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P. Maroju, Ramandeep Behl, S.S. Motsa

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Some novel and optimal families of King's method with eighth and sixteenth-order of convergence

P. Maroju, Ramandeep Behl [1] and S. S. Motsa

School of Mathematics, Statistics and Computer Sciences, University of KwaZulu-Natal, Private Bag X01, Scottsville 3209,

Pietermaritzburg, South Africa

Abstract

In this study, our principle aim is to provide some novel eighth and sixteenth-order families of King's method for solving nonlinear equations which should be superior than the existing schemes of same order. The relevant optimal orders of the proposed families satisfy the classical Kung-Traub conjecture which was made in 1974. The derivations of the proposed schemes are based on the weight function and rational approximation approaches, respectively. In addition, convergence properties of the proposed families are fully investigated along with one lemma and two main theorems describing their order of convergence. We consider a concrete variety of real life problems e.g. the trajectory of an electron in the air gap between two parallel plates, chemical engineering problem, Van der Waal's equation which explains the behavior of a real gas by introducing in the ideal gas equations and fractional conversion in a chemical reactor, in order to check the validity, applicability and effectiveness of our proposed methods. Further, it is found from the numerical results that our proposed methods perform better than the existing ones of the same order when the accuracy is checked in the multi precision digits.

keywords: Order of convergence, Newton's method, King's method, Simple roots, Iterative methods.

1 Introduction

Finding the solution techniques to solve the nonlinear equations, have always been a paramount importance in the field of numerical analysis which provide the accurate and efficient approximate solution α of a nonlinear equation of the form

$$f(x) = 0. \tag{1.1}$$

One of the main reason of paramount importance of this topic is the applicability in the applied science and the four major disciples of engineering: chemical, electrical, civil and mechanical (for the detailed explanation please see the Chapra and Canale [1]). For example, the location of the extremal points of a function describing some system requires finding the zeros of the derivatives of that function, many problems which involve critical paths also require the solution of algebraic equations, such as determining all the ray paths

[1]Corresponding author: Ramandeep Behl

E-mail: ramanbehl87@yahoo.in