Local Optimization of Nonsmooth, Nonconvex Spectral and Pseudospectral Functions in Theory and Practice

Michael L. Overton
Courant Institute of Mathematical Sciences
New York University

Joint work with James V. Burke and Adrian S. Lewis

Many functions arising in systems and control are nonsmooth and nonconvex. For continuous-time systems these include the spectral abscissa (maximum real part of the eigenvalues of a matrix), the pseudospectral abscissa (maximum real part of the epsilon-pseudospectrum of a matrix), the distance to instability (smallest perturbation that makes a matrix unstable) and the distance to uncontrollability (smallest perturbation that makes a matrix pair uncontrollable). Analogous measures apply to discrete-time systems. When matrices depend on parameters it is natural to consider optimization of such functions. We give an overview of variational analysis of these functions in matrix space, emphasizing the importance of regularity (in the sense of Clarke). We then discuss algorithms for evaluating these functions and locally optimizing them over parameters, computing, for example, locally optimal low-order controllers for challenging problems from the applications literature.