A New Approach to Nonnegativity and Polynomial Optimization

Deciding nonnegativity of real polynomials is a fundamental problem in real algebraic geometry and polynomial optimization. Since this problem is NP-hard, one is interested in finding sufficient conditions (certificates) for nonnegativity, which are easier to check. The standard certificates for nonnegativity are sums of squares (SOS). In practice, SOS based semidefinite programming (SDP) is the standard method to solve polynomial optimization problems.

In 2014, Iliman and I introduced a new nonnegativity certificate based on *sums of nonnegative circuit polynomials (SONC)*, which are *independent* of sums of squares. We successfully applied SONCs to global nonnegativity problems using geometric programming.

In 2016, Dressler, Iliman, and I proved a Positivstellensatz for SONCs, which provides a converging hierarchy of lower bounds for constrained polynomial optimization problems. These bounds can be computed efficiently via relative entropy programming.

In this talk, I will give an overview about sums of nonnegative circuit polynomials, introduce our Positivstellensatz, and if time permits, briefly explain the connection to relative entropy programming.