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Eighth Order Family of Iterative Methods for Nonlinear Equations and Their Basins of Attraction

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Abstract

We present a new family of eighth order methods for solving nonlinear equations. The order of convergence of the considered methods is proved and corresponding asymptotic error constants are expressed in terms of four parameters. Numerical examples, obtained using *Mathematica* with high precision arithmetic, demonstrate convergence and efficacy of our family of methods. For some combinations of parameter values, the new eighth order methods produce very good results on tested examples compared to the results produced by some of the eighth order methods existing in the related literature. An exploration of the relevant dynamics of the proposed methods is presented along with illustrative basins of attraction for various polynomials.

Keywords: Nonlinear equation, Newton's method, Eighth order methods, Iterative methods, Basins of attraction

Mathematics Subject Classification: 65H05

1. Introduction

We present a new eighth order family of iterative methods for finding a simple root α of the nonlinear equation $f(x)=0$, where $f:(a,b)\subset R\to R$ is scalar function on an open interval (a,b) and it is sufficiently smooth in the neighborhood of the root α.

Newton's method is a well–known iterative method for computing approximations of α. It converges quadratically in some neighborhood of α for some appropriate starting value x_0. To improve the local order of convergence, many modified methods have been proposed in the literature, see [11–28] and references therein. In [13], a family of methods for solving nonlinear equations is given. This family includes Newton's method (order 2), Potra–Pták,

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