A Rice Method proof of the Null-Space Property for a random matrix

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The Null-Space Property (NSP) is a necessary and sufficient condition for the recovery of the largest coefficients of solutions to an under-determined system of linear equations. Interestingly, this property governs also the success and the failure of recent developments in high-dimensional statistics, signal processing, error-correcting codes and the theory of polytopes.

Although this property is the keystone of ℓ_1-minimization techniques, it is an open problem to construct deterministic matrices satisfying NSP. One can only prove that NSP holds, with an overwhelming probability, when the matrix is chosen at random, in general with a rotation invariant distribution.

In this talk, we provide the first proof of NSP using random processes theory and the Rice method. As a matter of fact, our analysis gives non-asymptotic bounds for NSP with respect to rotation invariant distributions. Moreover, we derive a simple and explicit sufficient condition for NSP.