PROJECT PROPOSAL

Structural analysis of 3D-printed radial turbines

General information
Lab: Laboratory for applied mechanical design (LAMD)
Location: Microcity, Neuchâtel (travel and lunch allowance offered)
Supervisors: Kévin Rosset, Prof Jürg Schiffmann
Type: Semester/Master project
Starting date: 19/02/2018
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Background
In order to provide sufficient load capacity and to be stable, aerodynamic bearings require the rotor shaft to be as light as possible and its mass well distributed over the bearings. A convenient design for small-scale single-stage radial compressors/turbines is when the wheel is mounted at the shaft end and the motor/generator lies in between the two journal bearings. The drawback of such a design is the overhung position of the wheel compared to the bearings, which shifts the center of gravity of the rotor towards one of the bearings. A straightforward way of reducing this effect is to decrease the weight of the wheel by appropriately selecting the material. However, in some cases, the operating conditions of the machine (speed, temperature, blade loading, etc.) restrict the applicable materials. An attractive idea for reducing the mass of the wheel could be to 3D-print it with empty pockets inside.

Objective
The goal of this project is to investigate the effect of empty pockets on the structural behavior of a radial-inflow turbine (Figure 1). Different pocket layouts will be proposed and analyzed using finite element methods (ANSYS Workbench) in order to evaluate deformations and stresses arising from various operating conditions. In case of a master thesis, rotordynamic analysis will also be performed using an in-house MATLAB tool in order to evaluate the tradeoff between the structural integrity of the wheel and the stability threshold of the rotor shaft.

Figure 1: Test-case radial-inflow turbine running at 100'000 rpm