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Block pulse operational matrix for solving fractional partial differential equation

S.Momtahan*
Kerman Graduate University of Advanced Technology
Kerman, Iran

M.Mohseni Moghadam
Department of Mathematics, Islamic Azad University, Kerman Branch,
Kerman, Iran

H.Saeedi
Department of Mathematics, Faculty of Mathematics and Computer Science,
Shahid Bahonar University of Kerman, Kerman, Iran

Abstract

In this paper, we first introduce block pulse functions and the block pulse operational matrices of the fractional order integration. Also the block pulse operational matrices of the fractional order differentiation are obtained.Then we present a computational method based on the above results for solving a class of fractional partial differential equations.

Keywords: Block pulse functions, Operational matrix, Fractional partial differential equations.
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1 Introduction

Fractional differential equations are generalized from integer order ones, which are achieved by replacing integer order of derivatives by fractional ones. Compared with differential equations of integer order, their advantages are more accurate in natural physical process and dynamic systems [2].
In this paper, our study focuses on a class of fractional partial differential equations as the following form:

$$\frac{\partial^\alpha u}{\partial t^\alpha} = -\frac{\partial^\beta u}{\partial x^\beta} + \lambda u(x,t) + g(x,t), 0 \le x \le 1, 0 \le t \le T. \tag{1}$$

subject to the initial-boundry conditions:

$$u(0,t) = p(t), u(x,0) = v(x), \tag{2}$$

where $\frac{\partial^\alpha u(x,t)}{\partial x^\alpha}$ and $\frac{\partial^\beta u(x,t)}{\partial t^\beta}$ are fractional derivative in Caputo sense, $g(x,t)$ is the known continuous function, $u(x,t)$ is the unknown function, $0 < \alpha \le 1$ and $1 \le \beta \le 2$.

*Speaker