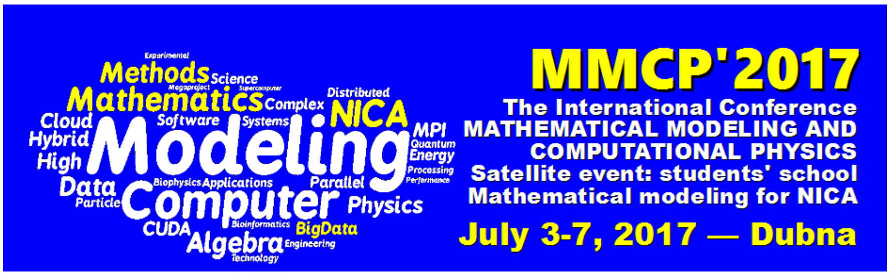

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GPU simulations of blood flow in CT based domains

Monday, 3 July 2017 17:00 (30 minutes)

Arterial aneurysms are dilations of arterial walls that can grow over time and, in case of rupture leads to dangerous hemorrhage.
Computer simulations of the blood flow and its interaction with the surrounding vessel tissue enables physicians to estimate rupture
risks by calculating the distribution of blood pressure, velocity and wall stresses in the aneurysm, in order to support the planning of clinical interventions.
For the numerical simulation, the computational domain is extracted from medical image data of the patient's vascular system. The blood is modeled as an incompressible Newtonian fluid, and the surrounding vessel wall as an isotropic linear elastic material.
Both the Navier-Stokes equations for the fluid domain and the Navier-Lame equations for the solid domain are handled with a finite element method, and the resulting linear equation systems are solved via and algebraic multigrid algorithm. Implicit coupling between blood flow and wall elasticity is achieved using an iterative fluid-structure interaction technique deforming the fluid mesh according to the wall displacement in each step. For the efficient solution of the resulting large-scale problem, we exploit efficient numerical methods and high performance computing on advanced heterogeneous CPU-GPU parallel architectures.

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