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REMESHING – CFD SIMULATION OF MOVING OBJECTS WITH OVERLAPPING TRAJECTORIES

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One of the main challenges in the simulation of devices such as pumps and compressors is the representation of the moving parts (e.g. rotors and gears) inside them. The moving parts can be simulated using different approaches such as Arbitrary Mesh Interface (AMI), Immersed Boundary Method (IBM) or Over-set [1]. In the methods such as IBM or Over-set the fields are interpolated between the moving part (which can be an overlapping mesh) and the background mesh, which makes them less accurate and computationally expensive. AMI is also limited to the simulations with non-overlapping trajectories. In many of the twin rotor pumps and compressors, the trajectories of moving parts are overlapping and usually it is interesting to know the exact fluid flow behaviour next to the rotors (e.g. for shear rate investigations) which makes the mentioned methods earlier not applicable.
In the current study, the authors present a combined deforming-remeshing strategy to simulate the behaviour of moving objects. In this strategy, a body-fitted mesh is generated on the geometry under investigation. To describe the movement of the object the boundaries and mesh next to them will be deformed and the relevant equations are solved. In each time step the quality of the deformed mesh is checked and in case the mesh quality falls below a certain criteria, the geometry will be re-meshed with the actual position of the moving objects. The simulation fields will be mapped from old mesh to the new one and the simulation will continue with the deforming of the new mesh. The presented method was implemented using open-source code OpenFOAM® for meshing, mesh manipulation (deforming mesh) and flow simulation and bash scripting for performing geometry updates and re-meshing. To show the capability of the presented method the behaviour of a Roots blower [2] was simulated and investigated. The temperature and pressure fluctuations in the high pressure gas stream were extracted and analysed to check the stability of the flow and heat dissipation in the device. Also Fast Fourier Transform (FFT) analysis of the time resolved pressure values provided a better understanding of the possible vibration frequencies of the blower.

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