Structured matrix recovery from matrix-vector products

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Can one recover a structured matrix efficiently from only matrix-vector products? If so, how many are needed? In this talk, we will describe algorithms to recover structured matrices, such as tridiagonal, Toeplitz-like, and hierarchical low-rank, from matrix-vector products. In particular, we derive an algorithm for recovering an unknown $N \times N$ hierarchical low-rank matrix from only $\mathcal{O}((k+p)\log N)$ matrix-vector products that is stable with high probability, where k is the rank of the off-diagonal blocks, and p is a small oversampling parameter. We do this by carefully constructing randomized input vectors for our matrix-vector products that use the hierarchical structure of the matrix. While existing algorithms for hierarchical matrix recovery use a recursive "peeling" procedure based on elimination, our approach uses a recursive projection procedure,

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