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# EULER WAVELETS SCHEME FOR NEUTRAL FRACTIONAL DELAY DIFFERENTIAL EQUATION

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## ABSTRACT

This article comprehensively studies the Neutral Fractional Volterra Delay Integro-Differential Equation (NFVDIDE) with variable coefficients and weakly-singular kernel. It takes into account Caputo's fractional derivative of orders  $\alpha \in (0, 1]$  and  $\beta \in (0, \alpha]$  for the current state and delayed state, respectively. To establish the existence results, we utilized the weighted norm concept and the Banach Contraction Principle. Furthermore, we established the Ulam-Hyers stability result. Additionally, we proposed an interpolationbased robust numerical algorithm to approximate the solutions of NFVDIDE and conducted a detailed error analysis. The proposed algorithm achieved a computational accuracy of  $O(h^{3-\alpha})$ . We analyzed several examples to demonstrate our theoretical findings and illustrated the efficacy of the obtained numerical scheme for various values of  $\alpha, \beta$ .

**Keywords** Fractional Derivative · Delay · Euler Fractional Wavelets

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