



Generation of solitons and breathers in the extended Korteweg-de Vries equation with positive cubic nonlinearity

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The initial-value problem for box-like initial disturbances is studied within the framework of an extended Korteweg-de Vries equation with both quadratic and cubic nonlinear terms, also known as the Gardner equation, for the case when the cubic nonlinear coefficient has the same sign as the linear dispersion coefficient. The discrete spectrum of the associated scattering problem is found, which is used to describe the asymptotic solution of the initial-value problem. It is found that while initial disturbances of the same sign as the quadratic nonlinear coefficient result in generation of only solitons, the case of the opposite polarity of the initial disturbance has a variety of possible outcomes. In this case solitons of different polarities as well as breathers may occur. The bifurcation point when two eigenvalues corresponding to solitons merge to the eigenvalues associated with breathers is considered in more detail. Direct numerical simulations show that breathers and soliton pairs of different polarities can appear from a simple box-like initial disturbance.