PHYSICAL MATHEMATICS SEMINAR

TOPIC: DISCRETIZATION OF PARABOLIC PDE'S FOR
STEFAN PROBLEMS AND IMAGE SEGMENTATION

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ABSTRACT:

Many phenomena in physical and life sciences can be modeled by partial differential equations that are parabolic in nature. Applications range from the conception of semi-conductors in Materials science (Stefan problem) to the treatment planning for cancer patients in radiation oncology (image segmentation). The modeling and numerical simulation of these equations share similar drawbacks, such as the computational burden imposed by a stringent time step restriction.

In this talk we will discuss some new numerical algorithms that address some of these issues. First a fourth order accurate finite difference numerical discretization for the Laplace and heat equations with Dirichlet boundary conditions on irregular domains will be described. Then, we turn our focus to the Stefan problem and construct a third order accurate implicit discretization. Multidimensional computational results are presented to demonstrate the order of accuracy of these numerical methods. An adaptive grid refinement for the Poisson equation in the context of the incompressible Euler equations of fluid dynamics will be briefly presented, noting that the aim of this work is to construct an adaptive method for parabolic equations. Finally, a fast hybrid level Set/k-Means algorithm for image segmentation and its application to the segmentation of organs in the context of radiation oncology will be presented.

DATE: TUESDAY, MARCH 2, 2004

TIME: 2:30 PM

LOCATION: Building 2, Room 338

Refreshments at 3:30 PM in Building 2, Room 349.

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