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A Convergence Analysis for Recycling Krylov Methods

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In many computational science and engineering problems, we have to solve a sequence of large, sparse, linear systems, in which the matrix changes slowly from one system to the next or changes in an algebraically structured way. The right hand side can change more drastically, although in many applications this is not the case. We have developed several methods that significantly improve the convergence of iterative solvers by recycling from one system to the next an approximate invariant subspace. For efficiency and because the system matrix changes continually, we do not expect the approximate invariant subspaces to be accurate. Nevertheless, this technique has proved very successful in reducing total iteration counts for a range of applications. In this presentation, we provide a convergence analysis for iterative linear solvers recycling an approximate invariant subspace. An important result of the analysis is that significant improvement of convergence results for very modest accuracy of the invariant subspace approximation.

This is joint work with Michael L. Parks