

PRECONDITIONERS FOR SADDLE POINT LINEAR SYSTEMS WITH HIGHLY SINGULAR (1,1) BLOCKS*

CHEN GREIF[†] AND DOMINIK SCHÖTZAU[‡]

Abstract. We introduce a new preconditioning technique for the iterative solution of saddle point linear systems with (1,1) blocks that have a high nullity. The preconditioners are block diagonal and are based on augmentation, using symmetric positive definite weight matrices. If the nullity is equal to the number of constraints, the preconditioned matrices have precisely two distinct eigenvalues, giving rise to immediate convergence of preconditioned MINRES. Numerical examples illustrate our analytical findings.

Key words. saddle point linear systems, high nullity, augmentation, block diagonal preconditioners, Krylov subspace iterative solvers

AMS subject classifications. 65F10

*Received September 20, 2005. Accepted for publication November 14, 2005. Recommended by M. Benzi. This work was supported in part by the Natural Sciences and Engineering Research Council of Canada.

[†]Department of Computer Science, University of British Columbia, Vancouver, BC V6T 1Z4, Canada (greif@cs.ubc.ca).

[‡]Mathematics Department, University of British Columbia, Vancouver, BC V6T 1Z2, Canada (schoetzau@math.ubc.ca).