

We generalize the classical Knuth-Schonhage algorithm computing GCD of two polynomials for solving arbitrary linear Diophantine systems over polynomials in time, quasi-linear in the maximal degree. As an application, we consider the following weighted curve fitting problem: given a set of points in the plane, find an algebraic curve (satisfying certain degree conditions) that goes through each point the prescribed number of times. The main motivation for this problem comes from coding theory, namely it is ultimately related to the list decoding of Reed-Solomon codes. We present a new fast algorithm for the weighted curve fitting problem, based on the explicit construction of Groebner basis. This gives another fast algorithm for soft-decoding of Reed-Solomon codes different from the procedure proposed by Feng (1999), which works in time $(w/r) \cdot O(1) \cdot n \log^2 n / \log \log n$, where r is the rate of the code, and w is the maximal weight assigned to a vertical line.