APPLIED MATHEMATICS COLLOQUIUM

Numerical Solution to Discontinuous PDEs: *From Liquid Films to Bouncing Droplets*

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ABSTRACT:
The focus of this talk is the numerical solution of the two-phase incompressible Navier- Stokes equations. These equations have discontinuous coefficients and their solutions exhibit jumps in the pressure field and in gradients of the velocity field. Traditional methods aim at smearing discontinuities. However, when considering numerical approximations on a grid of finite resolution, this approach leads to inaccurate solutions.

I will present a novel numerical framework to solve these PDEs considering discontinuities as sharp "zero-width" objects. This new approach relies on locally approximating the solutions using pairs of Hermite polynomials that correctly incorporate jump conditions. Since locating surfaces of discontinuities is an integral part of the solution, I will present a semi-Lagrangian gradient-augmented level set method for interface tracking based on the same Hermite interpolation framework.

Throughout, I will motivate and illustrate the present approach using examples such as falling liquid films, partial coalescence, bouncing droplets on a soap film, and walking droplets on a parametrically excited bath. Finally, I will discuss some advantages of the proposed approach such as locality and higher order, but also extensions beyond two-phase liquid/gas systems. Owing to the general nature of the proposed techniques, applications to other PDEs will be discussed.

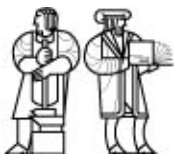
MONDAY FEBRUARY 23RD 2009

4:30 PM

Building 4, Room 237

Refreshments at 4:00 PM in Building 2, Room 349
(Applied Math Common Room)

Applied Math Colloquium: http://www-math.mit.edu/amc/spring09
Math Department: http://www-math.mit.edu



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