Imaging Seminar - Department of Mathematics

Date and Time: Wednesday April 1, 2015, 2-3 PM
Location: PGH 646

Title: *A Non-convex Approach for Signal and Image Processing*
Speaker: Yifei Lou, UT, Dallas.

Abstracts: A fundamental problem in compressed sensing (CS) is to reconstruct a sparse signal under a few linear measurements far less than the physical dimension of the signal. Currently, CS favors incoherent systems, in which any two measurements are as little correlated as possible. In reality, however, many problems are coherent, in which case conventional methods, such as L1 minimization, do not work well. In this talk, I will present a novel non-convex approach, which is to minimize the difference of L1 and L2 norms (L1-L2) in order to promote sparsity. Efficient minimization algorithms are constructed and analyzed based on the difference of convex function methodology. The resulting DC algorithms (DCA) can be viewed as convergent and stable iterations on top of L1 minimization, hence improving L1 consistently.

Through experiments, we discover that both L1 and L1-L2 obtain better recovery results from more coherent matrices, which appears unknown in theoretical analysis of exact sparse recovery. In addition, numerical studies motivate us to consider a weighted difference model L1-aL2 (a>1) to deal with ill-conditioned matrices when L1-L2 fails to obtain a good solution. An extension of this model to image processing will be also discussed, which turns out to be a weighted difference of anisotropic and isotropic total variation (TV), based on the well-known TV model and natural image statistics. Numerical experiments on image denoising, image deblurring, and magnetic resonance imaging (MRI) reconstruction demonstrate that our method improves on the classical TV model consistently, and is on par with representative start-of-the-art methods.