A rational Krylov method based on Hermite interpolation for the nonlinear eigenvalue problem

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Abstract

We present a new rational Krylov method for solving the nonlinear eigenvalue problem (NLEP)

$$A(\lambda)x = 0.$$

The method approximates $A(\lambda)$ by Hermite interpolation where the degree of the interpolating polynomial and the interpolation points are not fixed in advance. It uses a companion-type reformulation to obtain a linear generalized eigenvalue problem (GEP). This GEP is solved by a rational Krylov method that preserves the structure. As a result, the companion form grows in each iteration and the interpolation points can be dynamically chosen. Each iteration requires a linear system solve with $A(\sigma)$ where σ is the last interpolation point. We illustrate by numerical examples that the method is fully dynamic and can be used as a global search method as well as a local refinement method. We also compare the method to Newton's method.

Key words. Numerical linear algebra, Rational Krylov, Newton polynomials, Hermite interpolation, nonlinear eigenvalue problem