Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Modeling blood flow as a fluid- multilayered structure interaction problem consisting of poroelastic materials MARTINA BUKAC, PAOLO ZUNINO, IVAN YOTOV, University of Pittsburgh — We model arterial blood flow as an incompressible Newtonian fluid confined by a multilayered poroelastic wall. We consider a two layer model for the arterial wall, where the inner layers (the endothelium and the intima) behave as a thin structure modeled as a linearly elastic Koiter membrane, while the outer part of the artery (the media and adventitia) is described by the Biot model. The fluid, membrane, and poroelastic structure are two-way coupled via kinematic and dynamic coupling conditions. We propose and analyze a splitting strategy based on the Lie operator splitting method, which allows solving the Navier-Stokes and Biot equations separately. In this way, we uncouple the original problem into two problems defined on separate subregions, the lumen and the wall. We show that the proposed scheme is stable under mild restriction of the time approximation step. Numerically, we investigate the effects of porosity to the structure displacement. We distinguish a high storativity and a high permeability case in the Darcy equations, and compare them to the results obtained using a purely elastic model. Depending on the regime, we observe significantly different behaviors in response to perturbations of each parameter.

Martina Bukac
University of Pittsburgh

Date submitted: 02 Aug 2013

Electronic form version 1.4