数学与系统科学研究院

计算数学所网络学术报告

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报告题目：

Stability and the necessary and sufficient condition for the unique solution of the tail-minimization approach in compressed sensing with frames

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报告时间：2021 年 7 月 23 日（周五）

下午 14:00-15:00

报告工具：腾讯会议 ID：（854 310 031）

会议链接：

https://meeting.tencent.com/s/8Z7JEoLX9zzF

Abstract:

Sparse frame representations and sparse signal/channel recovery have immediate applications in 5G wireless communication, and in array signal processing. We present in this talk results of the $\ell_1$tail-minimization approach applied to sparse frame representations in compressed sensing, where $y=Af$ is the measurement, $f=Dx$, D is a dictionary/frame, and x is the sparse frame expansion coefficients. The tail-ℓ_1-synthesis approach is analyzed in detail. A tail dictionary null space property (tail-DNSP) is shown to be necessary and sufficient for the unique recovery of f. Stability results for solutions to sparse frame representation problems via tail-minimization are then derived using the tail-DNSP and variations. Stronger results for real A and D are also given. These analyses and extensive numerical tests show that the tail-minimization substantially out-performs the standard ℓ_1-synthesis approach. We also show by examples that A can satisfy the DNSP or tail-DNSP where AD fails NSP. In such cases unique recovery is guaranteed at the signal level f while failing at the coefficient level x. It is also demonstrated that A satisfying tail-DNSP is weaker than A satisfying DNSP.

Also presented includes an equivalence between the traditionalℓ_1-analysis approach and a synthesis problem with a new synthesized measurement matrix $\tilde A$. As a result, there is now a necessary and sufficient $tilde A$-NSP condition for the unique solution of the ℓ_1-analysis problem, which has never been seen in the literature to the best of our knowledge.

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