Speaker: Professor Naoki Saito, UC Davis
Title: Recent Advances in Image Analysis: On the Use of Laplacian Eigenfunctions for Images and Datasets.
Time: 2:00pm, Feb. 15 (Friday), 2008
Room: Goodwyn 202

Abstract:
Laplacian eigenfunctions, as a generalization of the Fourier basis over a rectangular domain, allow us to perform spectral analysis of data recorded on a domain of general shape. Examples include dendrite patterns of neurons in neuroscientific images and human face images. I will present a method to analyze such images by expanding them in terms of the Laplacian eigenfunctions defined over such general shape domains. Directly solving the associated Helmholtz equations on such domains or computing the Green's functions satisfying specific boundary conditions imposed on such domains are in general difficult. Instead, we find an integral operator commuting with the Laplacian without imposing strict boundary conditions a priori, and compute the eigenfunctions of this integral operator, which are in fact the Laplacian eigenfunctions. This approach is amenable to modern fast numerical algorithms such as the celebrated Fast Multipole Method (FMM).
I will also present applications to statistical image analysis and contrast our method with the popular Principal Component Analysis using real images.

Short Bio: Naoki Saito is Professor of Department of Mathematics, University of California Davis. He is currently serving as a chair of Graduate Group in Applied Mathematics there. Being a reputable applied mathematician, he has made significant contributions to signal and image processing. He is a Senior Member of Institute of Electrical and Electronics Engineers (IEEE). He is the recipient of the Presidential Early Career Award for Scientists and Engineers (PECASE), Oct., 2000. His other awards include a Best Paper Award (in Wavelet Applications in Signal and Image Processing Conference II, SPIE, July 1994), a Henri G. Doll Award (Schlumberger Interpretation Symposium, June, 1997 ) and an Office of Naval Research Young Investigator Award (Feb., 2000). Professor Saito holds two US and two UK patents. His research has been continuously supported by grants from various US federal agencies.