复旦大学数学科学学院
数学综合报告会

报告题目：One-bit Low-Tubal-Rank Tensor Recovery

报告人：王建军 教授 (西南大学)

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报告摘要：

This talk focuses on the recovery of low-tubal-rank tensors from binary measurements based on tensor-tensor product (or t-product) and tensor Singular Value Decomposition (t-SVD). Two types of recovery models are considered, one is the tensor hard singular tube thresholding and the other one is the tensor nuclear norm minimization. In the case no random dither exists in the measurements, our research shows that the direction of tensor $\bm{\mathcal{X}}\in \R^{n_1\times n_2\times n_3}$ with tubal rank r can be well approximated from $\Omega((n_1+n_2)n_3r)$ random Gaussian measurements. In the case nonadaptive dither exists in the measurements, it is proved that both the direction and the magnitude of $\bm{\mathcal{X}}$ can be simultaneously recovered. As we will see, under the nonadaptive measurement scheme, the recovery errors of two reconstruction procedures decay at the rate of polynomial of the oversampling factor $\lambda:=m/(n_1+n_2)n_3r$, i.e., $\mathcal{O}(\lambda^{-1/6})$ and $\mathcal{O}(\lambda^{-1/4})$, respectively. In order to obtain faster decay rate, we introduce a recursive strategy and allow the dithers in quantization to be adaptive to previous measurements for each iterations. Under this quantization scheme, two iterative recovery algorithms are proposed which establish recovery errors decaying at the rate of exponent of the oversampling factor, i.e., $\exp(-\mathcal{O}(\lambda))$. Numerical experiments on both synthetic and real-world data sets are conducted and demonstrate the validity of our theoretical results and the superiority of our algorithms.

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