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*Computing the Independence Polynomial in Shearer's Region for the Lovasz Local Lemma*

The independence polynomial has been widely studied in algebraic graph theory, in statistical physics, and in algorithms for counting and sampling problems. We consider the problem of computing the independence polynomial with a negative (or even complex) argument, whose magnitude is less than the smallest magnitude of any root of the polynomial. We show that there is a fully-polynomial-time approximation scheme (FPTAS) for such an argument. Our proof uses a novel multivariate form of the correlation decay technique. This FPTAS can be used to give a constructive algorithm for the Lovasz Local Lemma in probabilistic combinatorics.