An approximation of a two-dimensional Volterra-Fredholm integral equations via Inverse Multiquadric RBFs

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Abstract

The main purpose of this article is to present an approximate solution for the mixed two-dimensional nonlinear Volterra-Fredholm integral equations using inverse multiquadric (IMQ) functions as two-dimensional RBFs. In this method, we interpolate the given function by these RBFs. Also we obtain good results for error by different shape parameters in comparison with the approximation by multiquadric (MQ) RBFs. The numerical results are compared with MQ method to display efficiency of the proposed method.

Keywords: Mixed volterra-Fredholm integral equation, Inverse Multiquadric, Multiquadric, Radial basis function.
Mathematics Subject Classification [2010]: 65R20, 45D05, 45B05

1 Introduction

Integral equations have recieved considerable interest in the mathematical applications in different areas of sciences. RBFs interpolations were evaluated as the most accurate techniques. This method allows scattered data to be easily used in computation. There are many works on developing and analyzing numerical methods for solving Volterra-Frdeholm integral equations (IE) in [5, 6]. Alipanah et. al. [1], used RBFs method for solving a nonlinear integral equation in the one-dimensional case. Here we want to propose a method to approximate a class of mixed two-dimensional nonlinear Volterra-Fredholm integral equations on the interval $[-1, 1]$ by using IMQs radial basis functin.
The outline of this paper is as follows: At first we introduce the Volterra-Fredholm IEs, and IMQs interpolation. Next we describe the Legendre-Gauss-Lobatto quadrature, briefly. In the next section we discuss how to solve the integral equation by using the suggested method. In section 3 one numerical example shows the accuracy of the method.

1.1 Preliminaries and notaions

In this paper, we consider a mixed Volterra-Fredholm integral equation

$$f(s,t) = g(s,t) + \int_0^s \int_0^1 U\Big(s,t,x,y,f(x,y)\Big)dydx, \tag{1}$$

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