Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

An immersed boundary-thin shell finite element framework for fluid-structure interaction simulation of non-linear material[1] HOSSEIN ASADI, IMAN BORAZJANI, Texas AM University — A three-dimensional fluid-structure interaction (FSI) framework has been implemented for deformable tissues by coupling the sharp-interface curvilinear immersed boundary (CURVIB) incompressible Navier-Stokes flow solver with a large-deformation, rotation-free, Kirchhoff-Love thin shell finite element (FE) structure solver, which is based on Loop's subdivision surfaces. A set of Fung-elastic constitutive laws for in-plane and bending responses are implemented separately and is shown to be in good agreement with experimental results. A set of standard dynamic validation studies is performed to show the accuracy of the structure solver. The FSI solver uses a strongly-coupled approach which is stabilized using under-relaxation enhanced with Aitken acceleration technique. The coupled CURVIB-FE-FSI solver is validated by applying it to simulate an FSI problem. Finally, the capabilities of the framework is demonstrated by simulating the complex cardiovascular flow of a bio-prosthetic heart valve (BHV) and validating against experimental measurements. An efficient kinematic contact handling method is used to manage the closing phase of the leaflets.

[1]This work was partially supported by National Science Foundation award CBET 1453982. The computational resources were provided by the High-Performance Research Computing (HPRC) center at Texas AM University.

Hossein Asadi
Texas A
M University

Date submitted: 31 Jul 2020 Electronic form version 1.4