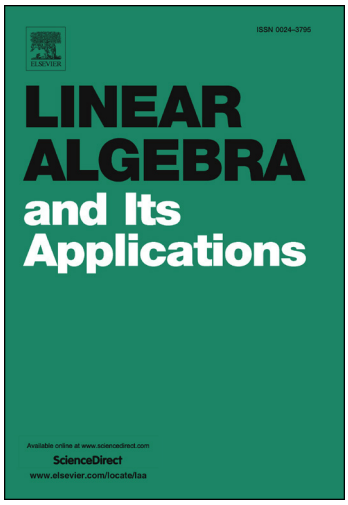

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The Deflated Conjugate Gradient Method: Convergence, Perturbation and Accuracy

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Abstract

Deflation techniques for Krylov subspace methods have seen a lot of attention in recent years. They provide means to improve the convergence speed of these methods by enriching the Krylov subspace with a deflation subspace. The most common approach for the construction of deflation subspaces is to use (approximate) eigenvectors, but also more general subspaces are applicable.

In this paper we discuss two results concerning the accuracy requirements within the deflated CG method. First we show that the effective condition number which bounds the convergence rate of the deflated conjugate gradient method depends asymptotically linearly on the size of the perturbations in the deflation subspace. Second, we discuss the accuracy required in calculating the deflating projection. This is crucial concerning the overall convergence of the method, and also allows to save some computational work.

To show these results, we use the fact that as a projection approach deflation has many similarities to multigrid methods. In particular, recent results relate the spectra of the deflated matrix to the spectra of the error propagator of twogrid methods. In the spirit of these results we show that the effective condition number can be bounded by the constant of a weak approximation property.

Keywords: conjugate gradients, deflation, multigrid, convergence, perturbation

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