Optimizing Matrix Stability

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Abstract: A matrix is stable if its spectral abscissa (maximum real part of its eigenvalues) is negative. The spectral abscissa models only asymptotic behavior of associated dynamical systems, so more practical stability measures include the pseudospectral abscissa (maximum real part of the pseudospectrum) and the distance to instability (minimum norm perturbation required to make a stable matrix unstable).

Matrices often arise in applications as parameter dependent, a classic example being $A(K) = A_0 + BKC$, the static output feedback model in control. We formulate two optimization problems over a parameterized matrix family: minimization of the pseudospectral abscissa and maximization of the distance to instability, and present a new algorithm that approximates local optimizers. One of our numerical examples is a difficult stabilization problem from the control literature: a model of a Boeing 767 at a flutter condition.

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