Solution Paths of ℓ^1-Regularizations

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joint work
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Abstract

To reconstruct a signal from a few linear measurements, one often computes the minimizers of energy functionals with a quadratic data fidelity term and an ℓ^1-regularization. The data fidelity term captures how closely we fit the measured data, while the ℓ^1-regularization imposes prior information about the signal to be reconstructed. The choice of the regularization parameter t, which determines the trade-off between fitting the data and satisfying the prior information, is often a delicate issue. Instead of solving the problem for a fixed regularization parameter t, I will explain how to compute a solution for every nonnegative parameter, i.e., a solution path.

Under a so called one-at-a-time condition, the well-known homotopy method computes the solution path by solving a sequence of linear systems. To illustrate that this condition is necessary, I will discuss an example in which the homotopy method fails. Subsequently, I will introduce a new generalized homotopy method, which replaces the linear systems with nonnegative least squares problems, and provably works in every scenario. If time permits, I will also extend the generalized homotopy method from ℓ^1-regularizations to polyhedral regularizations.