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A Numerical Approach for Solving Delay Volterra Integral Equations with a Spatial Variable and Mixed Kernels

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Abstract: We propose a numerical method based on Taylor polynomials to construct a collocation solution for approximating the solution of delay Volterra integral equations (DVIEs) with a spatial variable. The method effectively handles both time delay and spatial dependence, which are essential in modeling nonlinear dynamic systems. A rigorous convergence analysis establishes that the method is accurate and stable, with an $O((h+k)^p)$ error bound. Numerical experiments confirm its efficiency and demonstrate its applicability to nonlinear dynamical problems governed by delay integral equations. The proposed approach provides a reliable and computationally efficient tool for solving DVIEs arising in nonlinear dynamics, setting a foundation for further extensions to higher-dimensional problems.

Keywords: *delay Volterra integral equation with spatial variable; collocation method; Taylor polynomials.*

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