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Sumudu Decomposition Method for Solving Higher-Order Nonlinear Volterra-Fredholm Fractional Integro-Differential Equations

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Abstract: In this paper, the Sumudu decomposition method is developed to solve the general form of the fractional nonlinear Volterra-Fredholm integro-differential equation. The fractional derivative is described in the Caputo sense. The proposed method is based on the application of the Sumudu transform to the fractional nonlinear Volterra-Fredholm integro-differential equation. The nonlinear term can easily be handled with the help of Adomian polynomials. Illustrative examples are given, and numerical results are provided to demonstrate the efficiency of the proposed method.

Keywords: *approximate Solutions; fractional integro-differential equation; Adomian decomposition; Sumudu transform.*

Mathematics Subject Classification (2010): 45J05, 45G10, 65R20, 65D20.

1 Introduction

Many problems in mathematical physics, theory of elasticity, visco-dynamics fluid and mixed problems of mechanics of continuous media can be reduced to the integral equation (Volterra or Fredholm) of the first or second kind. In [1, 2], the Adomian decomposition method was used to solve a higher-order nonlinear Volterra-Fredholm integro-differential equation of the form

$$\sum_{k=0}^{m} p_k(x)u^{(k)}(x) = f(x) + \lambda_1 \int_a^x \sum_{i=0}^{r} A_i(x,t)F_i(u(t))dt + \lambda_2 \int_a^b \sum_{j=0}^{s} B_j(x,t)G_j(u(t))dt \tag{1}$$

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