Hybrid rational Krylov methods for matrix functions

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Matrix functions appear in exact solutions of various algebraic or differential equations. For example, the solution of a first-order linear ODE is given in terms of a matrix exponential, or in solutions of second-order linear ODEs trigonometric functions arise. It is not surprising that this has increased the interest in fast methods to evaluate matrix functions. Rational Krylov methods are among such methods. We present a novel hybrid rational Krylov method, which is particularly useful for approximating the action of a matrix function onto many different vectors. This method is a combination of the widely used Rayleigh–Ritz method and a more recent method, the PAIN method (which stands for poles and interpolation nodes, cf. [**?**]), both of which are implicitly based on rational interpolation. We combine the excellent ability of the Rayleigh–Ritz method to obtain near-optimal interpolation nodes, and use these nodes as input parameters for the PAIN method. The latter method requires less iteration work and storage need, which makes it possible to run multiple instances of this method on a parallel computer.

References

[1] S. Güttel, *Rational Krylov methods for operator functions*, Dissertation thesis, TU Bergakademie Freiberg, 2010.