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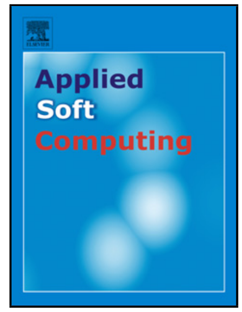

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Artificial neural networks based modeling for solving Volterra integral equations system

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Abstract

Properly designing an artificial neural network is very important for achieving the optimal performance. This study aims to utilize an architecture of these networks together with the Taylor polynomials, to achieve the approximate solution of second kind linear Volterra integral equations system. For this purpose, first we substitute the N-th truncation of the Taylor expansion for unknown functions in the origin system. Then we apply the suggested neural net for adjusting the numerical coefficients of given expansions in resulting system. Consequently, the reported architecture using a learning algorithm that based on the gradient descent method, will adjust the coefficients in given Taylor series. The proposed method was illustrated by several examples with computer simulations. Subsequently, performance comparisons with other developed methods was made. The comparative experimental results showed that this approach is more effective and robust.

Keywords: Volterra integral equations system; Feed-back neural network; Taylor series; Approximate solution

1 Introduction

Integral equation methods offer an attractive alternative to conventional finite difference and finite elements for solving partial differential equations that arise in science and engineering. They offer several advantages: complex physical boundaries are easy to incorporate, the ill-conditioning associated with directly discretizing the governing equation is avoided, high-order accuracy is easier to attain, and far-field boundary conditions are handled naturally. Since these equations usually can not be solved explicitly, so it is required to obtain approximate solution [20]. In recent years, many different algorithms have been developed for solving numerically various classes of integral equations such as Taylor expansion approach [7, 15, 16], Variational iteration method [12], Homotopy analysis method [3, 5, 6, 13, 14], Legendre polynomial method [21, 22], artificial neural networks approach