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Symmetric indefinite systems, positive definite preconditioning, and interior eigenvalues

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We present the Preconditioned Locally Harmonic Residual (PLHR) method for computing a subset of interior eigenvalues and their associated eigenvectors of a large, possibly sparse, symmetric matrix. The method is based on a short-term block recurrence, with iteration coefficients given by the T-harmonic Rayleigh–Ritz procedure. PLHR does not require traditional spectral transformations, matrix factorizations, or inversions. Instead, it takes advantage of symmetric positive definite preconditioning. We describe a simple derivation of the algorithm, which is motivated by a relation between interior eigensolvers and preconditioned linear solvers for symmetric indefinite systems, and discuss possible preconditioning approaches. Several numerical experiments will be presented to illustrate efficiency and robustness of the algorithm.