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Dynamical low-rank approximations: from eigenvalues to PDEs

ABSTRACT:
The efficient computation of low rank solutions of matrix differential equations is a powerful tool in Numerical Analysis nowadays involved in the solution of many problems of wide interest. In particular, we focus on the problems of approximating the spectral abscissa of high dimensional operators and the solutions of partial differential equations, which are particularly meaningful in plasma physics. When evolutive problems are stated in terms of searching for low rank solutions of matrix differential equations, then the underlying dynamics is described according to the dynamical low rank appoximation approach. In this way, fixed a value of the rank, the solution is factorized, according to such value, and the differential equations for the factors are considered. In our approach, the numerical solution of such systems is computed by developing specific splitting methods, which can provide special adaptations to manage the variability of the rank or the management of meaningful quantities for the particular type of system under examination.