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# A generalized shift-splitting preconditioner for complex symmetric linear systems\*

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**Abstract** In this paper, the generalized shift-splitting (GSS) preconditioner is implemented for solving a class of generalized saddle point problems which stem from the solution of complex symmetric linear systems. The GSS preconditioner is induced by the generalized shift-splitting iterative method. Theoretical analysis shows that the generalized shift-splitting iterative method is unconditionally convergent. Some numerical experiments are provided to show the effectiveness of the proposed preconditioner.

**Keywords:** complex symmetric linear systems; generalized shift-splitting; convergence; preconditioner.

## 1 Introduction

Consider the iterative solution of the system of linear equations

$$\mathcal{A}u = b, \mathcal{A} \in \mathbb{C}^{n \times n}, u, b \in \mathbb{C}^n, \quad (1.1)$$

where  $\mathcal{A}$  is a complex symmetric matrix of the form

$$\mathcal{A} = W + \mathbf{i}T, (\mathbf{i} = \sqrt{-1}) \quad (1.2)$$

and  $W, T \in \mathbb{R}^{n \times n}$  are symmetric matrices. Here and in the sequel, we let  $W$  be positive definite and  $T$  be positive semidefinite. Such linear systems arise in a variety of scientific

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