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An Immersed Boundary Method for Rigid Bodies AMNEET PAL SINGH BHALLA, BAKY TZHAN KALLEMOV, ALEKSANDAR DONEV, Courant Institute of Mathematical Sciences, New York University, BOYCE GRIF-FITH, University of North Carolina at Chapel Hill — The traditional immersed boundary (IB) method is a very flexible method for coupling elastic structures to fluid flow. When rigid bodies are modeled using an IB approach, a penalty method is usually employed to approximately enforce the rigidity of the body; this requires small time step sizes and leads to difficult-to-control errors in the solution. We develop a method that exactly enforces a rigidity constraint by solving a linear system coupling a standard semi-implicit discretization of the fluid equations with a rigidity constraint. We develop a preconditioned iterative solver that combines an approximate multigrid solver for the fluid problem with an approximate direct solver for the Schur complement system. We demonstrate the efficiency and study the accuracy of the method on several test problems for both zero and finite Reynolds numbers.

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