Universität Stuttgart

INSTITUT FÜR AERODYNAMIK UND GASDYNAMIK IAG

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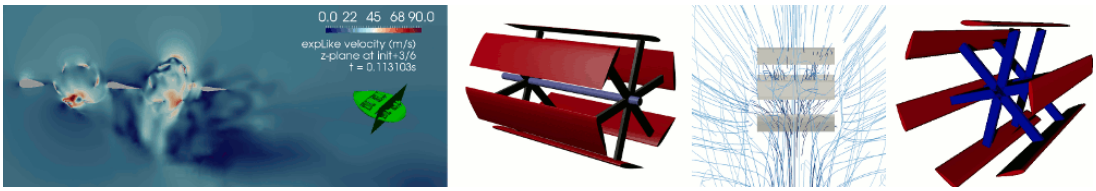
Master Thesis Topic

Create a Fluid-Structure Simulation Framework for Cycloidal Rotors



Cycloidal rotors have the advantages of providing 360° 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 cyclorotors ideal for research. The aerodynamic phenomena they produce are investigated by means of numerical fluid simulation.

The current state of the art CFD simulations of cycloidal rotors neglect the spanwise deformation of the blades. Unfortunately, this reduces the accuracy of the obtained results because such deformation is unavoidable yet may have, as for helicopter rotors' flapping blades, a considerable influence on the aerodynamic response or cyclorotors.

The theme of the proposed thesis is thus to *rely on a pre-existing coupling software suite to conduct nonviscous 3D simulation test case of a cycloidal rotor with flexible blades*. The objective is to *provide a framework to allow subsequent refinement of the currently used CFD models of cycloidal rotors.*

Tentative milestones:

- familiarize with the **OpenFOAM** CFD toolbox and the **MBDyn** multibody dyn. software
- perform oscillating airfoil CFD, test **coupling** with MBDyn through the preCICE toolbox
- extend to the third dimension and add the possibility to **deform the blade** along its span
- **couple** the blade surface mesh to the beam mesh of the multibody dynamics simulation
- conduct a **parametric study** to balance accuracy and solution speed

Prerequisites:

- interest for fluid dynamics and structural mechanics
- willingness to work with scripts and terminal-based software
- patience and attention to detail
- experience with either FVM, FEM, or code debugging is recommended

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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