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# A Novel Numerical Approach for Solving Nonlinear Volterra Integral Equation with Constant Delay

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**Abstract:** In this paper, we discuss the application of an iterative collocation method based on the Lagrangian polynomials to the numerical solution of a class of nonlinear Voltera integral equations with constant delay. This application contains, but is not limited to, many important Voltera delay integral equations that arise in physical and biological modeling processes and that are widely used in the analysis of dynamical systems. In addition, the appoximate solution is given in a suitable polynomial spline space by using explicit formulas without resorting to solving any algebric system. The proposed technique is efficient and easy to implement. The error analysis of the proposed numerical method is studied theoreticaly. Finally, illustrative examples are given to demonstrate the efficiency of the proposed method.

**Keywords:** *nonlinear delay Volterra integral equation; collocation method; iterative method; Lagrange polynomials.*

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## 1 Introduction

In this paper, we study a numerical method for the solution of Volterra integral nonlinear equations with constant delay $\tau > 0$,

$$x(t) = f(t) + \int_0^t k_1(t, s, x(s))ds + \int_0^{t-\tau} k_2(t, s, x(s))ds, t \in I = [0, T], \qquad (1)$$

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