

Abstract

The $(2+1)$ -dimensional generalized fifth-order KdV (2GKdV) equation is revisited via combined physical and mathematical methods. By the Hirota perturbation expansion technique and via setting nonzero background wave on the multiple soliton solution of the 2GKdV equation, breather waves are constructed, for which some transformed wave conditions are considered that yield abundant novel nonlinear waves including the X/Y -Shaped (XS/YS), asymmetric M -Shaped (MS), W -Shaped (WS), Space-Curved (SC) and Oscillation M -Shaped (OMS) solitons etc. Furthermore, distinct nonlinear wave molecules and interactional structures involving the asymmetric MS, WS, XS/YS, SC solitons, and breathers, lumps are constructed after considering the corresponding existence conditions. The dynamical properties of the obtained nonlinear molecular waves and interactional structures are revealed via analyzing the trajectory equations along with the change of the phase shifts.