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An iterative reproducing kernel method in Hilbert space for the multi-point boundary value problems

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Abstract

In this paper, an iterative method is proposed to solve the nonlinear Bitsadze-Samarskii boundary value problems with multi-point boundary conditions. The algorithm is based on the reproducing kernel Hilbert space method. We use an iterative scheme to overcome the nonlinearity of the problem. The convergence and error estimate of the iterative scheme are established. The reproducing kernel Hilbert space method is used to generate an approximation of the linearized problem. In fact, the reproducing kernel Hilbert space method is combined with an iterative scheme to approximate the solution and an error estimate of the approximate solution is derived. In order to show the efficiency and versatility of the proposed method, some numerical results are reported. The comparison of numerical results with the analytical solution and the best results reported in the literature confirms the good accuracy and applicability of the proposed method.

Key words: Multi-point boundary conditions; Iterative reproducing kernel Hilbert space method; Convergence; Error estimate

1 Introduction

Multi-point boundary value problems arise in many branches of sciences as mathematical models of various real-world processes such as modeling large size bridges [1], the theory of elastic stability [2], the flow of fluid such as water, oil and gas through ground layers and fluid flow through multi-layer porous medium [3] and the vibrations of a guy wire of uniform cross-section and composed of N parts of

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