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Patient-specific simulation of a trileaflet aortic heart valve in a realistic left ventricle and aorta ANVAR GILMANOV, TRUNG LE, Saint Anthony Falls Laboratory, University of Minnesota, HENRYK STOLARSKI, Civil Engineering, University of Minnesota, FOTIS SOTIROPOULOS, Saint Anthony Falls Laboratory, Civil Engineering, University of Minnesota — We develop a patient-specific model of the left ventricle consisting of: (1) magnetic-resonance images (MRI) data for wall geometry and kinematics reconstruction of the left ventricle during one cardiac cycle and (2) an elastic trileaflet aortic heart valve implanted in (3) a realistic aorta interacting with blood flow driven by the pulsating left ventricle. Blood flow is simulated via a new fluid-structure interaction (FSI) method, which couples the sharp-interface CURVIB [L. Ge, F. Sotiropoulos, JCP, (2007)] for handling complex moving boundaries with a new, rotation-free finite-element (FE) formulation for simulating large tissue deformations [H. Stolarski, A. Gilmanov, F. Sotiropoulos, IJNME, (2013)] The new FE shell formulation has been extensively tested and validated for a range of relevant problems showing good agreements. Validation of the coupled FSI-FE-CURVIB model is carried out for a thin plate undergoing flow-induced vibrations in the wake of a square cylinder and the computed results are in good agreement with published data. The new approach has been applied to simulate dynamic interaction of a trileaflet aortic heart valve with pulsating blood flow at physiological conditions and realistic artery and left ventricle geometry.

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