Nonlinear Dynamics and Systems Theory, **12** (3) (2012) 215–236

Numerical Solutions of System of Non-linear ODEs by Euler Modified Method

B. S. Desale * and N. R. Dasre

School of Mathematical Sciences, North Maharashtra University, Jalgaon 425001, India

Received: June 29, 2011; Revised: June 19, 2012

Abstract: In this paper, we have proposed Euler's modified method for solving the six coupled system of non-linear ordinary differential equations (ODEs), which are aroused in the reduction of stratified Boussinesq equations. This method can also be called as revised Euler's modified method for solving two simultaneous ODEs. We have obtained the numerical solutions on stable and unstable manifolds. The error between the numerical solution and exact solution is of order 10^{-20} to 10^{-6}. We have coded this programme in C-language.

Keywords: *stratified Boussinesq equation, Euler modified method, integrable systems.*

Mathematics Subject Classification (2010): 34A09, 65L05, 65L99.

1 Introduction

The stratified Boussinesq equations form a system of Partial Differential Equations (PDEs) modelling the movements of planetary atmospheres. It may be noted that literature also refers to Boussinesq approximation as Oberbeck–Boussinesq approximation. For this, one may refer to an interesting article by Rajagopal et al [1] which provides a rigorous mathematical justification for perturbations of the Navier-Stokes equations. Majda & Shefter [2] have chosen certain special solutions of this system of ODEs to demonstrate the onset of instability when the Richardson number is less than 1/4. Majda and Shefter [3] have shown that the analysis, in the special cases considered, reduces to the solutions of Hamiltonian system. These reductions form an interesting coupled system of six non-linear ODEs. Shrinivasan et al [4] have also tested the system for complete integrability by use of first integrals. Further, Desale [6] has incorporated the effect

* Corresponding author: mailto:bsdesale@nmu.ac.in