TEMPLE UNIVERSITY
Department of Mathematics

Applied Mathematics and Scientific Computing Seminar

Room 617 Wachman Hall

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Numerical Solution of Eigenvalue Problems with Spectral Transformations (Part I)

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Abstract. This series of two talks is concerned with inexact eigenvalue algorithms for solving large sparse matrix eigenvalue problems. In many applications where some interior eigenvalues are wanted, a spectral transformation is usually employed to map them to dominant ones of the transformed problem so that they can be easily captured. At each step of the eigenvalue algorithm (outer iteration), the matrix-vector product involving the transformed linear operator requires the solution of a linear system of equations, which is generally done by preconditioned iterative linear solvers inexactly if the matrices are very large.

In this first part, we present a detailed analysis of preconditioned MINRES for approximately solving the linear systems that arise when Rayleigh Quotient Iteration (RQI) is used to compute the lowest eigenpair of a symmetric positive definite matrix. We study the convergence of unpreconditioned MINRES algorithm and compare the performance of several versions of MINRES in this context. In particular, we obtain a better understanding of the limitation of regular preconditioned MINRES and the virtue of a new type of preconditioner with "tuning". We also present a refined version of the tuned preconditioner to guarantee its positive definiteness.