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APPROXIMATE SOLUTION FOR PROPORTIONAL-DELAY RICCATI DIFFERENTIAL EQUATIONS BY HAAR WAVELET METHOD

BASHARAT HUSSAIN, AFROZ, AND SHAH JAHAN[†]

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Abstract. In this paper, Haar wavelet based numerical scheme is applied to obtained the approximate solution of Riccati differential equations(RDEs) and proportional-delay Riccati differential equations(PDRDEs)of quadratic nature. The basic idea of this algorithm is that it transform the differential equations into a system of algebraic equations from which approximate numerical solution of the problem is obtained. Several problems are solved and results are compared with Bezier curves method to show the proficiency and simple applicability of the method. We observed that the absolute error is decreasing uniformly with the increase in level of resolution.

1. Introduction

The Riccati differential equations come under the class of nonlinear differential equations. These equations are widely studied for numerous problems of contemporary analysis and its applications, and are not easy to solve explicitly, this make it interesting to investigate the solutions of these equations. Here, we have considered the following Riccati differential equations:

$$y'(t) = q_1(t) + y(t)\left(q_2(t) + q_3(t)y(t)\right), t_0 \leq t \leq t_f, y(t_0) = y_0, \tag{1.1}$$

where $q_1(t), q_2(t)$ and $q_3(t)(\neq 0)$ are continuous, t_0, t_f and $y(t_0)$ are arbitrary constant and $y(t)$ is unknown function.
Its proportional-delay variant can be written as

$$y'(t) = \psi(t) + by(t) + cy(\alpha t)(d - y(\alpha t)), t_0 \leq t \leq t_f, y(t_0) = y_0, \tag{1.2}$$

where $c \neq 0,\ b,\ d\ y_0 \in C$, and $\alpha > 0$,$\psi(t)$ is a continuous and $\alpha \neq 1$. When $0 < \alpha < 1$ (1.2) yields a retarded equation, whereas $\alpha > 1$ produces advanced equation. It follows

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