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Solving Problems in Approximate Polynomial Algebra via SVD methods

Many problems in polynomial algebra can be formulated for polynomials which are given with inexact coefficients. When considered numerically many of these algebraic problems are ill-posed—small perturbations to coefficients lead to large changes in the answer. For example, very small random changes to a factorizatable multivariate polynomial typically result in an irreducible polynomial. Other examples of problems of this type are polynomial division, GCD computation and polynomial decomposition.

It is possible to find reasonable partial solutions for a number of problems in approximate algebra by linearizing and using singular value decomposition (SVD) methods. If the problem can be restated as a problem of computing null vectors of a given matrix, then we typically can do two things: first, given a polynomial without a given property, we can find a lower bound on the distance to the nearest polynomial with the property and second, we can compute a "nearby" polynomial which has the given property, though we cannot in general find the nearest such polynomial.

In this talk we will discuss the general technique, as well as the specific details for the GCD, and factorization problems.