Universität Stuttgart

INSTITUT FÜR AERODYNAMIK UND GASDYNAMIK IAG

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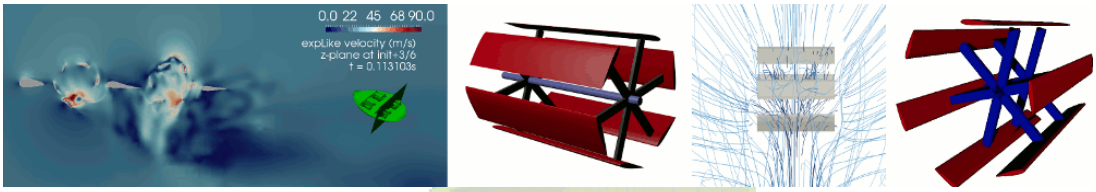
Master Thesis Topic

Adapt the Arbitrary Mesh Interface of OpenFOAM to Decrease Computational Load of Highly Parallelized Cycloidal Rotor Simulations



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 CFD models for complex cycloidal rotor geometries do not scale well with the number of computing cores. This is caused in part by the poor parallelization of the currently used interpolation algorithms. Another cause is the recourse to highly inhomogeneous interfaces across the boundaries of the CFD interface.

The theme of the proposed thesis is thus to *refine, rewrite, or better parallelize the C++ interpolation and bisection algorithm used for cycloidal rotor simulations*. The objective is to *reduce the computer time required to compute interpolation weights at each simulation time step*.

Tentative milestones:

- familiarize with both **OpenFOAM.com** and **foam-extent** CFD toolboxes for the AMI and GGI interfaces
- implement a case with meshing constraints similar to those of cycloidal rotors
- change the AMI or the GGI meshing methodology to **speedup** the computations
- identify potential improvements in the code such a better **parallel load distribution**
- consider improvements such as **caching** interpolation weights and resorting to interface meshes which can be **bisected** without resorting to search algorithms

Prerequisites:

- ready for scripts and the **Linux** console
- **patience** and attention to **detail**
- experience with **C++** is recommended
- experience with **meshing** is a plus

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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