Applied & Computational Math Seminar

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Friday, November 6, 2015
1-2pm, HH-3013

The closest point method: a simple embedding method for solving surface partial differential equations

Abstract:

Partial differential equations (PDEs) posed on surfaces are found more and more in fields such as biological systems, mathematical physics, fluid dynamics, computer graphics, image processing and medical imaging. A standard numerical method for solving surface PDEs has only recently been established. The closest point method is a numerical framework that embeds the surface problem in the surrounding Euclidean space to give a Cartesian analog of the PDE. This enables the use of standard Cartesian numerical methods, while handling general manifolds that are open or closed, with or without orientation, and of mixed codimension. This talk will give an overview of this simple embedding numerical method for solving surface PDEs. It will be shown that the closest point method can be applied to a general class of surface PDEs, including advection, diffusion, reaction-diffusion and eigenvalue problems. Examples from image processing, pattern formation and eigenvalues problems will illustrate the generality of the method. These examples include heat flow on surfaces, segmentation of images on surfaces, and Turing and the Brusselator pattern formation.