Detecting hyperbolic quadratic eigenvalue problems

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The Hermitian quadratic eigenvalue problem (HQEP) is to find scalars λ and nonzero vectors x such that $\mathbf{Q}(\lambda)x := (\lambda^2 M + \lambda D + K)x = 0$ holds for the given Hermitian matrices M, D and K. Additionally, if M is positive definite and there exists a real number λ_0 such that the matrix $\mathbf{Q}(\lambda_0)$ is negative definite, then the given HQEP is *hyperbolic*. We are interested in detecting if a given HQEP is hyperbolic.

Although there exist many algorithms for detecting the hyperbolicity, most of them are not suitable for large HQEPs. In this talk, we propose a basic subspace algorithm for detecting large hyperbolic QEPs. It can be easily adapted to detect a large *overdamped* QEP (meaning, it is hyperbolic with D positive definite and K positive semidefinite). Our algorithm is based on iterative testing of small compressed HQEPs formed by using search subspaces of small dimensions. We also propose a specialized algorithm and its preconditioned variant.

[1] https://link.springer.com/epdf/10.1007/s11075-019-00702-0

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