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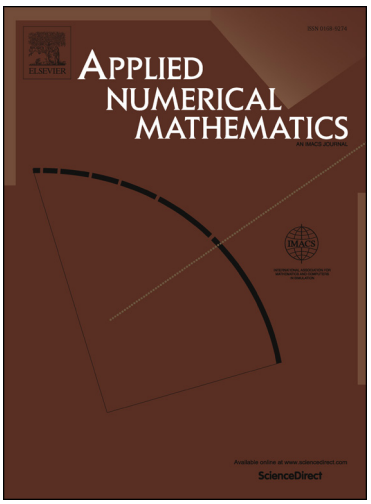

An effective numerical method for solving fractional pantograph differential equations using modification of hat functions

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An effective numerical method for solving fractional pantograph differential equations using modification of hat functions

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Abstract

In this work, a spectral method based on a modification of hat functions (MHFs) is proposed to solve the fractional pantograph differential equations. Some basic properties of fractional calculus and the operational matrices of MHFs are utilized to reduce the considered problem to a system of linear algebraic equations. The greatest advantage of using MHFs is the large number of zeros in their operational matrix of fractional integration, product operational matrix and also pantograph operational matrix. This property makes these functions computationally attractive. Some illustrative examples are included to show the high performance and applicability of the proposed method and a comparison is made with the existing results. These examples confirm that the method leads to the results of convergence order $\mathcal{O}(h^3)$.

Keywords: fractional pantograph differential equations, modification of hat functions, operational matrix, Caputo derivative, Riemann-Liouville integral

1. Introduction

In recent years, fractional calculus has been regarded as an effective tool for investigating the behavior of many phenomena in science and engineer-

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