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Research Article

New Algorithm for the Numerical Solutions of Nonlinear Third-Order Differential Equations Using Jacobi-Gauss Collocation Method

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A new algorithm for solving the general nonlinear third-order differential equation is developed by means of a shifted Jacobi-Gauss collocation spectral method. The shifted Jacobi-Gauss points are used as collocation nodes. Numerical examples are included to demonstrate the validity and applicability of the proposed algorithm, and some comparisons are made with the existing results. The method is easy to implement and yields very accurate results.

1. Introduction

During the past three decades, there has been a remarkable growth of interest in problems associated with systems of linear, nonlinear, and algebraic ordinary differential equations with split initial or boundary conditions. Throughout engineering and applied science, we are confronted with nonlinear or algebraic initial (two-point boundary) value problems that cannot be solved by analytical methods. With this interest in finding solutions to particular nonlinear initial (two-point boundary) value problems, came an increasing need for techniques capable of rendering relevant profiles. Although considerable progress has been made in developing new and powerful procedures, notably in the fields of fluid and celestial mechanics and chemical and control engineering, much remain to be done.

In an initial value problem, we have to approximately determine in some interval $t_0 \leq t \leq T$ that solution $u(t)$ of a third-order differential equation

$$\partial_t^3 u(t) = f\left(t, u(t), \partial_t u(t), \partial_t^2 u(t)\right), \tag{1.1}$$