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An efficient computational method for solving system of nonlinear generalized Abel integral equations arising in astrophysics

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HIGHLIGHTS

- We consider generalized Abel integral equations.
- The generalized Abel integral equations naturally occur in astrophysics.
- A reliable numerical approach is applied to examine the problem.
- Convergence analysis of the proposed scheme is shown.

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ABSTRACT

In this paper, we aim to solve nonlinear system of generalized Abel integral equations arising in astrophysics. The suggested approach is operational matrix technique by using Legendre scaling functions as a basis. Convergence analysis of the suggested technique is provided. Numerical experiments are performed to show the effectiveness of the proposed scheme. The results are shown through figures and tables.

1. Introduction

The Abel integral equations naturally arise in the study of various scientific problems such as radio astronomy, seismic travel times, electron emission, stereology, spectroscopy, optical fibres. In view of the great importance of Abel integral equations, we study a system of integral equations, namely

$$\left.\begin{aligned} a_{11}(x)\int_0^x \frac{F_1(u_1(t),u_2(t))dt}{(x-t)^\beta} + a_{12}(x)\int_x^1 \frac{F_2(u_1(t),u_2(t))dt}{(t-x)^\beta} &= f_1(x) \\ a_{21}(x)\int_0^x \frac{F_3(u_1(t),u_2(t))dt}{(t-x)^\beta} + a_{22}(x)\int_x^1 \frac{F_4(u_1(t),u_2(t))dt}{(x-t)^\beta} &= f_2(x) \end{aligned}\right\}, \quad (1)$$

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