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An efficient block rational Krylov solver for Sylvester equations with adaptive pole selection

We present an algorithm for the solution of Sylvester equations with right-hand side of low rank, based on projection onto a block rational Krylov subspace. Extending the convergence analysis in [2] to the block case, we link the convergence with the problem of minimizing the norm of a small rational matrix over the spectra or field-of-values of the involved matrices. This is in contrast with the non-block case, where the minimum problem is scalar, instead of matrix-valued. Replacing the norm of the objective function with an easier to evaluate function yields several adaptive pole selection strategies, providing a theoretical analysis for known heuristics, as well as effective novel techniques.

[1] A. Casulli, L. Robol, An efficient block rational Krylov solver for Sylvester equations with adaptive pole selection. arXiv:2301.08103, 2023.
[2] B. Beckermann. An error analysis for rational Galerkin projection applied to the Sylvester equation. SIAM Journal on Numerical Analysis, 2011.

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