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 GF(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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