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Sinc-Galerkin Method for Solving Higher Order Fractional Boundary Value Problems

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Abstract: In this work we use the sinc-Galerkin method to solve higher order fractional boundary value problems. We estimate the second order fractional derivative in the Caputo sense. More precisely, we find a numerical solution for

$$g_1(t)D^{\alpha}u(t) + g_2(t)D^{\beta}u(t) + p(t)u^{(4)}(t) + q(t)u(t) = f(t),$$

$$0 < t < 1, \quad 0 < \beta < 1, \quad 1 < \alpha < 2,$$

subject to the boundary conditions $u(0) = 0, \quad u'(0) = 0, \quad u(1) = 0, \quad u'(1) = 0$. Our contribution appears in the estimate of $D^{\alpha}u$ for higher order α. Numerical examples are described to show the accuracy of this attempt where we applied the sinc-Galerkin method for fractional order differential equations with singularities.

Keywords: *higher order fractional boundary value problems; Caputo derivative; sinc-Galerkin method; numerical solution.*

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1 Introduction

Boundary value problems come into view in many areas of science, engineering, and economy. One of the physical modelings for boundary value problems is to suppose a finite length elastic beam, which is fixed at one end, and rested on an elastic bearing at the other end. We may add along its length a load to cause deformations, see [1]. In this work we solve a more general model which has mechanical interpretation that involves higher order fractional derivatives.

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