Nonlinear Dynamics and Systems Theory, **18** (3) (2018) 297–306

Solving Two-Dimensional Integral Equations of Fractional Order by Using Operational Matrix of Two-Dimensional Shifted Legendre Polynomials

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Received: November 4, 2017; Revised: June 16, 2018

Abstract: In this paper, we first present a new numerical method for solving two-dimensional integral equations of fractional order. The method is based upon two-dimensional shifted Legendre polynomials. Then we construct an operational matrix for two-dimensional fractional integral. Also, we give the error analysis. Finally, three examples are shown to confirm the theoretical results.

Keywords: *two-dimensional shifted Legendre polynomials; two-dimensional fractional integral equations; operational matrix.*

Mathematics Subject Classification (2010): 45AXX, 26A33.

1 Introduction

In this paper, we present a numerical method for the solution of two-dimensional Volterra integral equations of fractional order in the form

$$f(x,y) - \frac{1}{\Gamma(r_1)\Gamma(r_2)}\int_0^x\int_0^y (x-s)^{r_1-1}(y-t)^{r_2-1}k(x,y,s,t)f(s,t)\,dtds = g(x,y),$$
$$(r_1,r_2)\in(0,\infty)\times(0,\infty), f\in L^1(\Omega), \Omega := [0,l_1]\times[0,l_2]. \tag{1}$$

In [1–3] the authors mentioned that equation (1) is a solution for a class of impulsive partial hyperbolic differential equations involving the Caputo fractional derivative. Therefore, researchers are interested in solving this kind of equations. In recent years, several numerical methods for solving two-dimensional integral equations of fractional

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