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RESTARTING TECHNIQUES FOR THE (JACOBI-)DAVIDSON SYMMETRIC EIGENVALUE METHODS *

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Abstract. The (Jacobi-)Davidson method, which is a popular preconditioned extension to the Arnoldi method for solving large eigenvalue problems, is often used with restarting. This has significant performance shortcomings, since important components of the invariant subspace may be discarded. One way of saving more information at restart is through "thick" restarting, a technique that involves keeping more Ritz vectors than needed. This technique and especially its dynamic version have proved very efficient for symmetric cases. A different restarting strategy for the Davidson method has been proposed in [14], motivated by the similarity between the spaces built by the Davidson and Conjugate Gradient methods. For the latter method, a three term recurrence implicitly maintains all required information.

In this paper, we consider the effects of preconditioning on the dynamic thick restarting strategy, and we analyze both theoretically and experimentally the strategy based on Conjugate Gradient. Our analysis shows that, in some sense, the two schemes are complementary, and that their combination provides an even more powerful technique. We also describe a way to implement this scheme without additional orthogonalizations or matrix multiplications.

Key words. Davidson, Jacobi-Davidson, Lanczos, Conjugate Gradient methods, eigenvalue, implicit restarting, deflation, preconditioning.

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