

**ANALYTICAL SOLUTIONS OF THE TIME-FRACTIONAL NON-LINEAR
SCHRODINGER EQUATION WITH ZERO AND NON ZERO TRAPPING
POTENTIAL THROUGH THE SUMUDU DECOMPOSITION METHOD**

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ABSTRACT

Sumudu decomposition method is used to construct the approximate analytical solutions of time-fractional nonlinear Schrodinger equations with zero and nonzero trapping potential. The Sumudu decomposition method is a combined form of the Sumudu transform and the Adomian decomposition method. The fractional derivatives are defined in the Caputo sense. The exact solutions of some nonlinear Schrodinger equations are given as a special case of our approximate analytical solutions. The computations show that the described method is easy to apply, and it needs smaller size of computation as compared to the other existing methods. Further, the solutions are derived in a convergent series form which shows the effectiveness of the method for solving a wide variety of nonlinear fractional differential equations.

Keywords: Fractional derivative; Time-fractional Schrodinger equation; Adomian decomposition method; Sumudu transforms.

INTRODUCTION

The time-fractional nonlinear Schrodinger equations has the following form:

$$\begin{aligned} iD_t^\alpha u(x,t) &= -\frac{1}{2}\Delta^2 u + V_d(x)u + \beta_d |u|^2 u, \quad 0 < \alpha \leq 1, \\ u(x,0) &= u_0(x), \quad x \in \mathfrak{R}^d, t > 0, \end{aligned} \quad (1)$$

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