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ON ACCURACY OF THE HAAR WAVELET METHOD

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The Haar wavelet discretization method (HWDM)considered herein has been introduced by Chen and Hsiao in [1] and has been adopted for solution of a wide range of problems including differential and integral equations, optimal control theory, buckling and vibration of elastic beams, etc [2, 3]. However, the results covering the convergence and accuracy of the HWDM are still limited in literature and not well known. It has been proved by Babolian and Shahsavaran, Saeedi et.al that the case of function approximation with Haar wavelet the order of convergence is equal to one. Authors of the current study have been derived the error estimate of the Haar wavelet method for general n-th order ODE and showed that the order of convergence of the HWDM is equal to two [4]. The obtained results are validated by numerical convergence analysis [5]. Current study is focused on accuracy analysis of the HWDM in the case of fractional differential equations. It has been observed that the accuracy and convergence results depend on the value of the highest order fractional derivative α included in differential equation. There exist two principally different regimes where $0 < \alpha < 1$ and $\alpha \geq 1$. New Haar wavelet expansion providing higher rate of convergence for regime $0 < \alpha < 1$ has been proposed.

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