EULERIAN APPROACH TO SIMPLIFIED FLUID-STRUCTURE INTERACTION

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ABSTRACT

We consider the simplified fluid-structure interaction (FSI) model of a rigid body in an incompressible fluid. This consists of the Navier-Stokes equations for the fluid and Newton-Euler equations for the solid. Our computational approach is based on an Eulerian approach to allow for large deformations relative to the initial spatial configuration, and as it has been shown that topology changes in the (fluid) domain are viable in the Eulerian setting. To this end, we extended an Eulerian time-stepping from [1] to the time-dependent Stokes equations on a moving domain with prescribed motion [2]. To analyse the method for the case of the solid's motion results from the forces acting from the fluid onto the solid, we remove the pressure from the system and consider a parabolic model problem for the fluid while we restrict the solid's motion to translational movement. We show that the resulting scheme is stable and converges optimally in space and time [3]. Based on data from a physical experiment of falling balls in a viscous fluid, we apply the method to the complete fluid-rigid body problem in [4], including the ball's rebound off the bottom of the fluid domain.

References

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