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An Immersed Boundary Finite-Element Solver for Flow-Induced Deformation of Soft Structures with Application in Cardiac Flows RAJNEESH BHARDWAJ, RAJAT MITTAL, Johns Hopkins University — The modeling of complex biological phenomena such as cardiac mechanics is challenging. It involves complex three dimensional geometries, moving structure boundaries inside the fluid domain and large flow-induced deformations of the structure. We present a fluid-structure interaction solver (FSI) which couples a sharp-interface immersed boundary method for flow simulation with a powerful finite-element based structure dynamics solver. An implicit partitioned (or segregated) approach is implemented to ensure the stability of the solver. We validate the FSI solver with published benchmark for a configuration which involves a thin elastic plate attached to a rigid cylinder. The frequency and amplitude of the oscillations of the plate are in good agreement with published results and non-linear dynamics of the plate and its coupling with the flow field are discussed. The FSI solver is used to understand left-ventricular hemodynamics and flow-induced dynamics of mitral leaflets during early diastolic filling and results from this study are presented.

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