Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

A dynamic model of human physiology[1] MELISSA GREEN, CAROLYN KAPLAN, ELAINE ORAN, JAY BORIS, Naval Research Laboratory — To study the systems-level transport in the human body, we develop the Computational Man (CMAN): a set of one-dimensional unsteady elastic flow simulations created to model a variety of coupled physiological systems including the circulatory, respiratory, excretory, and lymphatic systems. The model systems are collapsed from three spatial dimensions and time to one spatial dimension and time by assuming axisymmetric vessel geometry and a parabolic velocity profile across the cylindrical vessels. To model the actions of a beating heart or expanding lungs, the flow is driven by user-defined changes to the equilibrium areas of the elastic vessels. The equations are then iteratively solved for pressure, area, and average velocity. The model is augmented with valves and contractions to resemble the biological structure of the different systems. CMAN will be used to track material transport throughout the human body for diagnostic and predictive purposes. Parameters will be adjustable to match those of individual patients. Validation of CMAN has used both higher-dimensional simulations of similar geometries and benchmark measurement from medical literature.

[1]This work was supported, in part, by the NRC Research Associate Program, ONR through NRL, and DTRA-JSTO for Chemical and Biological Defense.

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Date submitted: 27 Jul 2010 Electronic form version 1.4