with dedicated numerical methods.

The objective of the master thesis is to develop a ROM of a small-scale turbocompressor based on Reynold's equation and to assess its validity on realistic configurations.

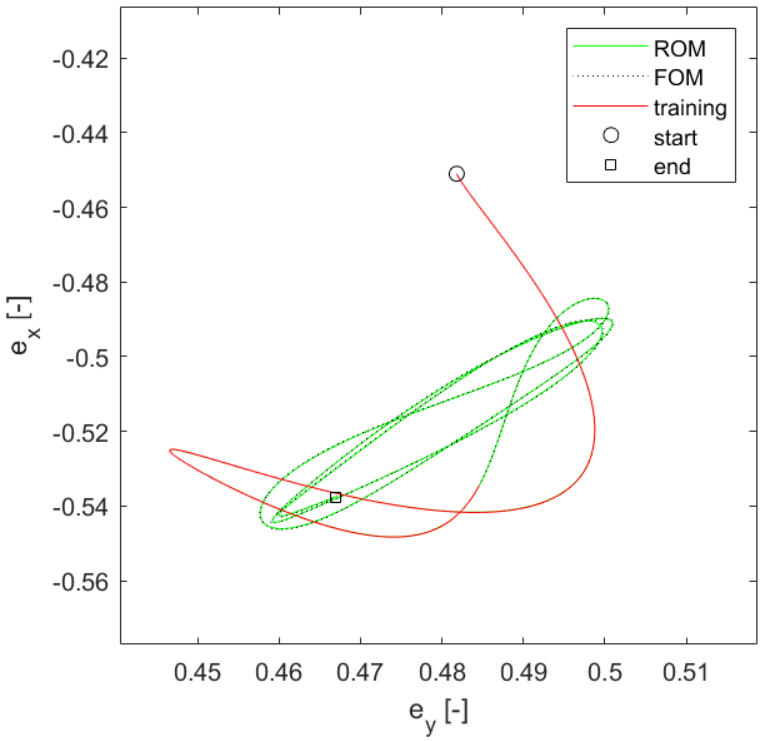

Figure: The reduced order model (ROM) predicts the trajectory of the rotor center from a limited knowledge on the exact solution, and much faster than the full order model (FOM).

Tasks:

1. Literature review (numerical methods for Reynolds' equation, reduced order modelling)
2. Development of a high-fidelity rotordynamics model (Full Order Model - FOM)
3. Development of a fast surrogate model (Reduced Order Model - ROM)
4. Identify the validity domain of the ROM on a realistic configuration
5. Comparison of the developed ROM based on Reynolds' equation with the existing ROM based on NGT
6. Report and presentation

Key words:

computational mechanics, reduced order model, small-scale turbocompressor

References:

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[3] D. Bonneau, J. Huitric, B. Tournerie, Finite Element Analysis of Grooved Gas Thrust Bearings and Grooved Gas Face Seals. ASME. J. Tribol. 1993.