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Immersed Boundary Fractional Step Method[1] KUNIHIKO TAIRA, TIM COLONIUS, California Institute of Technology — We present a new formulation of the immersed boundary method for incompressible flow over moving rigid bodies. Like many existing techniques we introduce a set of interpolation points on the surface at which the no-slip boundary condition is satisfied by including a (regularized) force in the momentum equations. By introducing interpolation and regularization operators and grouping pressure and force unknowns together, the discretized Navier-Stokes equations with the immersed boundary method can be formulated with an identical structure to the traditional fractional step method, but with a modified Poisson equation whose unknowns are both the pressure and the boundary force. The method highlights the analogous roles of pressure and boundary forcing as Lagrange multipliers in order to satisfy the divergence free and no-slip constraints, respectively. The overall method is found to be a simple addition to an existing fractional step code and the extended Poisson equation is solved efficiently with the conjugate gradient method. We demonstrate convergence and present results for two-dimensional flows with a variety of moving rigid bodies.

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