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An efficient strongly coupled immersed boundary method for deforming bodies[1] ANDRES GOZA, TIM COLONIUS, California Institute of Technology — Immersed boundary methods treat the fluid and immersed solid with separate domains. As a result, a nonlinear interface constraint must be satisfied when these methods are applied to flow-structure interaction problems. This typically results in a large nonlinear system of equations that is difficult to solve efficiently. Often, this system is solved with a block Gauss-Seidel procedure, which is easy to implement but can require many iterations to converge for small solid-to-fluid mass ratios. Alternatively, a Newton-Raphson procedure can be used to solve the nonlinear system. This typically leads to convergence in a small number of iterations for arbitrary mass ratios, but involves the use of large Jacobian matrices. We present an immersed boundary formulation that, like the Newton-Raphson approach, uses a linearization of the system to perform iterations. It therefore inherits the same favorable convergence behavior. However, we avoid large Jacobian matrices by using a block LU factorization of the linearized system. We derive our method for general deforming surfaces and perform verification on 2D test problems of flow past beams. These test problems involve large amplitude flapping and a wide range of mass ratios.

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