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.