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AN IMPROVED LOCAL ANALYSIS OF DEFORMED HALLEY METHOD IN BANACH SPACES

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Abstract. In this paper, we provide an improved local analysis of deformed Halley method using Hölder continuous first-order Fréchet derivative in Banach spaces. This analysis avoids the use of the extra assumption on the boundedness of the first derivative. Finally, numerical applications confirm that our analysis provides larger convergence radii in comparison with the earlier study.

1. Introduction

We present an advanced analysis of local convergence of deformed Halley scheme for solving nonlinear operator equations in the form

$$\mathcal{P}(s) = 0, \tag{1.1}$$

where $\mathcal{P} : \Omega \subseteq \mathcal{X} \to \mathcal{Y}$ is a Fréchet differentiable operator with values in the Banach space $\mathcal{Y}$ and Ω is a convex subset of the Banach space $\mathcal{X}$. Nonlinear equations play an important role in solving many application problems arise in various domains of engineering and applied sciences. Applying mathematical models many problems in Optimization, Chemistry, Economics, Physics and other applied areas can be transformed into these nonlinear equations. Due to complexity and non-availability of direct methods, iterative procedures are generally applied to address these equations [1, 2, 3, 4, 5, 7, 8, 9, 19, 21, 23, 25, 26, 27, 30, 31, 32, 37, 38, 39]. The well-known Newton's procedure for solving equations in the form (1.1) is given as:

$$s_{j+1} = s_j - [\mathcal{P}'(s_j)]^{-1}\mathcal{P}(s_j), \ j = 0, 1, 2, ... \tag{1.2}$$

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