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General constraint preconditioning iteration method for singular saddle-point problems.

Summary: For the singular saddle-point problems with nonsymmetric positive definite (1, 1) block, we present a general constraint preconditioning (GCP) iteration method based on a singular constraint preconditioner. Using the properties of the Moore-Penrose inverse, the convergence properties of the GCP iteration method are studied. In particular, for each of the two different choices of the (1, 1) block of the singular constraint preconditioner, a detailed convergence condition is derived by analyzing the spectrum of the iteration matrix. Numerical experiments are used to illustrate the theoretical results and examine the effectiveness of the GCP iteration method. Moreover, the preconditioning effects of the singular constraint preconditioner for restarted generalized minimum residual and quasi-minimal residual methods are also tested.

Keywords: singular saddle-point problems; Moore-Penrose inverse; constraint preconditioning; convergence; iteration method; numerical experiment; minimal residual methods