

Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

A Numerical Model for Time-Dependent Gravity-Driven Flow in a Collapsible Tube AMANDA PETERS, MICHELLE BORKIN, SHREYAS MANDRE, Harvard University — We present details of a Navier-Stokes solver to address fluid flows through a circular tube with elastic walls. This is the first implementation of a large structured-grid fluid dynamics code on this architecture. This class of problems, fluid flow through collapsible tubes, is very important to the study of biological systems (respiratory system, circulatory system, etc.) and physical systems (fluid dynamics, engineering, etc.). In contrast to other models, we focus on integrating wall elasticity and time dependence. We successfully model the flow of blood through the jugular vein of a giraffe over time by numerically evaluating a series of hyperbolic PDEs using Lax-Wendroff. Through careful error and stability analysis, we were able to create an accurate and stable simulation. We were able to examine the role that elasticity plays at various length scales and determine it has an impact on the flow velocity over large length scales (i.e. a giraffe) whereas it is negligible over small length scales (i.e. a human) as it is likely overwhelmed by factors such as lateral flow and viscosity. This work presents a strong framework for future CFD studies regarding various human blood flow physiologies including the abdominal aorta.

Amanda Peters
Harvard University

Date submitted: 11 Aug 2009

Electronic form version 1.4