Department of Mathematics

University of Houston

Scientific Computing Seminar

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Aortic and cerebral pulse waveforms: the effect of viscoelasticity (and other physical properties)

Tuesday, Nov. 13, 2012
3:00 PM- 4:00 PM
Room 646 PGH

Abstract:

The shape of the arterial pulse waveform is intimately related to the physical properties of the cardiovascular system. It is clinically relevant to measure those properties that are related to cardiovascular function, such as the local elasticity and viscosity of the arterial wall, total compliance and net peripheral resistance of the systemic arterial tree. Most of these properties cannot be directly measured in vivo, but they can be calculated from pressure, flow and wall displacement measurements that can be obtained in vivo. We carry out a linear analysis of the one-dimensional (1-D) equations of blood flow in Voigt-type visco-elastic vessels to study the effects on pulse wave propagation of several physical properties. Based on this analysis, we derive methods to calculate the local elastic and viscous moduli of the arterial wall, and the total arterial compliance, net resistance, time constant and peripheral outflow pressure of the systemic arterial tree from pressure, flow and wall displacement data that can be measured in vivo. We verify the results of the linear analysis and assess the accuracy of our estimation methods using pulse waveforms simulated in a nonlinear visco-elastic 1-D model of the larger conduit arteries of the upper body, which includes the circle of Willis in the cerebral circulation.