Numerically stable sparse interpolation

Mark Giesbrecht and Daniel Roche
Cheriton School of Comput., University of Waterloo Waterloo, Canada

We consider the problem of interpolating an unknown sparse multivariate polynomial from approximate evaluations. Building upon recent work of Garg and Schost on interpolation over finite fields, we exhibit the first provably stable algorithm (in the sense of relative error) for this problem for polynomials over the complex numbers with floating-point coefficients. The number of evaluations required grows only quadratically with the number of non-zero terms, and depends only logarithmically on the degree. A key new technique is a randomization which makes all coefficients of the unknown polynomial distinguishable, producing what we call an epsilon-diverse polynomial. Another departure from most previous approaches is that our algorithms do not rely on root finding as a subroutine. We show how these improvements affect the practical performance with trial implementations.