Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Computational analysis of fluid-structure interaction in blood vessels[1] YULIA PEET, MICHAEL MIKSIS, STEPHEN DAVIS, DAVID CHOPP, Northwestern University — Vessels carrying blood flow in a human body are known to be flexible tissues. Interaction of the internal blood flow with the vessel wall compliance, in addition to significant alteration of the fluid mechanical properties (shear and normal stresses), can also result in a variety of interesting mechanical phenomena, such as flow limitation, self-exciting oscillations (flutter), wall collapse. We investigate computationally an unsteady behavior of flexible vessels carrying a blood flow assuming incompressible newtonian fluid approximation for blood. We first utilize a membrane model with constant tension for the vessel walls and apply it to simulate the coupled fluid-wall behavior in 2D collapsible channels and 3D collapsible tubes. We show that although the model works well for 2D cases, it always leads to a complete wall collapse for 3D cases for any negative transmural pressure difference, showing the necessity of including the bending rigidity. We revisit the same problems using full linear elasticity fluid-structure interaction model for finite thickness walls developed in a high-order spectral element fluid solver. We finally investigate the unsteady flow behavior in flexible channels and tubes with the newly-developed FSI solver.

[1]We acknowledge the support of NSF RTG grant DMS-0636574.

Yulia Peet
Northwestern University

Date submitted: 05 Aug 2011

Electronic form version 1.4