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Multi-Breather, Rogue Wave and Multi-Bright-Dark Soliton Interaction of the (2+1)-Dimensional Nonlocal Fokas System

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Abstract. We study the (2+1)-dimensional nonlocal Fokas system by using the Hirota's bilinear method. Firstly, a general tau-function of Kadomtsev-Petviashvili (KP) hierarchy satisfied with the bilinear equation under nonzero boundary condition is derived by considering differential relations and a variable transformation. Secondly, two Gram-type solutions are utilized to the construction of multi-breather, high-order rogue wave, and multi-bright-dark soliton solutions. Then the corresponding parameter restrictions of these solutions are given to satisfy with the complex conjugation symmetry. Furthermore, we find that if the parameter p_{il} takes different values, the rogue wave solution can be classified as three types of states, such as dark-dark, four-peak and bright-bright high-order rogue wave. If the parameter c_i takes different values, the soliton solution can be classified as three type of states, including the multi-dark, multi-bright-dark and multi-bright solitons. By considering third-type of reduced tau-function to the Hirota's bilinear equations, we give the collisions between the high-order rogue wave and the multi-bright-dark solitons on constant (N is positive even) or periodic background (N is positive odd). In order to understand the dynamics behaviors of the obtained solutions better, the various rich patterns are theoretically and graphically analyzed in detail.

AMS subject classifications: 65M10, 78A48

Key words: (2+1)-dimensional nonlocal Fokas system, KP hierarchy reduction, multi-breather wave, high-order rogue wave, multi-bright-dark soliton.

1. Introduction

The parity ($\mathscr{P}$) and the time ($\mathscr{T}$) symmetries proposed by Bender and Boettcher [5] as the one type of important discrete symmetries were used to replace the Hermiticity of the Hamiltonians in quantum theory. In classic quantum theory, Hermiticity guarantees

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