Title: Three-dimensional multi-scale models of deformable platelets and fibrin network

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Abstract: A novel three-dimensional multi-scale model is described and used in this poster to simulate receptor-mediated adhesion of deformable platelets at the site of vascular injury under different shear rates of blood flow [1]. The novelty of the model is based on a new approach of coupling submodels at three biological scales crucial for the early clot formation: novel hybrid cell membrane submodel to represent physiological elastic properties of a platelet, stochastic receptor–ligand binding submodel to describe cell adhesion kinetics and lattice Boltzmann submodel for simulating blood flow. The model implementation on the GPU cluster significantly improved simulation performance. Predictive model simulations revealed that platelet deformation, interactions between platelets in the vicinity of the vessel wall as well as the number of functional GPIbα platelet receptors played significant roles in platelet adhesion to the injury site. Variation of the number of functional GPIbα platelet receptors as well as changes of platelet stiffness can represent effects of specific drugs reducing or enhancing platelet activity. 3D model of the the fibrin network calibrated using recent experimental data [4] will be also presented.

1. Wu Z, Xu Z, Kim O, Alber M. [2014], Three-dimensional multi-scale model of deformable platelets adhesion to vessel wall in blood flow. *Phil. Trans. R. Soc. A.*, vol. 372 no.2021 20130380.

2. Oleg V. Kim, Rustem I. Litvinov, John W.Weisel and Mark S. Alber [2014], Structural basis for the nonlinear mechanics of fibrin networks under compression, *Biomaterials* 35, 6739-6749.