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# Restarted Hessenberg method for solving shifted nonsymmetric linear systems

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## Abstract

It is known that the restarted full orthogonalization method (FOM) outperforms the restarted generalized minimum residual (GMRES) method in several circumstances for solving shifted linear systems when the shifts are handled simultaneously. Many variants of them have been proposed to enhance their performance. We show that another restarted method, the restarted Hessenberg method [M. Heyouni, Méthode de Hessenberg Généralisée et Applications (Ph.D. Thesis), Université des Sciences et Technologies de Lille, France, 1996] based on Hessenberg procedure, can effectively be employed, which can provide accelerating convergence rate with respect to the number of restarts. Theoretical analysis shows that the new residual of shifted restarted Hessenberg method is still collinear with each other. In these cases where our proposed algorithm needs less enough elapsed CPU time to converge than the earlier established restarted shifted FOM, the weighted restarted shifted FOM, and some other popular shifted iterative solvers based on the short-term vector recurrence, as shown via extensive numerical experiments involving the recently popular application of handling time fractional differential equations.

*Key words:* Shifted linear system; Hessenberg process; Pivoting strategy; Restarted Hessenberg method; Collinear; Fractional differential equations.

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