An Implementation of Polynomial System Solving Algorithm

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Abstract

In this paper, we will discuss how to solve system of the algebraic equations with the following form

\[
\begin{align*}
P_1(x_1, x_2, \cdots, x_n) &= 0 \\
P_2(x_1, x_2, \cdots, x_n) &= 0 \\
\vdots \\
P_m(x_1, x_2, \cdots, x_n) &= 0
\end{align*}
\]

where \( K \) is a field of characteristic 0 and \( x_1, x_2, \cdots, x_n \) are indeterminates. \( P_1, P_2, \cdots, P_m \) are polynomials in the ring \( K[x_1, x_2, \cdots, x_n] \).

Based on the characteristic set method, we will give a modified algorithm.

For a polynomial set \( PS \), the zero set of \( PS \) has the following decomposition.

\[
Zero(PS) = \sum_k Zero(AS_k/J_k)
\]

in which \( AS_i \) is an ascending set. After we get this zero decomposition, we can solve each system \( AS_k \) by symbolic or numerical method. Because the polynomials produced in the computation process will be factorized, the amount of computation will be reduced greatly. This algorithm can be used to solve both 0-dimensional system or higher dimensional system.