Development of parametrization techniques for rapid impeller geometry generation and optimization

Semester Project/MSc Thesis Proposal

General Information
Laboratory: Laboratory for Applied Mechanical Design LAMD
Supervisors: Sajjad Zakeralhoseini, Prof. J. Schiffmann
Location: Neuchâtel (Travel allowance offered)
Duration: 3/6 months
Contracts: sajjad.zakeralhoseini@epfl.ch, jurg.schiffmann@epfl.ch

Backgrounds and objectives
Emerging applications for turbomachines e.g. waste heat recovery and Organic Rankine Cycle (ORC) require careful innovative design procedures. Preliminary designing and Empirical models available in the literature are mostly applicable to large-scale turbomachines and employing these models for small-scale applications without further analysis and optimization leads to inefficient turbomachines. To do this optimization, a robust tool is needed to generate and parametrize blade profiles from mean-line analysis and eventually create the optimal blade profile resulted from 3D fluid dynamics and optimization methodologies.

Thus, the objective is to develop a tool that construct and parametrize a variety of turbomachinery impellers e.g. axial and radial turbine blades which at the end should be coupled to a mesh generator and a CFD solver. The developed tool will be employed for optimization of impeller shape for a different types of turbomachines.

Requisites:
The candidate should have a background in programming and CFD analysis or the passion and motivation to learn.

Tasks and Deliverables
1. To become acquainted with the developed tools (Turbine/Compressor/Pump) within the lab
2. Develop a tool for optimization
   a. To create the parametric geometry of impeller from the respective mean-line model of each turbomachines
   b. Integrate the tool to an open-source or a commercial mesh-generator and CFD solver to perform direct optimization or surrogate modeling
3. Deliver a short report with presentation along with the tool