Semester/MSc project proposal

Theoretical investigation of the axial forces within a small-scale partial admission turbine

General Information:
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Background and Objectives:

A small-scale steam turbine with a diameter of 15 mm was tested successfully at LAMD. The turbine was tested with cold air initially. The next step is to test it with hot air at 200° C and later on with water vapor. The turbine has partial admission and prismatic blades. The stator in the figure is turned upside-down.

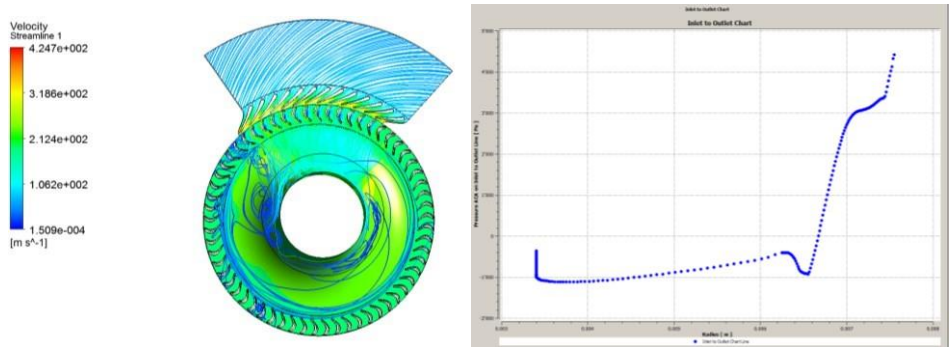

Figure 1 – CFD of the radial inflow small-scale turbine and visualization of axial force (left) and graph of pressure vs. radius (right)

An existing analytical model of the axial turbine forces should be benchmarked with the already-obtained experimental data. Various previous studies carried out at LAMD can be made advantage for achieving this purpose. For a better understanding of the axial forces in this unit, a computational fluid dynamic (CFD) simulation of the unit was already carried out. Because of the partial admission effect, a full circle CFD was chosen (see Figure 1). For a possible Master project, this simulation could be extended to include the turbine backflow. In a final step, the validated / improved analytical model is implemented in LabView to estimate the real-time axial force, based on pressure measurements.

Tasks:

- Understanding the behavior of axial forces in turbomachinery.
- Analyze the current analytical axial force model and digest the previous student projects at LAMD.
- Validate the theoretical model with experimental data and then modify it if necessary.
- Include the turbine backflow of an already existing full circle turbine CFD model (Master thesis).
- Implement a real time axial force calculation in LabView based on in situ measurements of the unit.