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Entitled

POWER SERIES SOLUTIONS OF NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS: APPLICATIONS IN NONLINEAR PHYSICS

by

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Abstract:

Obtaining analytical solutions for nonlinear partial differential equations (PDEs) is becoming a crucial role for many scientific researchers due to their importance in various physical systems. Many analytical and numerical techniques have been developed to solve PDEs, however, there is no general applicable method for such equations. In this study, we present an efficient iterative power series method for nonlinear boundary value problems that treats the typical divergence problem and increases arbitrarily the radius of convergence. This method is based on expanding the solution around an iterative initial point. Three nonlinear systems are considered here, the nonlinear Schrödinger equation (NLSE) with three interesting versions in which include the nonintegrable higher order NLSE, the ordinary form of the unsteady nonlinear Navier-Stokes equations, and the chaotic Lorenz system. The present method successfully captures the exact solitonic solutions for the fundamental NLSE and its higher-order versions including the localized and oscillatory solutions for the nonintegrable higher order NLSE. The method reproduces also dual solutions for both the flow and heat transfer fields. Furthermore, the method solves accurately the Lorenz system. Some comparisons with previous works emphasized the validity, accuracy, and efficiency of the present method.

Keywords: Iterative power series solution; NLSE; Unsteady flow; Heat transfer; Contracting cylinder; Chaotic behaviour; Lorenz system.