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"Efficient Handling of Complex Shift Parameters in the Low-rank ADI method"

Abstract:
The solution of large-scale Lyapunov equations is a crucial problem for several fields of modern applied mathematics, e. g., balanced truncation model order reduction. The low-rank version of the alternating directions implicit method (LR-ADI) is an iterative algorithm that computes approximate low-rank factors of the solution. In order to achieve a fast convergence it requires adequate shift parameters, which can be complex if the Lyapunov equation is defined by an unsymmetric matrix. This will require arithmetic computations as well as storage of complex data and thus, increase the overall complexity and memory requirements of the method. In this talk we present a novel reformulation of LR-ADI which generates real low-rank factors by carefully exploiting the dependencies of the iterates with respect to pairs of complex conjugate shift parameters. It significantly reduces the amount of complex arithmetic calculations and memory, and is hence often superior in terms of efficiency compared to other formulations.