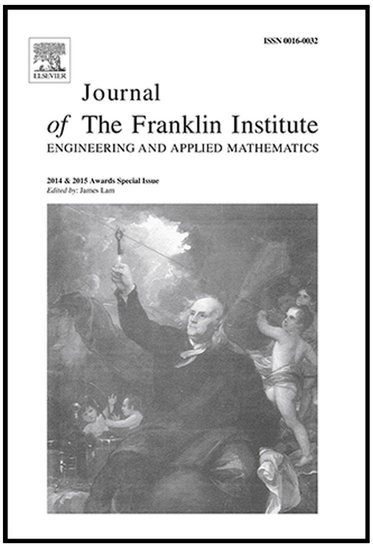

A relaxed gradient based algorithm for solving generalized coupled Sylvester matrix equations

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A relaxed gradient based algorithm for solving generalized coupled Sylvester matrix equations *

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Abstract: The present work proposes a relaxed gradient based iterative (RGI) algorithm to find the solutions of coupled Sylvester matrix equations $AX + YB = C, DX + YE = F$. It is proved that the proposed iterative method can obtain the solutions of the coupled Sylvester matrix equations for any initial matrices X_0 and Y_0. Next the RGI algorithm is extended to the generalized coupled Sylvester matrix equations of the form $A_{i1}X_1B_{i1} + A_{i2}X_2B_{i2} + \ldots + A_{ip}X_pB_{ip} = C_i, (i = 1, 2, \ldots, p)$. Then, we compare their convergence rate and find RGI is faster than GI, which has maximum convergence rate, under an appropriative positive number ω and the same convergence factor μ_1 and μ_2. Finally, a numerical example is included to demonstrate that the introduced iterative algorithm is more efficient than the gradient based iterative (GI) algorithm of [Ding, 2006] in speed, elapsed time and iterative steps.

keywords: Coupled Sylvester matrix equations; Relaxed gradient based iterative algorithm; Relaxation factor; Convergence rate ; Numerical solutions

AMS Subject Classifications(2000): 15A06; 15A24

1 Introduction

The Sylvester matrix equation $AX + XB = C$ and generalized Sylvester matrix equation $AX + YB = C$ have been attracted much attention from both theoretical and practical points of view. The Sylvester matrix equation and generalized Sylvester matrix equation have many applications in linear system theory, e.g. pole/eigenstructure assignment [1-4], robust pole assignment [5-8], robust partial pole assignment [9], observer design[10], model matching problem [11], regularization of descriptor systems[12,13], disturbance decoupling problem [14] and non-interacting control [15].

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