MAX-PLANCK-INSTITUT
FÜR DYNAMIK KOMPLEXER
TECHNISCHER SYSTEME
MAGDEBURG

CSC Seminar

SPEAKER

Jonas Schulze

TITLE

A unifying framework for ADI-like methods for linear matrix equations and beneficial consequences

ABSTRACT

We derive the alternating-directions implicit (ADI) method based on a commuting operator split and apply the results in detail to the continuous time algebraic Lyapunov equation with low-rank constant term and approximate solution, giving pointers for the Sylvester case. Previously, it has been mandatory to start the low-rank ADI for Lyapunov equations (CF-ADI, LR-ADI, G-LR-ADI) or Sylvester equations (fADI, G-fADI) with an all-zero initial value. Our approach extends the known efficient iteration schemes of low-rank increments and residuals to arbitrary low-rank initial values for all these methods. We further generalize two properties of the low-rank Lyapunov ADI to the generic ADI applied to arbitrary linear equations using a commuting operator split, namely the invariance of iterates under permutations of the shift parameters, and the efficient handling of complex shift parameters.

We investigate the performance of arbitrary initial values using two outer iterations in which the low-rank Lyapunov ADI is typically called. First, we solve an algebraic Riccati equation with the Newton method. Second, we solve a differential Riccati equation with a first-order Rosenbrock method. Numerical experiments confirm that the proposed new initial value of the ADI can lead to a significant reduction in the total number of ADI steps, while also showing a 17% and 8x speed-up over the zero initial value for the two equation types, respectively.

Tuesday, January 21, 2025 at 2 pm

seminar room Prigogine