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Fixed-Polynomial Approximate Spectral Transformations for Preconditioning the Eigenvalue Problem

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Arnoldi's method is often used to compute the eigenvalues and eigenvectors of large, sparse matrices. Various techniques can by employed to improve the convergence of this method, some resulting in considerable expense. We will present an efficient preconditioning scheme that accelerates the convergence of Arnoldi's method to the accelerates the convergence of Arnoldi's method to the eigenvalues of smallest magnitude for Hermitian and non-Hermitian matrices. This scheme uses a fixed-polynomial operator to approximate the spectral transformation. When used with the Implicitly Restarted Arnoldi (IRA) method, this achieves the effect of a spectral transformation without factoring a matrix.

Numerical results indicate that this employing this preconditioning scheme with IRA is very effective. It is just as accurate as IRA in regular mode, more accurate than using preconditioned GMRES started anew for each linear solve, and considerably less expensive than either. Furthermore, using a fixed-polynomial operator with IRA compares favorably with two other current methods: Jacobi-Davidson and Locally Optimal Block Preconditioned Conjugate Gradient.