Eigenvalue backward errors of structured polynomial eigenvalue problems

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Abstract

Let $P(z) = \sum_{i=0}^{m} z^i A_i$, where $A_i \in \mathbb{C}^{n,n}$ for $i = 0, \ldots, m$ be a regular matrix polynomial. The matrix polynomial $P(z)$ is said to be structured if the matrices A_i, for $i = 0, \ldots, m$ belong to a special subset $\mathbb{S}$ of $(\mathbb{C}^{n\times n})^{m+1}$.

Structured matrix polynomials have occurred in many engineering applications and have been studied widely for the last two decades. Structured eigenvalue-eigenpair backward error analysis of structured matrix polynomials is important in order to know the backward stability of algorithms that compute them without losing the structure of the polynomial.

In this talk, I will derive formulas for the structured eigenvalue backward errors of matrix polynomials that have Hermitian and related structures, like skew-Hermitian, $*$-even, $*$-odd. This involves a reformulation of the original problem of computing eigenvalue backward error into an equivalent problem of minimizing the maximum eigenvalue of a parameterized Hermitian matrix. Numerical experiments show that there is a significant difference between the backward errors with respect to perturbations that preserve structure and those with respect to arbitrary perturbations.