SEMINAR NOTICE

Department of Electrical and Systems Engineering

STABILITY OF RECONSTRUCTING SIGNALS WITH LOW-DIMENSIONAL STRUCTURES

PhD Preliminary Research Examination

Gongguo Tang
PhD Candidate
Department of Electrical and Systems Engineering
Washington University in St. Louis

Abstract: The last decade witnessed a burgeoning interest in exploiting low-dimensional structures for signal processing, most notably, the sparseness of vectors, low-rankness of matrices, and low-dimensional manifold structure of general nonlinear data sets. Applications include signal sampling and compression, medical imaging, solving electromagnetic inverse problems, control systems, commercial data mining, sensor networks, video information retrieval, to name a few.

We investigate the stability of signal reconstruction with a known low-dimensional structure, in particular the sparseness and low-rankness. We show that the constrained minimal singular values of the measurement matrix/operator determine, in a very concise manner, the reconstruction performance of convex relaxation algorithms, such as Basis Pursuit, the Dantzig selector, and the LASSO estimator. Numerical simulations illustrate that bounds based on the constrained singular value are tighter, and apply to sensing matrices/operators with a wider range of sizes. We show also that, with high probability, many important random sensing matrices/operators have constrained singular values concentrated around one, as long as the number of measurements is relatively large. We design three algorithms based on the projected gradient method and the interior point algorithm to compute the -constrained minimal singular values of arbitrary measurement matrix. A lower bound of the -constrained minimal singular value is also available by solving a semi-definite programming problem obtained via the lifting procedure. The results are useful for determining the goodness of a sensing scheme before actually taking measurements, quantifying the confidence of a reconstructed signal, and serving as a basis for optimal sensing system design.

DATE: Thursday, July 15, 2010
TIME: 2:00 p.m.
PLACE: Bryan Hall, Room 305

Thesis advisor:
Dr. Arye Nehorai

This seminar is in partial fulfillment
of the Doctor of Philosophy degree

Washington University in St. Louis
School of Engineering & Applied Science