Improvement of a FV tool for thermal modeling in micro-turbomachinery

Semester Project Proposal

General information

Laboratory: Laboratory for Applied Mechanical Design
Supervisor: Eric Olmedo, Lili Gu, J. Schiffmann
Location: Neuchâtel (travel and lunch allowance offered)
Starting date: Spring semester, 2018
Duration: Until end of term (14 weeks + presentation)
Contacts: luiseric.olmedo@epfl.ch, lili.gu@epfl.ch, jurg.schiffmann@epfl.ch

Background and Scope

Thermal management in high-speed micro-turbomachines can be a critical aspect in both design and operation phases. For compact systems, the reduced area-to-volume ratio and the limited space for active cooling solutions hinder heat evacuation. An adequate description of the system’s thermal behavior is thus a valuable tool in the turbomachinery development process.

The current project focuses on a finite volume approach to modeling the steady-state thermal behavior of a 2D rotor/stator configuration. The project pursues the improvement of a Matlab finite-volume tool previously developed at LAMD. The developed tool should serve as a module for an integrated design of micro-turbomachinery while maintaining a high computational efficiency and adequate accuracy.

Detailed description

1) Identification of areas of improvement
   a) Tool acquaintance, tool documentation and literature review.
   b) Propose benchmarking cases for CFD.

2) CFD Benchmark
   a) Perform CFD simulations for the benchmarked scenarios.
   b) Compare CFD vs tool performance.
   c) Propose improvements to current FV implementation (e.g. modification of thermal boundaries, thermal models for air domains, etc...).

3) Implementation and results
   a) Implement in MATLAB the proposed improvements.
   b) Quantify changes.
   c) Deliver a written report with findings and relevant simulations.

Requisites:
Knowledge of Matlab and object-oriented (OO) programming (tool is written in OO).

Keywords: heat-transfer, finite difference, finite volume, thermal management, micro-turbomachinery.