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Inexactness in low-rank methods for large matrix equations

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One established strategy to solve large-scale algebraic matrix equations is to compute a low-rank approximations of the solution by iterative methods. Often, these methods work internally with rational Krylov subspaces which necessitates to solve a large and sparse linear system of equations inside each iteration step. In this presentation we will look at inexact variants of rational Krylov subspace and low-rank ADI methods [1], where "inexact" refers to the scenario when the occurring *inner* linear systems are solved inexactly by iterative methods such as, e.g., preconditioned Krylov subspace methods. Our main focus are estimates for the required accuracy regarding the inner linear systems which will dictate when the *inner* Krylov subspace methods can be terminated, thus potentially saving some computational effort without endangering the functionality of the *outer* low-rank method. If time permits, we will also look at inexact matrix-valued low-rank Krylov methods [2] for general linear matrix equations, where inexactness occurs in the form of low-rank truncations and similar considerations as before can be done.

References

[1] P. Kürschner, M. Freitag, *Inexact methods for the low rank solution to large scale Lyapunov equations*, BIT Numerical Mathematics. 60:1221–1259, 2020

[2] D. Palitta, P. Kürschner, *On the convergence of Krylov methods with low-rank truncations*, Numerical Algorithms, 2021