Inexact Inverse Iteration for Symmetric Matrices

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The computation of eigenvalues of large sparse matrices is often an important part of the assessment of stability in large scale practical problems. In this talk we discuss inexact inverse iteration for the real eigenvalue problem $A\mathbf{v} = \lambda M\mathbf{v}$, where A is symmetric and M is symmetric positive definite.

The analysis is designed to apply to the case when A and M are large and sparse and where iterative methods are used to solve the shifted linear systems $(A - \sigma M)\mathbf{y} = M\mathbf{x}$ where σ is the Raleigh quotient. We first present a general convergence theory that is independent of the nature of the inexact solver used. Next we consider in detail the performance of preconditioned MINRES as the solver for $(A - \sigma M)\mathbf{y} = M\mathbf{x}$. In particular we analyse the cost of one solve and then the overall cost of the whole algorithm. Also we present a new treatment of the approach discussed by [2] to set up an appropriate right hand side for the preconditioned system. We also compare two stopping conditions for the iterative solver.

A detailed account of inexact inverse iteration for general non-symmetric eigenvalue problems is given in [1].

References

[1] Jörg Berns-Müller. *Inexact Inverse Iteration using Galerkin Krylov solvers.* PhD thesis, University of Bath, 2003.

[2] V. Simoncini and L. Eldén. Inexact Rayleigh quotient-type methods for eigenvalue computations. *BIT*, **42**, (1), 2002, 159 – 182.