Haar Wavelet Method for Series Expansion of Fractional Wiener Integral

Farshid Mirzaee*, Afsun Hamzeh
Malayer University

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Extended Abstract

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Introduction

The stochastic calculus plays an important role in the study of stochastic integral equations and stochastic differential equations. The fractional Brownian motion has many applications in different branches of sciences such as economics, physics and biology.

In many situations, the exact solution of these equations are not available or finding their exact solution is a very difficult process. Thus, finding an accurate and efficient numerical method for solving stochastic differential equations, and stochastic integral equations is important. Researchers have applied various numerical methods such as Dirichlet forms, Euler approximation, Skorohod integral, etc. In this paper, we used Haar wavelet functions for solving fractional Wiener integrals. Moreover, the error analysis of the proposed method is investigated.

Material and methods

In this scheme, first we present the properties of the Haar wavelet functions then an efficient method based on these functions is proposed to estimate the solution of fractional Wiener integral with Hurst parameter $H \in \left(\frac{1}{2}, 1\right)$.

Results and discussion

We solve two numerical examples by using present method to demonstrate the efficiency and simplicity of the present method. For different values of H, mean of error and standard deviation of error are shown in the tables. The obtained results confirm that proposed method enables us to find reasonable approximate solutions.

Conclusion

The Haar wavelet is the simplest possible wavelet, so proposed method is easy to implement and it is a powerful mathematical tool to obtain the numerical solution of various kind of problems.

Keywords Haar wavelet functions; Fractional wiener integrals; Brownian motion.

*Corresponding author: f.mirzaee@malayeru.ac.ir