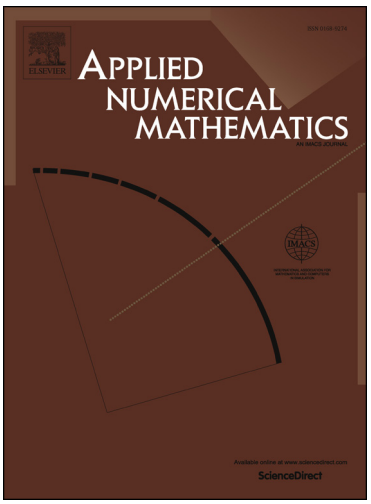
Accepted Manuscript



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PII: S0168-9274(17)30103-4
DOI: http://dx.doi.org/10.1016/j.apnum.2017.04.007
Reference: APNUM 3201

To appear in: *Applied Numerical Mathematics*

Received date: 17 June 2016
Revised date: 7 December 2016
Accepted date: 19 April 2017

Please cite this article in press as: F. Liao et al., Numerical analysis of cubic orthogonal spline collocation methods for the coupled Schrödinger–Boussinesq equations, *Appl. Numer. Math.* (2017), http://dx.doi.org/10.1016/j.apnum.2017.04.007

Numerical analysis of cubic orthogonal spline collocation methods for the coupled Schrödinger-Boussinesq equations

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Abstract In this article, we formulate two orthogonal spline collocation schemes, which consist of a nonlinear and a linear scheme for solving the coupled Schrödinger-Boussinesq equations numerically. Firstly, the conservation laws of our schemes are derived. Secondly, the existence solutions of our schemes are investigated. Thirdly, the convergence and stability of the nonlinear scheme are analyzed by means of discrete energy methods, while the convergence of the linear scheme is proved by cut-off function technique. Finally, numerical results are reported to verify our theoretical analysis for the numerical methods.

Keywords Orthogonal spline collocation; Schrödinger-Boussinesq equations; Conservation law; Convergence; Stability

1. Introduction

In this paper, we examine the use of the cubic orthogonal spline collocation (OSC) method for approximate solution of the coupled Schrödinger-Boussinesq (SBq) equations

$$iu_t + \gamma u_{xx} - \xi uv = 0, (t,x) \in \Omega_T, \tag{1}$$

$$v_t = \phi_{xx}, (t,x) \in \Omega_T, \tag{2}$$

$$\phi_t = v - \alpha v_{xx} + f(v) + \omega|u|^2, (t,x) \in \Omega_T, \tag{3}$$

with the initial-boundary conditions

$$u(x,0) = u_0(x), v(x,0) = v_0(x), \phi(x,0) = \phi_0(x), x \in \Omega, \tag{4}$$

$$u(x,t) = v(x,t) = \phi(x,t) = 0, x \in \partial\Omega, t \in [0,T], \tag{5}$$

[1]This work is supported by Jiangsu Innovation Program for Graduate Education under Grant No.KYZZ160161 and the National Science Foundation of China under Grant No.11571181. Corresponding author. E-mail: zhanglm@nuaa.edu.cn (L.Zhang), wawjd3kwcom@163.com (F.Liao), wangss@nuaa.edu.cn (S.Wang).