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Numerical Simulations of Blood Flows in the Left Atrium LUCY ZHANG, Rensselaer Polytechnic Institute — A novel numerical technique of solving complex fluid-structure interactions for biomedical applications is introduced. The method is validated through rigorous convergence and accuracy tests. In this study, the technique is specifically used to study blood flows in the left atrium, one of the four chambers in the heart. Stable solutions are obtained at physiologic Reynolds numbers by applying pulmonary venous inflow, mitral valve outflow and appropriate constitutive equations to closely mimic the behaviors of biomaterials. Atrial contraction is also implemented as a time-dependent boundary condition to realistically describe the atrial wall muscle movements, thus producing accurate interactions with the surrounding blood. From our study, the transmitral velocity, filling/emptying velocity ratio, durations and strengths of vortices are captured numerically for sinus rhythms (healthy heart beat) and they compare quite well with reported clinical studies. The solution technique can be further used to study heart diseases such as the atrial fibrillation, thrombus formation in the chamber and their corresponding effects in blood flows.

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