数学与系统科学研究院

计算数学所系列学术报告

报告人： Prof. Yin Zhang

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报告题目：

A Non-RIP Theory for Compressive Sensing

邀请人： 刘歆 博士

报告时间：

Lecture 1：2012年5月25日（周五）上午10：00-11：00

Lecture 2：2012年5月28日（周一）上午10：00-11：00

Lecture 3：2012年5月30日（周三）上午10：00-11：00

Lecture 4：2012年6月1日（周五）上午10：00-11：00

报告地点： 科技综合楼三层 311

计算数学所报告厅

Abstract:

Compressive sensing (CS), an emerging methodology in computational signal processing, has recently attracted intensive research activities. The most fundamental CS theory includes recoverability and stability: the former quantifies the central fact that a sparse signal of length n can be exactly recovered from far fewer than n linear measurements via ℓ_1-minimization or other recovery techniques, while the latter specifies robusteness of a recovery technique in the presence of measurement errors and inexact sparsity. So far, most analyses in CS rely heavily on the Restricted Isometry Property (RIP) for sensing matrices.

In these lectures, we present an alternative, non-RIP analysis for CS via ℓ_1-minimization. Our purpose is three-fold: (a) to introduce an elementary non-RIP treatment of the basic CS theory; (b) to extend the current recoverability and stability results to a framework that allows possibilities of utilizing prior knowledge for enhanced recoveries via ℓ_1-minimization; and (c) to substantiate a property called uniform recoverability of ℓ_1-minimization; that is, for almost all random measurement matrices recoverability is asymptotically identical. With the aid of two classic results, the non-RIP theory offers the insight that recoverability is really a subspace-related property independent of the choice of basis matrices, whilst RIP is a matrix property.

Prerequisite: Linear algebra. Basic linear programming.

<u>Lecture 1</u>:

Nonnegativity and Sparsity makes CS easy, in theory

We start by introducing the concept of CS, which can be mathematically represented as finding the sparsest solution to a underdetermined linear system Ax = b, where the coefficient matrix A is to be optimally designed.

The fundamental theoretical question concerns the relationship between sparsity k, the number of equations m, and the matrix A. When the signs of the solution elements are known (such as being nonnegative), the analysis is much simplified. We will show that A can be chosen so that if m >= 2k, then the k-sparse solution is unique and can be computed in polynomial time via linear programming, in theory However, can we really compute it numerically?

欢迎大家参加！