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Periodic propagation of complex-valued hyperbolic-cosine-Gaussian solitons and breathers with complicated light field structure in strongly nonlocal nonlinear media. (English)

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Summary: In this study, the propagation characteristics of complex-valued hyperbolic-cosine-Gaussian (CVHCG) beams were studied based on the nonlocal nonlinear Schrödinger equation in strongly nonlocal nonlinear media (SNNM). The CVHCG beams exhibited some unique propagation characteristics. By adjusting the complex-valued parameters, CVHCG beams can propagate with different forms in SNNM, including Gaussian-like, nearly flat-topped, multi-peak, and four-peak forms. CVHCG beams can form shape-invariant solitons and breathers under certain incident parameters. In addition, CVHCG beams can also form generalized shape-variant high-order spatial solitons and breathers. In general, the beam width and light intensity pattern of the CVHCG beams always change periodically. A complete theoretical model was constructed, and the expressions for the propagation, light intensity, and second-order moment beam width were obtained analytically. Some typical propagation characteristics were demonstrated via numerical simulations. The results of this study can be extended to investigate other complex-valued beams.

MSC:

35Q55 NLS equations (nonlinear Schrödinger equations)
35Q60 PDEs in connection with optics and electromagnetic theory
78A60 Lasers, masers, optical bistability, nonlinear optics
78A40 Waves and radiation in optics and electromagnetic theory
35C08 Soliton solutions
37K40 Soliton theory, asymptotic behavior of solutions of infinite-dimensional Hamiltonian systems

Keywords:

nonlinear Schrödinger equation; high-order solitons; periodic propagation

Full Text: DOI

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