Department of Mathematics

University of Houston

Scientific Computing Seminar

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Numerical Study of a Monolithic Fluid-Structure Formulation

Friday, Feb. 26, 2016
10 AM- 11 AM
Room 646 PGH

Abstract: The conservation laws of continuum mechanics are naturally written in an Eulerian frame where the difference between a fluid and a solid is only in the expression of the stress tensors, usually with Newton's hypothesis for the fluids and with Helmholtz potentials of energy for hyperelastic solids.

There are currently two favored approaches to Fluid Structured Interactions both working with the equations for the solid in the initial domain; one uses an ALE formulation for the fluid and the other matches the fluid-structure interfaces using Lagrange multipliers and the fictitious domain method.

By contrast the proposed formulation works in the frame of physically deformed solid and propose a discretization where the structures have large displacements computed in the deformed domain together with the fluid in the same, in a monolithic formulation where the velocity of both are computed all at once by a semi-implicit in time plus finite element method.

Besides the simplicity of the formulation the advantage is a single algorithm for a variety of problems including multi-fluid, free boundary and FSI. On the flipped side it needs a robust mesh generator.

Stability will be studied showing were are the difficulties and why we were able to show convergence of an earlier monolithic algorithm for a fluid within a shell restricted to small displacements.

Numerical examples will be given.