Polynomial Preconditioning GMRES with Mixed Precisions

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As new computer hardware becomes available that supports low precision math operations, mixed precision linear solvers are gaining popularity. We discuss applying polynomial preconditioning to mixed precision GMRES algorithms. The polynomial is based upon the GMRES polynomial, using harmonic Ritz values as roots. We apply single precision polynomial preconditioning to double precision GMRES and to GMRES-IR. GMRES-IR performs an inner iteration in single precision with an outer refinement step in double precision. Polynomial preconditioning can give excellent performance in single precision due to speedup in the sparse matrix vector product. Finally, we briefly discuss using other preconditioners in low precision, including block Jacobi and multigrid.

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