Assorted optical solitons of the cubic and cubic quintic nonlinear Schrödinger equation featuring beta derivative

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Abstract

Although fractional and classical order cubic quintic nonlinear Schrödinger (NS) equation and cubic nonlinear Schrödinger equation are used simultaneously in nonlinear optics disciplines, the fractional-order NS equations are nowadays extensively used due to their higher coherence. The space-time fractional cubic quintic and nonlinear cubic Schrödinger equations integrating beta derivative are significant in modeling to nonlinear optics, photonics, plasmas, condensed matter physics, and other domains. The fractional wave transformation is exploited to translate the space-time fractional equations and the optical soliton solutions in the form of exponential, trigonometric, and hyperbolic functions with free parameters have been established in this article by putting to use the improved Bernoulli sub-equation function (IBSEF) approach. The shape of the solutions includes kink, periodic, bell-shaped soliton, breathing soliton, bright soliton, and singular kink type soliton. The physical features of the solitons have been revealed by depicting 3D, 2D, contour, and density graphs of some of the solutions. The results demonstrate that the IBSEF approach is simple, straightforward, effective and that it can be applied to a wide range of nonlinear fractional-order models in optics and communication engineering to achieve soliton solutions.

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