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An optimal and efficient general eighth-order derivative free scheme for simple roots

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Abstract

The main motivation of this study is to present an optimal scheme in a general way that can be applied to any existing optimal multipoint fourth-order iterative scheme whose first substep employs Steffensen's method or Steffensen like method to further produce optimal eighth-order iterative schemes. A rational function approximation approach is used in the construction of proposed scheme. In addition, we also discussed the theoretical and computational properties of our scheme. Each member of the presented scheme satisfies the optimality conjecture for multipoint iterative methods without memory which was given by Kung and Traub in 1970. Finally, we also concluded on the basis of obtained numerical results that our methods have faster convergence in contrast to the existing methods of same order because they have minimum residual errors, minimum error difference between two consecutive iterations and minimum asymptotic error constants corresponding to the considered test function.

Keywords: Nonlinear equations, Simple roots, Computational order of convergence, Steffensen's type method.

2000 Mathematics Subject Classification: 65G99, 65J15, 49M15.

1 Introduction

The construction of new solution techniques have always been a paramount importance in the field of numerical analysis in order to find the approximate solutions of nonlinear equations. Newton's method is

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