SIAM Student Chapter Seminar

PDE Techniques in Wavelet Transforms and Image Processing

Prof. Hao-Min Zhou
School of Mathematics, Georgia Institute of Technology

Abstract: Standard wavelet linear approximations (truncating high frequency coefficients) generate oscillations (Gibbs’ phenomenon) near singularities in piecewise smooth functions. Nonlinear and data dependent methods are often used to overcome this problem. In the past decade, a new research direction has emerged, which introduces partial differential equation (PDE) and variational techniques (including techniques developed in computational fluid dynamics (CFD)) into wavelet transforms for the same purpose.

In this talk, I will present a couple of examples in our research to illustrate such developments. The first part will be on an adaptive ENO wavelet transform designed by using ideas from Essentially Non-Oscillatory (ENO) schemes for numerical shock capturing. ENO-wavelet transforms retains the essential properties and advantages of standard wavelet transforms such as concentrating the energy to the low frequencies, obtaining arbitrary high order accuracy uniformly and having a multiresolution framework and fast algorithms, all without any edge artifacts. Applications to image compression will be briefly mentioned.

The second part of the talk is on using a variational framework, in particular the minimization of total variation (TV), to select and modify the retained standard wavelet coefficients so that the reconstructed images have fewer oscillations near edges. Examples in image denoising, compression and wavelet inpainting will be shown too.

The talk is based on joint work with Tony Chan and Jackie Shen.

Wednesday, March 5, 2008, 4:00 pm
Mathematics and Science Center: W302

Pizza will be served after the talk.

Mathematics and Computer Science
Emory University