Solving Polynomial Systems

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The problem of solving polynomial systems arises very frequently in various fields of science and engineering. In the last two decades, the homotopy continuation method has been established in the U.S. for finding the full set of isolated solutions to a polynomial system numerically. The method involves first solving a trivial system, and then deforming these solutions along smooth paths to the solutions of the target system. Over the years, practical evidences have proven that the homotopy continuation methods are efficient, reliable and powerful in solving polynomial systems numerically. Recently, modeling the sparse structure of a polynomial system by its Newton polytopes leads to a major computational breakthrough. Based on an elegant formula for computing the mixed volume, the new polyhedral homotopy can find all isolated zeros of a polynomial system by following much fewer solution paths. The method has been successfully implemented and proved to be very powerful in many occasions, especially when the systems are sparse. The method will be elaborated in detail in this talk.