

Rogue Waves Arising on the Standing Periodic Wave in the High-Order Ablowitz-Ladik Equation

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Abstract : The nonlinear Schrödinger (NLS) equation models wave dynamics in many physical problems related to fluids, plasmas, and optics. The standing periodic waves are known to be modulationally unstable, and rogue waves (localized perturbations in space and time) have been observed on their backgrounds in numerical experiments. The exact solutions for rogue waves arising on the periodic standing waves have been obtained analytically. It is natural to ask if the rogue waves persist on the standing periodic waves in the integrable discretizations of the integrable NLS equation. We study the standing periodic waves in the semidiscrete integrable system modeled by the high-order Ablowitz-Ladik (AL) equation. The standing periodic wave of the high-order AL equation is expressed by the Jacobi cnoidal elliptic function. The exact solutions are obtained by using the separation of variables and one-fold Darboux transformation. Since the cnoidal wave is modulationally unstable, the rogue waves are generated on the periodic background.

Keywords : Darboux transformation, periodic wave, Rogue wave, separating the variables

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