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NUMERICAL SOLUTIONS OF SYSTEM OF LINEAR DIFFERENTIAL EQUATIONS USING HAAR WAVELET APPROACH

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Abstract. In this article, a general procedure of forming the Haar wavelets operational matrix is discussed. The Haar wavelet system which has localization property is applied to find approximate solution to a given system which is very near to the exact solution of the system. We demonstrate this procedure through numerical examples. A comparison of approximate solutions and the exact solutions is done along with the error analysis in order to establish that the Haar wavelet system gives better approximate solutions.

1. Introduction

The concept of physical systems in engineering and applied sciences is modeled through differential equations. Since then, many numerical methods for finding the solutions to these differential equations have been proposed. Some of them are variational iteration method [9], perturbation method [3], finite difference method [10, 11], Bernoulli matrix method [4, 6, 7, 13, 19, 20, 21, 22], and Galerkin method [2, 8, 12, 17], etc. These techniques aim to approach a better approximation of the solution with restricted computational inceptions.

Wavelet theory is a comparatively new emanating discipline in applied sciences and soon wavelet techniques have been used in almost every branch of applied sciences. One advantage is it reduces most complex problems to a system of algebraic equations which felicitates these problems remarkably. This procedure for a differential equation is based on the reformation of the given differential equations into a system of algebraic equations and then using an operational matrix to tackle various integral operators. For more of these procedures, one may refer to [1, 14, 15, 16, 18, 23].

In this paper, we discuss a procedure for forming the Haar wavelets basis and operational

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