APPLIED MATHEMATICS COLLOQUIUM

THE MATHEMATICS OF INTERACTION

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ABSTRACT:

This talk will describe mathematical models of several problems in fluid dynamics. A common feature is that all involve finding a quantitative description of how two or more entities interact.

First, we consider a novel swimming mechanism at zero Reynolds number in which organisms (such as water snails) propel themselves by interacting dynamically with a free capillary surface. This interaction mechanism destroys the reversibility of the problem (the "scallop theorem") and can lead to net translation. A novel mathematical model of this interaction is proposed and is found to admit a class of exact solutions which can be systematically studied to find the characteristics of the most efficient swimmer. (This is work in progress, joint with Hosoi, Lauga, Lee and Samson.)

Next, we move to the infinite Reynolds number regime and study a basic problem of vortex dynamics. A well-studied model of vorticity is the vortex patch model where the dynamics is reduced to tracking just the boundaries of the vortex patches ("contour dynamics"). This topic has been studied extensively over the last 30 years but almost all prior work is restricted to problems in free-space. It is of interest (e.g. in oceanography) to understand how vortices interact with solid impenetrable boundaries (e.g. islands and shorelines). We show that a contour dynamics algorithm still exists in this case and present a flexible numerical algorithm for the computation of patch motion in geometrically complex domains on both the plane and a spherical surface. (This is joint work with A. Surana.)

If time permits, I will also describe how we have extended an iterated conformal mapping technique (originally due to Hastings and Levitov) to model the formation of multiple interacting clusters in diffusion-limited aggregation. (Joint work with R. Ciaravino.)

MONDAY, NOVEMBER 5, 2007
4:30 PM
Building 4, Room 270

Reception at 4:00 PM in Building 4, Room 174
(Math Majors Lounge

Applied Math Colloquium: http://www-math.mit.edu/amc/fall07
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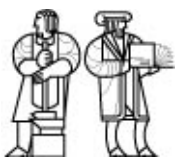

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