

A NUMERICAL METHOD FOR A NONLINEAR
INTEGRO-DIFFERENTIAL BOUNDARY VALUE PROBLEM

M. Basile, E. Messina

Dip. di Matematica e Appl., Università di Napoli " Federico II "

Via Cintia, I-80126 Napoli, Italy

W. Themistoclakis, A. Vecchio

Ist. per Appl. del Calcolo "M.Picone", Sede di Napoli - CNR -

I Via P. Castellino,111 - 80131 Napoli - Italy

mariateresa.basile@unina.it

We design and analyse a numerical method for the solution of the following second order integro-differential boundary value problem,

$$\nu(y)g(y) = \int_0^{\infty} k(x)g(x)dx (D(y)g'(y))' + p(y), \quad y \geq 0, \quad g'(0) = 0, \quad g(+\infty) = 0,$$

which arises in the study of the kinetic theory of dusty plasmas.

First we provide those informations on the existence and other qualitative properties of the solution that will be essential in the numerical investigation. Then we propose a method which is based on the discretization of the differential and integral terms and on an iteration process to solve the resulting nonlinear system. Under suitable hypotheses we prove the convergence of the overall method. The peculiarity of this equation is that the coefficients of the differential terms depend on the integral of the unknown function. This influences both the choice of the discretization process and the approach for studying its convergence. We will show the characteristics of the method by means of some numerical simulations.