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An Adaptive and Implicit Immersed Boundary Method for Cardiovascular Device Modeling AMNEET PAL S. BHALLA, BOYCE E. GRIFFITH, University of North Carolina at Chapel Hill — Computer models and numerical simulations are playing an increasingly important role in understanding the mechanics of fluid-structure interactions (FSI) in cardiovascular devices. To model cardiac devices realistically, there is a need to solve the classical fluid-structure interaction equations efficiently. Peskins explicit immersed boundary method is one such approach to model FSI equations for elastic structures efficiently. However, in the presence of rigid structures the IB method faces a severe timestep restriction. To overcome this limitation, we are developing an implicit version of immersed boundary method on adaptive Cartesian grids. Higher grid resolution is employed in spatial regions occupying the structure while relatively coarser discretization is used elsewhere. The resulting discrete system is solved using geometric multigrid solver for the combined Stokes and elasticity operators. We use a rediscretization approach for standard finite difference approximations to the divergence, gradient, and viscous stress. In contrast, coarse grid versions of the Eulerian elasticity operator are constructed via a Galerkin approach. The implicit IB method is tested for a pulse duplicator cardiac device system that consists of both rigid mountings and elastic membrane.

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