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FINITE ELEMENT SIMULATION OF BLOOD FLOW IN THE LEFT VENTRICLE

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Cardiovascular disease is the number one cause of death in the world and therefore, the understanding of normal cardiac function and diseases is of high importance. Today, computer simulation is emerging as an important tool in enhancing our understanding of the heart and offers the potential to serve as decision support in diagnostics and treatment. Our interest lies in modeling the blood flow in the left ventricle (LV) by a finite element method, which is based on the open source software Unicorn for high performance finite element simulations [1], [3].
The model geometry in the form of surface triangulations is generated from ultrasound measurements of the position of the endocardial wall of the LV at a number of snapshots in time during the cardiac cycle, from which intermediate states are constructed by interpolation. A three dimensional volume mesh is deformed in time to fit these LV surface meshes using mesh smoothing algorithms. Finally, an Arbitrary Lagrangian-Eulerian (ALE) space-time finite element method is used to simulate the blood flow by solving the

incompressible Navier-Stokes equations. Velocity profiles and pressure boundary conditions are set to model the inflow from the mitral valve and outflow through the aortic valve.
In this talk we present recent work in enhancing the geometry by embedding different models of the aortic valve and expanding the problem statement to the realm of fluid-structure interaction. The detailed description of the unified continuum formulation of the FSI problem can be found in [2].
The parallel efficiency of the solver as well as the convergence of the numerical solution are examined. Different quantities of interest are extracted and compared with medical data.

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