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

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12/2/2015 at 11:00 am
Core A (Room 301)

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 \(r = o(n/\log n/\log \log n)\), 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 \(f\).