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Simulations of heart valves by thin shells with non-linear material properties.[1] IMAN BORAZJANI, HAFEZ ASGHARZADEH, MOHAMMADALI HEDAYAT , The State University of New York at Buffalo — The primary function of a heart valve is to allow blood to flow in only one direction through the heart. Triangular thin-shell finite element formulation is implemented, which considers only translational degrees of freedom, in three-dimensional domain to simulate heart valves undergoing large deformations. The formulation is based on the nonlinear Kirchhoff thin-shell theory. The developed method is intensively validated against numerical and analytical benchmarks. This method is added to previously developed membrane method to obtain more realistic results since ignoring bending forces can results in unrealistic wrinkling of heart valves. A nonlinear Fung-type constitutive relation, based on experimentally measured biaxial loading tests, is used to model the material properties for response of the in-plane motion in heart valves. Furthermore, the experimentally measured liner constitutive relation is used to model the material properties to capture the flexural motion of heart valves. The Fluid structure interaction solver adopts a strongly coupled partitioned approach that is stabilized with under-relaxation and the Aitken acceleration technique.

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