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Simulating Cardiac Fluid-Structure Interaction by an Immersed Finite Element Method[1] BOYCE GRIFFITH, MARSHALL DAVEY, University of North Carolina at Chapel Hill, CHARLES PUELZ, New York University, SIMONE ROSSI, MARGARET ANNE SMITH, DAVID WELLS, University of North Carolina at Chapel Hill — Cardiovascular diseases remain the leading causes of death worldwide, and tools for improving diagnosis, treatment planning, or medical device design promise to have a major impact on patient health. Simulating cardiac fluid dynamics across the cardiac cycle motivates the development of models that account for interactions between the blood, the muscular walls of the heart, and the thin cardiac valves. The immersed boundary method is a numerical approach to such problems of fluid-structure interaction (FSI). This talk will describe ongoing work to develop medical image-based models of cardiac FSI for modeling cardiac fluid dynamics. Our model of the heart includes image-based descriptions of the major anatomical features of the heart, including the atria and ventricles, and the nearby great vessels along with idealized anatomical models of the cardiac valves and experimentally constrained biomechanical models. To simulate cardiac FSI, we use an immersed boundary method that employs a finite element description of the immersed structure that enables the use of large-deformation nonlinear elasticity. The talk will outline the numerical approach and model formulation, and will investigate the role of pericardial tethering on establishing realistic intracardiac fluid flows.

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