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Solution of systems of integro–differential equations using numerical treatment of fixed point

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Abstract. We approximate the solution of a system of nonlinear mixed Fredholm–Volterra integro–differential equations of the second kind, using fixed point techniques and Schauder bases in certain Banach spaces. The convergence and error are studied. Several numerical examples are given, and the obtained numerical approximations are compared with the corresponding exact solutions.

Key words: Fixed Point Theorem, Schauder basis, systems of nonlinear mixed Fredholm–Volterra integro–differential equations.

2010 Mathematics Subject Classification: 45J05, 45L10, 65R05.

1 Introduction

The importance of the systems of integral and integro-differential equations in the study of problems arising from the real world, have made them an important research topic in Applied Mathematics, and it is often necessary develop numerical techniques to approximate the solutions of such equations.

This has lead to great deal of research in recent years with the use of different approximation methods such that the Chebyshev polynomial method [1], the secant-like methods [2], the parameterization method [7], the wavelet methods [10], a collocation method in combination with operational matrices of Berstein polynomials [12], the variational iteration method [13], the He's homotopy perturbation method [15], the Bessel collocation method [16], etc.

The fixed point theorem (which is frequently used in other types of functional equations) and Schauder bases in a Banach space have been used also successfully in [3]–[6] and [8] to solve numerically systems of differential, integral and integro-differential equations. These methods have some significant advantages over others numerical methods because these are very easy to implement in a computer and the approximating functions are the sum of integrals of piecewise univariate and bivariate polynomials of degree 1 and 2 with coefficients easy of calculate.