Department of Mathematics

University of Houston

Scientific Computing Seminar

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A Model for Hemodynamics for Optimal Design

Tuesday, April 29, 2014
1:30 PM- 2:30 PM
Room 646 PGH

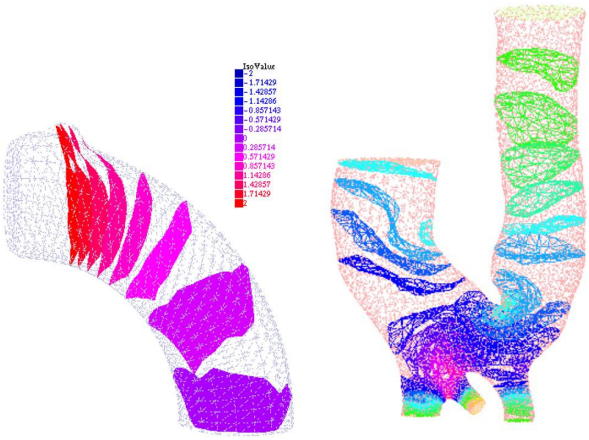
Abstract:

Simulations of blood flows in arteries require numerical solutions of fluid–structure interactions involving Navier–Stokes equations coupled with large displacement visco–elasticity for the vessel.

Among the various simplifications which have been proposed, the surface pressure model provide a natural and strong coupling between the structure and the fluid. Consequently we can derive unconditionally stable discretizations by combining implicit time schemes with Finite Element discretizations of the Navier-Stokes equations. Such models have prescribed pressure on the walls, functions of the normal velocity, but they can be analyzed mathematically and shown to be well posed.

As the change of geometry is simulated by a change into a numerical coefficient of the boundary condition, optimal design for the best stent, for instance, for reducing the maximum pressure can be solved by a gradient optimization method on a fixed geometry.

We shall show numerically the feasibility of the method and discuss the numerical implementation with the software `freefem++`.



Left. Change (exaggerated for visualization) in the geometry to reduce the pressure. Right. Pressure iso surfaces on a real aorta.

This seminar is easily accessible to persons with disabilities. For more information or for assistance, please contact the Mathematics Department at 743-3500.