数学与系统科学研究院

计算数学所学术报告

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报告题目：

1-Bit Compressive Sensing: Sign Recovery Theory

邀请人：　戴彧虹 研究员

报告时间：2015 年 12 月 18 日（周五）

上午 10:00~10:55

报告地点：　科技综合楼三层

311 报告厅

Abstract:

Recently, the 1-bit compressive sensing (1-bit CS) has been studied in the field of sparse signal recovery. Since the amplitude information of sparse signals in 1-bit CS is not available, it is often the support or the sign of a signal that can be exactly recovered with a decoding method. In this research, we first show that a necessary assumption (that has been overlooked in the literature) should be made for some existing methods for 1-bit CS. Without such an assumption, the found solution by some existing decoding algorithms might be inconsistent with 1-bit measurements. This motivates one to pursue a new direction to develop uniform and nonuniform recovery theories for 1-bit CS with a new decoding method which always generates a solution consistent with 1-bit measurements. We focus on an extreme case of 1-bit CS, in which the measurements capture only the sign of the product of a sensing matrix and a signal. We show that the 1-bit CS model can be reformulated equivalently as an l0-minimization problem with linear constraints. This reformulation naturally leads to a new linear-program-based decoding method, referred to as the 1-bit basis pursuit, which is remarkably different from existing formulations. It turns out that the uniqueness condition for the solution of the 1-bit basis pursuit yields the so-called restricted range space property (RRSP) of the transposed sensing matrix. This concept provides a basis to develop sign recovery conditions for sparse signals through 1-bit measurements. We prove that if the sign of a sparse signal can be exactly recovered from 1-bit measurements with 1-bit basis pursuit, then the sensing matrix must admit a certain RRSP, and that if the sensing matrix admits a slightly enhanced RRSP, then the sign of a k-sparse signal can be exactly recovered with 1-bit basis pursuit.

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