

Wang, Pan; Ma, Tian-Ping; Qi, Feng-Hua

Analytical solutions for the coupled Hirota equations in the firebringt fiber. (English)

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Summary: Under investigation in this paper are the coupled Hirota (CH) equations, which describe the collision of two waves in the deep ocean and the propagation of the ultrashort optical pulses in a birefringent fiber. Based on the bilinear method, multi-soliton solutions for the CH equations are given. From the perspective of analysis, the interaction dynamics of solitons are obtained. The head-on and overtaking interactions of two/three solitons are analyzed. The elastic and inelastic interactions of two/three solitons are presented. The soliton velocity can be controlled by adjusting the physical parameters ϕ_j , ($j = 1, 2, \dots, N$) and ϵ . The energy exchange occurs between the variables u and v before and after the collision. The local interference of two/three solitons is observed. The closer to the center of the interaction, the more significant the interference. The real and imaginary parts of the parameters ϕ_j , ($j = 1, 2, \dots, N$) have the effects on the numbers of peaks and holes in the collisions. The structure of four eyes and one peak is observed during the two-soliton interaction. The three-soliton interactions are given with two peaks and local interference. It is hoped that the results of this study can provide some reference for the wave interaction in deep ocean, pulse propagation in optical fiber, financial option pricing, valuation of intangible assets in sports and so on.

MSC:

35Qxx Partial differential equations of mathematical physics and other areas of application

78Axx General topics in optics and electromagnetic theory

37Kxx Dynamical system aspects of infinite-dimensional Hamiltonian and Lagrangian systems

Keywords:

coupled Hirota equation; bright-soliton solution; bilinear method

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