Convex Geometry-Based Guarantees for Low-rank Matrix Recovery with Adversarial Noise

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The problem of recovering a high-dimensional low-rank matrix from a limited set of random measurements has enjoyed various applications and gained a detailed theoretical foundation over the last 15 years. As a convex proxy for the NP-hard problem of constrained rank minimization, nuclear norm minimization has been suggested instead. For matrices whose entries are "spread out" well enough, the convex problem admits a unique solution which corresponds to the ground truth. In the presence of measurement noise, the reconstruction performance remains less well-described. Various error bounds have been suggested using both convex and nonconvex approaches. Still, the presented bounds remain suboptimal compared to numerical experiments and information-theoretic lower bounds. In particular, it has been shown that under small-scale adversarial noise, the reconstruction error can be significantly amplified. In this work, we investigate this behaviour quantitatively for the problems of matrix completion and blind deconvolution. We provide new reconstruction bounds for both small and large noise levels that suggest a quadratic dependence between the reconstruction error and the noise level.