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Simulations of heart mechanics over the cardiac cycle[1] STAVROS TAVOULARIS, MATTHEW DOYLE, YVES BOURGAULT, University of Ottawa
— This study is concerned with the numerical simulation of blood flow and myocardium motion with fluid-structure interaction of the left ventricle (LV) of a canine heart over the entire cardiac cycle. The LV geometry is modeled as a series of nested prolate ellipsoids and is capped with cylindrical tubes representing the inflow and outflow tracts. The myocardium is modeled as a multi-layered, slightly compressible, transversely isotropic, hyperelastic material, with each layer having different principal directions to approximate the fibrous structure. Blood is modeled as a slightly compressible Newtonian fluid. Blood flow into and out of the LV is driven by left atrial and aortic pressures applied at the distal ends of the inflow and outflow tracts, respectively, along with changes in the stresses in the myocardium caused by time-dependent changes in its material properties, which simulate the cyclic contraction and relaxation of the muscle fibers. Numerical solutions are obtained with the use of a finite element code. The computed temporal and spatial variations of pressure and velocity in the blood and stresses and strains in the myocardium will be discussed and compared to physiological data. The variation of the LV cavity volume over the cardiac cycle will also be discussed.

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