

Improved rank bounds for design matrices and a new proof of Kelly's theorem

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Abstract

We study the rank of complex sparse matrices in which the supports of different columns have small intersections. The rank of these matrices, called design matrices, was the focus of a recent work by Barak et. al. in which they were used to answer questions regarding point configurations. In this work we derive near-optimal rank bounds for these matrices and use them to obtain asymptotically tight bounds in many of the geometric applications. As a consequence of our improved analysis, we also obtain a new, linear algebraic, proof of Kelly's theorem, which is the complex analog of the Sylvester-Gallai theorem.