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Numerical study of blow-up to the purely elliptic generalized Davey-Stewartson system

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Abstract

Blow-up solutions for the purely elliptic generalized Davey-Stewartson system are studied by using a relaxation numerical method. The numerical method is based on an implicit finite-difference scheme with a second-order accuracy in both time and space. The stability of the numerical method is analysed by investigating the linear stability of plane wave solutions. To evaluate the ability of the relaxation method to detect blow-up, numerical simulations are conducted for several test problems. A particular attention is paid to the gap interval neither a global existence nor a blow-up result established. The monotonocity properties of blow-up time on the coupling parameter is also investigated numerically.

Keywords: Relaxation method, Generalized Davey-Stewartson system, Blow-up, Global Existence, Plane Wave Stability
2010 MSC: 35Q55, 65M06, 65M012

1. Introduction

In this paper we study blow-up solutions of the generalized Davey-Stewartson (GDS) system given by

$$i\ u_t + \sigma u_{xx} + u_{yy} = \kappa \mid u \mid^2 u + \gamma(\phi_x + \psi_y)u \tag{1.1}$$

$$\phi_{xx} + m_2\phi_{yy} + n\psi_{xy} = (\mid u \mid^2)_x \tag{1.2}$$

$$\lambda\psi_{xx} + m_1\psi_{yy} + n\phi_{xy} = (\mid u \mid^2)_y \tag{1.3}$$

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