Department of Mathematics

University of Houston

Scientific Computing Seminar

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Challenges in computational hemodynamics: multiphysics and cost reduction

Thursday, Sept. 24, 2015
1:30 PM- 2:30 PM
Room 646 PGH

Abstract: Modeling and computational analysis play an increasingly important role in the investigation of blood flow problems. Significant challenges in the context of computational hemodynamics are the multiphysics nature of the problems (e.g., interaction of blood with artery walls or valve leaflets) and the associated high computational cost. We discuss efficient algorithms to simulate the interaction of blood (an incompressible fluid) and an elastic structure. Two cases are considered: 1. the elastic structure covers part of the fluid boundary and undergoes small displacement and 2. the elastic structure is immersed in the fluid and it features large displacement. For the first case, we propose an Arbitrary Lagrangian-Eulerian (ALE) method based on Lies operator splitting. The resulting algorithm is unconditionally stable and weakly coupled: it requires the solution of one fluid subproblem and one structure subproblem per time step. Standard ALE methods fail when the structural displacement is large. Thus, for the second case we propose an extended ALE method that avoids remeshing and relies on a variational mesh optimization technique. Finally, we report on some recent developments of reduced order modeling in order to lower the computational cost in a numerical study to understand the causes of the Coanda effect in cardiology.

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