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# EFFICIENT PRECONDITIONING FOR SEQUENCES OF PARAMETRIC COMPLEX SYMMETRIC LINEAR SYSTEMS *

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**Abstract.** Solution of sequences of complex symmetric linear systems of the form $A_j x_j = b_j$, $j = 0, ..., s$, $A_j = A + \alpha_j E_j$, $A$ Hermitian, $E_0, ..., E_s$ complex diagonal matrices and $\alpha_0, ..., \alpha_s$ scalar complex parameters arise in a variety of challenging problems. This is the case of time dependent PDEs; lattice gauge computations in quantum chromodynamics; the Helmholtz equation; shift-and-invert and Jacobi–Davidson algorithms for large-scale eigenvalue calculations; problems in control theory and many others. If $A$ is symmetric and has real entries then $A_j$ is *complex symmetric*.

The case $A$ Hermitian positive semidefinite, $\mathrm{Re}(\alpha_j) \geq 0$ and such that the diagonal entries of $E_j$, $j = 0, ..., s$ have nonnegative real part is considered here.

Some strategies based on the update of incomplete factorizations of the matrix $A$ and $A^{-1}$ are introduced and analyzed. The numerical solution of sequences of algebraic linear systems from the discretization of the real and complex Helmholtz equation and of the diffusion equation in a rectangle illustrate the performance of the proposed approaches.

**Key words.** Complex symmetric linear systems; preconditioning; parametric algebraic linear systems; incomplete factorizations; sparse approximate inverses.

**AMS subject classifications.** 65F10, 65N22, 15A18.

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