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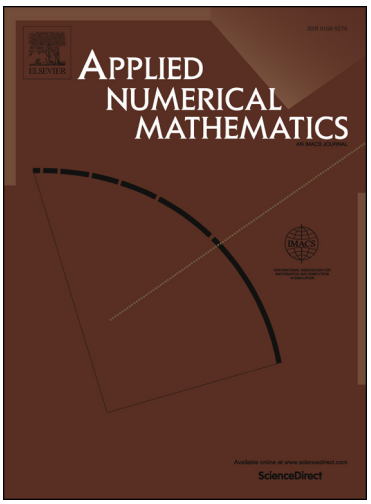

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Fully spectral collocation method for nonlinear parabolic partial integro-differential equations

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Abstract

The numerical approximation of solution to nonlinear parabolic Volterra and Fredholm partial integro-differential equations is studied in this paper. Unlike the conventional methods which discretize the time variable by finite difference schemes, we use the spectral method for this purpose. Indeed, both of the space and time discretizations are based on the Legendre-collocation method which lead to conversion of the problem to a nonlinear system of algebraic equations. The convergence of the proposed method is proven by providing an L^∞ error estimate. Several numerical examples are included to demonstrate the efficiency and spectral accuracy of the proposed method in the space and time directions.

MSC: 45K05, 65R20, 65M12, 65M70

Keywords: *Volterra integro-differential equations; Fredholm integro-differential equations; Legendre-spectral method; Gauss quadrature formulas; Complex-step derivative*

1 . Introduction

It is well known that the spectral methods are very powerful tools for solving many kinds of differential and integral equations especially with smooth solutions [4, 8, 23, 47]. Indeed, for smooth problems spectral methods exhibit exponential convergence (often so-called "spectral accuracy") and have been very successfully used in practical problems. For time-dependent partial differential and integro-differential equations if the spectral method is used for space

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