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Dynamically Coupled Fluid-Body Interactions with a Versatile Multi-Domain Immersed Boundary Library[1] CHENGJIE WANG, JEFF D. ELDREDGE, University of California, Los Angeles — A computational algorithm is developed to simulate dynamically coupled interaction between fluid and rigid bodies. The basic computational framework is built upon a multi-domain immersed boundary method library, whirl, developed in previous work. The multi-domain approach inspired by Colonius and Taira (2008) is intended to cover a large simulation domain with multiple bodies by using a hierarchy of nested domains with different sizes and grid resolutions. This approach enables a versatile and economical use of computational resources. The library hides the details of the fully parallel treatment from the code developer, leading to simple construction of 2D or 3D solvers. In the present case, the incompressible Navier-Stokes equations are solved in vorticity-streamfunction form. The rigid body equations of motion are assembled with the flow equations with immersed boundary forces. The resulting saddle point system is solved in strongly coupled form by the Schur complement reduction method. The resulting scheme is tested by several numerical examples, such as vortex induced oscillation of a cylinder in 2D. Preliminary results are shown for the flapping of a low-aspect-ratio hinged wing at low Reynolds number. The results are compared with previous simulations and experiments.

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