

Relative Entropy Relaxations for Signomial Optimization

Venkat Chandrasekaran, California Institute of Technology

Signomial programs (SPs) are optimization problems consisting of an objective and constraints specified by signomials, which are sums of exponentials of linear functionals of a decision variable. SPs are non-convex optimization problems in general, and instances of NP-hard problems can be reduced to SPs. We describe a hierarchy of convex relaxations to obtain successively tighter lower bounds of the optimal value in SPs. This sequence of lower bounds is computed by solving increasingly larger-sized relative entropy optimization problems, which are convex programs specified in terms of linear and relative entropy functions. Our approach relies crucially on the observation that the relative entropy function – by virtue of its joint convexity with respect to both arguments – provides a convex parametrization of certain sets of globally nonnegative signomials with efficiently computable nonnegativity certificates via the arithmetic-geometric-mean (AM/GM) inequality. By appealing to representation theorems from real algebraic geometry, we demonstrate that our sequence of lower bounds converges to the global optimum for broad classes of SPs. Finally, we discuss numerical experiments that demonstrate the effectiveness of our approach. (Joint work with Parikshit Shah)