Available online at www.qu.edu.iq/journalcm
JOURNAL OF AL-QADISIYAH FOR COMPUTER SCIENCE AND MATHEMATICS
ISSN:2521-3504(online) ISSN:2074-0204(print)

Combining Cubic B-Spline Galerkin Method with Quadratic Weight Function for Solving Partial Integro-Differential Equations

Hameeda O.Al-Humedi [a] , ***Zahraa Adnan jameel*** [b]

[a] *Department of Mathematics, College of Education for Pure Sciences, Basrah University, Basrah, Iraq. Email: ahameeda722@yahoo.com*

[b] *Department of Mathematics, College of Education for Pure Sciences, Basrah University, Basrah, Iraq. Email: zahraad788@yahoo.com*

ARTICLE INFO

Article history:
Received: 18/12 /2019
Rrevised form: 07/1/2020
Accepted : 28/1/2020
Available online: 17/02 / 2020

Keywords:

B-spline method, Galerkin method, integro-differential equation, Von-Neuman.

ABSTRACT

In this article, a numerical scheme was implemented for solving the partial integro-differential equations (PIDEs) with weakly singular kernel by using the cubic B-spline Galerkin method with quadratic B-spline as a weight function. backward Euler scheme was used for time direction and the cubic B-spline Galerkin method with quadratic weight function was used for spatial derivative. We observed from the numerical examples that the proposed method possesses a high degree of efficiency and accuracy. In addition, the numerical results are in suitable agreement with the exact solutions via calculating L_2 and L_∞ norms errors. Theoretically, we discussed the stable evaluation of the current method using the Von-Neumann method, which explained that the present technique is unconditionally stable.

MSC :

DOI : 10.29304/jqcm.2020.12.1.660

1 . Introduction

Many mathematical formulations of physical phenomena contain PIDEs, which can describe some physical situations such as viscoelasticity, convection- diffusion problems, heat flow in materials with memory, nuclear reactor dynamics, geophysics and plasma physics etc.

Consider the following PIDE with a weakly singular kernel is

$$u_t(x,t) + m\,u_x(x,t) - b\,u_{xx}(x,t) = \int_0^t K(t-s)\,u(x,s)ds + f(x,t) \quad x \in [a,b], t > 0 \qquad (1)$$

where, $K(t-s) = (t-s)^{-\alpha}$, $0 < \alpha < 1$

subject to the initial condition are :

Corresponding author Zahraa Adnan jameel

Email addresses: zahraad788@yahoo.com

Communicated by Alaa H. H. Al-Ka'bi