TEMPLE UNIVERSITY
Department of Mathematics

Applied Mathematics and Scientific Computing Seminar

Room 617 Wachman Hall

Wednesday, 27 January 2010, 2:30 p.m.

Investigating mechanisms for particle transport in whole blood using lattice Boltzmann-Immersed Boundary methods

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Abstract.

In this talk I will present a lattice Boltzmann-Immersed Boundary method to solve for the fluid dynamics of whole blood and a new (in progress) lattice Boltzmann method for advection-diffusion to model red blood cell-enhanced mixing of chemical species in plasma.

Platelets play essential roles in blood clotting; they adhere to damaged tissue and release chemicals that activate other platelets. In order to adhere, platelets must first come into contact with the injured vessel wall. Under arterial flow conditions, platelets have an enhanced concentration near blood vessel walls. This non-uniform cell distribution depends on the fluid dynamics of blood as a heterogeneous medium. We use a parallelized lattice Boltzmann-immersed boundary method to solve the flow dynamics of red cells and platelets in a periodic 2D vessel with no-slip boundary conditions at the walls. Red cells are treated as biconcave immersed boundary objects with isotropic Skalak membrane tension. Our results indicate that the effective diffusion of platelets due to red blood cells may be 1000 fold larger than Brownian motion under arteriolar flow conditions. Moreover, platelet diffusion is highly non-uniform across the vessel diameter and this may play a major role in the creation of the near-wall excess of platelets seen in vivo and in vitro.