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Optimization and critical point methods for numerical characterization of real varieties

Given a system of polynomial equations with real approximate coefficients, a fundamental unsolved problem is to give a stable numerical algorithm to characterize its real solution set (real variety). This means stably computing at least one real approximate point on each connected real solution component of the variety. There has been dramatic recent progress in this area, and I will describe some of this progress including our recent contributions. This is joint work with Fei Wang, Henry Wolkowicz and Wenyuan Wu.

The techniques described involve semi-definite programming, facial reduction and critical point methods. The critical points are real points on the variety that optimize the distance from a point or plane to the real solution components. Some comments about larger structured problems will be made.