Rigidity of Random Toeplitz Matrices with an Application to Depth Three Circuits

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Abstract

Joint work with Oded Goldreich.

We prove that random $n$-by-$n$ Toeplitz matrices over $\mathbb{F}_2$ have rigidity $\Omega(n^{3/(r^2 \log n)})$ for rank $r > \sqrt{n}$, with high probability. This improves, for $r = o(n / \log \log \log n)$, over the $\Omega((n^2/r) \log(n/r))$ bound that is known for many explicit matrices.

Our result implies that an explicit trilinear function $f$ on $n$ variables has complexity $\Omega(n^{3/5})$ in the multilinear circuit model suggested by Goldreich and Wigderson (ECCC, 2013), which yields an $\exp(n^{3/5})$ lower bound on the size of the so-called canonical depth-three circuits for $f$. 

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