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Maximum Principle Theorems For Forth Order Differential Equations

Davod Rostamy Samaneh Ghasemy* Nazdar Abdollahi
Imam khomeyni Inter national university

Abstract

In this paper first we present continuous maximum principle theorem for fourth order differential equations. Then we express discrete maximum principle theorem for matrix form of discrete problem(by finite element method or finite difference method). At the end we make an example to find maximum of u.

1 Introduction

The early development of numerical analysis of partial differential equations was dominated by functional analysis. In such a method an approximate solution is sought at the end points of a finite grid of points, and the approximation of differential equation is accomplished by replacing appropriate difference quotients and a finite linear system of algebraic equations. The maximum principle theorem is used to show uniqueness and continuous dependence on data for solution and approximate solution of partial equation. In this paper we consider the discrete approximation to the fourth order boundary value problem

$$u^{(4)}(x) = f(x, u(x), u^{'}(x), u^{''}(x), u^{'''}(x)), \qquad a \leq x \leq b, \tag{1}$$

subject to the boundary conditions

$$u(a) = g_0, \tag{2}$$

$$u(b) = g_1, \tag{3}$$

$$u'(a) = \alpha_1, \qquad u'(b) = \alpha_2. \tag{4}$$

Some applications of involving population dynamics with spatial migration, chemical reaction and control systems are given by some authors e.g. [1, 2, 3] and the references therein. In all these studies, we observe that a result of employing a special type of (1). By using the maximum principle theorem and discrete maximum principle we have proved uniqueness both in (1) and the finite difference method respectively.
Therefore,the paper is organized as follows.
In the next section we give the continuous maximum principle theorem. This problem is implemented in section 3 and we give a discrete maximum principle theorem. At the end to illustrate this principle we give an example.

*Speaker