

# Numerical method for solution of nonlinear initial value problems

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Received: 10-03-2011; Accepted: 12-20-2011 \*Corresponding author

**Abstract** In this paper, the approximate solutions to the first order nonlinear boundary-value problems are presented using the Reproducing kernel space method. The argument is based on the reproducing kernel space  $W_2^2[0, 1]$ . The approach provides the solution in the form of a convergent series with easily computable components. Analytical results are given for several examples to illustrate the implementation and efficiency of the method. A comparison of the results obtained by the present method with results obtained by [4] reveals that the present method is more effective and convenient.

**Key Words** Gram-Schmidt orthogonal process, Reproducing kernel space

**MSC 2000** 34K28, 65L05

## 1 Introduction

Consider the following nonlinear first order initial value problem presented in [4] :

$$\begin{cases} u^{(1)} + a(x)u = f(x, u(x)), & 0 < x \leq 1, \\ u(0) = 0 \end{cases} \quad (1.1)$$

where  $a(x)$  is bounded function.

Ghazala and Hamood [1] discussed computational method for solving singularly perturbed first order initial value problem with initial conditions at any end point. Hamood *et al.* [4] presented the numerical solution for the non-linear first order initial value problems. So far, many classical problems in probability and statistics, had been solved in reproducing kernel space [2, 3].

The paper is organized into four sections including the introduction. In section 2, construction of reproducing kernel is presented for solving (1.1). The solution of the problem in reproducing kernel Hilbert space is presented in section 3. In section 4, two numerical examples are shown to demonstrate the accuracy of present method method.

# Numerical Solution Of Nonlinear Problems

**James M. Ortega, Werner C. Rheinboldt**



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