

Posudek oponenta diplomové práce

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Název práce: **Thermodynamic modeling of rolling fluid turbine**

The goal of this thesis is to investigate a thermodynamical description and explanation of phenomena occurring in rolling fluid turbine. The first part of the thesis introduces basic continuum mechanics setup for fluids, deriving Navier-Stokes equations and their simplifications to Euler equations and potential flows. Then the next chapter follows the approach taken in [F. Maršík, J. Falta, M. Sedláček. Theoretical Analysis and Experimental Verification of the Rolling Turbines Performance] and looks at the problem from the point of view of initial stability or instability. A critical Re number is identified such that there is a unique solution for Reynolds numbers below that value.

The novel contribution is presented in chapter 4, where an alternative approach is introduced to explain the physics behind the rolling turbine. The aim is to investigate the steady flow solution in the working mode of the turbine. First the time varying problem geometry is transformed by co-rotating frame of reference to work in fixed geometry. Then dimensional analysis is used to reduce the system of equations and deduce a formula for the power. Then two main questions are formulated and answered, namely - Are there parameters such that there is a stationary solution with positive power generation, and - Whether such a solution is stable.

In the last chapter a simplified numerical solution using FEM and software package FEniCS is presented.

The thesis tackles an interesting yet difficult physical problem. Overall the rolling turbine seems like a simple working mechanical system at first sight, but to explain why it works seems to be quite a deep and complicated problem.

Stylistic remarks:

- In the bibliography, the reference no. [14] is missing publication details
- Some english formulations are questionable and there are several misprints.
- The numerical references throughout the text are not consistent, sometimes it is not clear whether the reference points to a figure, section or equation. Moreover tables are without any caption or numbers while in text the table (4.2) is referenced.

Question for the discussion:

- In the main part - the section 4.2 - series of simplifications and approximations at different steps are introduced to reach the goal - there it would be beneficial to make some final overview summary what was neglected and what effects were in fact kept in the derivations. While the calculations appear correct, justification of some of the reductions could be more detailed. For example the reduction to 2D is done on page 26, reducing the problem to a cylindrical manifold near the rotor, while at another step the viscous terms are neglected. Can this together be reasonably justified?

The thesis is well written with a reasonable amount of typos and presents original results that can be further extended in several directions.

Doporučuji práci uznat jako diplomovou.

V Praze, 6.7.2020

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