Contribution ID: **11** Type: **Talk**

A subspace-conjugate gradient method for linear matrix equations

Wednesday, September 3, 2025 10:00 AM (30 minutes)

Large-scale multiterm linear matrix equations of the form
$A_1XB_1+\cdots+A_\ell XB_\ell = C, ariseasthealgebraicformulationinvariousapplicationproblems, suchasdiscretizedmultivariable$
$timePDEsandinverseproblems.Whileeffectivemethodsexistfortwo-termequations(\ell = 2)$, limited options are available for $\ell > 2$. Thus, efficiently solving multiterm matrix equations remains an open problem in numerical linear algebra. In this talk, we present a new iterative scheme called the Subspace-Conjugate Gradient (Ss-cg) method for the efficient solution of large-scale multiterm linear matrix equations. This method relies on the matrix-oriented CG scheme but better uses the underlying (low-rank) matrix structure. By imposing a peculiar orthogonality condition, the CG scalar coefficients for the iterative solution and the descent direction are replaced by low-dimensional matrices in Ss-CG. We employ truncation strategies to maintain the computed matrix iterates of low rank since limiting memory consumption becomes essential, especially when the number of terms ℓ is large. To this end, an additional ad-hoc randomized range-finding strategy is developed to further speed up computations.
The features of the Ss-CG method lead to remarkable computational gains, as demonstrated by several computational experiments. In particular, we compare Ss-CG with existing algorithms for solving Sylvester and Lyapunov multiterm equations to highlight its potential.

Primary authors: PALITTA, Davide (Alma Mater Studiorum, Università di Bologna); IANNACITO, Martina (Dipartimento di Matematica, Alma Mater Studiorum - Università di Bologna); SIMONCINI, Valeria (Universita' di Bologna)

Presenter: IANNACITO, Martina (Dipartimento di Matematica, Alma Mater Studiorum - Università di Bologna)

Session Classification: Morning Session