International workshop Mathematical Modeling in Hemodynamics

Numerical modelling of incompressible flows in time-dependent domains and hemodynamic applications

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We present a stable finite-element scheme for incompressible flows in time-dependent domains. The time step is independent of the mesh size, and only one linear system is solved on each time step. We consider fluid-structure interaction (FSI) and Navier-Stokes equations in time-dependent domains. The properties of the scheme are shown on several benchmarks and hemodynamic applications.

In particular, we address 2D and 3D flows in blood vessels with nonlinear hyperelastic models of wall, steady and periodic interactions between a viscous incompressible fluid and a nonlinear solid filament in a 3D setting for which experimental data are collected using phase-contrast magnetic resonance imaging. We also present simulation of a flow in a model of the left ventricle of the human heart, where the ventricle wall dynamics is reconstructed from a sequence of contrast enhanced Computed Tomography images.

This is the joint work with Maxim Olshanskii (University of Houston), Alexander Danilov, Alexander Lozovskiy and Victoria Salamatova (INM RAS, Sechenov University, MIPT).

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