Quantitative invertibility of random matrices: a combinatorial perspective

Vishesh Jain (MIT)

Abstract: Let $s_n(M_n)$ denote the smallest singular value of an $n \times n$ random (possibly complex) matrix $M_n$. We will discuss a novel combinatorial approach (in particular, not using either inverse Littlewood–Offord theory or net arguments) for obtaining upper bounds on the probability that $s_n(M_n)$ is smaller than $\eta \geq 0$ for quite general random matrix models. Such estimates are a fundamental part of the non-asymptotic theory of random matrices and have applications to the strong circular law, numerical linear algebra etc. In several cases of interest, our approach provides stronger bounds than those obtained by Tao and Vu using inverse Littlewood–Offord theory.

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