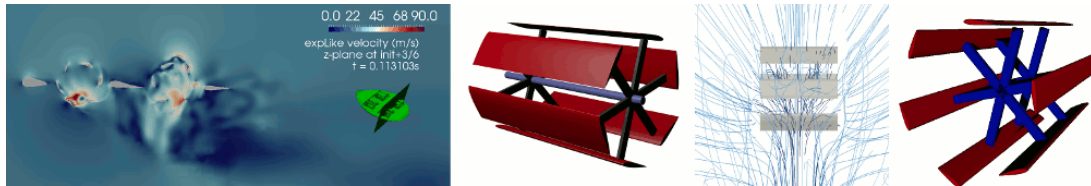


## Master Thesis Topic

### Accurate Aerodynamic Power Assessment of Cycloidal Rotors using CFD



**Cycloidal rotors** have the advantages of providing  $360^\circ$  thrust forces and having constant flow velocities on their blades. However, the deformation of their blades reduces efficiency and is not well understood. Also, while air enters and exits the rotor, it encounters the blade twice and this favors dynamic stall and blade-vortex interaction. The given advantages over conventional helicopter rotors and consequent challenges make cycloidal rotors ideal for research. The aerodynamic phenomena they produce are investigated by means of numerical fluid simulation.

The current state of the art models are able to reproduce the thrust produced by the rotors to a satisfactory level of precision. Unfortunately, the same cannot be said for the torque on the rotor, and consequently, for its power consumption.

The theme of the proposed thesis is thus to *study possible improvements to the modeling methodology, possibly relying on the Large Eddy Simulation turbulence modeling method.* The objective is to *bring the estimation of the consumed rotor power closer to reality.*

#### Tentative milestones:

- familiarize with the **OpenFOAM** CFD toolbox and the pimpleFoam tutorials
- implement the **pitching motion** of an oscillating airfoil for a case from the literature
- improve the setup in order to obtain **accurate drag** predictions
- extend the case to a **full-rotor** simulation using data from the literature
- further improve the setup to obtain **accurate power** predictions
- verify improved model with different **literature** cases
- rate effectivenesses of the different tested approaches to achieve **correct drag and power**

#### Prerequisites:

- interest for fluid mechanics and rotors
- willingness to work with scripts, the terminal, and Linux
- patience and attention to detail
- experience with airfoils, meshing, or CFD is a plus but is not essential

#### Language:

The supervision can be conducted in German, English, French, or Italian according to the preference of the student.

The thesis should be in German or English.

#### Interested?

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