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## A Hyperbolic Extension of Kadison-Singer Type Results

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Abstract: In 2013, Marcus, Spielman, and Srivastava resolved the famous Kadison-Singer conjecture. It states that for n independent random vectors  $v_1, \cdots, v_n$  that have expected squared norm bounded by  $\epsilon$  and are in the isotropic position in expectation, there is a positive probability that the determinant polynomial  $\det(xI - \sum_{i=1}^n v_i v_i^\top)$  has roots bounded by  $(1+\sqrt{\epsilon})^2$ . An interpretation of the Kadison-Singer theorem is that we can always find a partition of the vectors  $v_1, \cdots, v_n$  into two sets with a low discrepancy in terms of the spectral norm (in other words, rely on the determinant polynomial).

In this paper, we provide two results for a broader class of polynomials, the hyperbolic polynomials. Furthermore, our results are in two generalized settings:

- \* The first one shows that the Kadison-Singer result requires a weaker assumption
- \* The second one relaxes the Kadison-Singer result's distribution assumption to the Strongly Rayleigh distribution

To the best of our knowledge, the previous results only support determinant polynomials [Anari and Oveis Gharan'14, Kyng, Luh and Song'20]. It is unclear whether they can be generalized to a broader class of polynomials. In addition, we also provide a sub-exponential time algorithm for constructing our results.

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