



Sinc-Finite difference collocation method for time-dependent convection diffusion equations

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Abstract

In this paper, Sinc-collocation method is used for time-dependent convection-diffusion equations. Sinc-collocation method based on double exponential transformation(DE) is used for space dimension and finite difference method is used for time dimension. The error in the approximation of the solution is shown to converge at an exponential rate, and the numerical results confirm that compared with the results based on single exponential transformation(SE), our method is of high accuracy and of good convergence.

keywords:Sinc-collocation method, Convection diffusion problems, finite difference method

1 Introduction

Sinc methods have been studied extensively and found to be a very effective technique for the solution ODEs and PDEs, particularly for problems with singular solutions and those on unbounded domain. Despite all advantages, it is difficult for the traditional Sinc method to solve some types of two or more dimensional boundary value problem. In these types of problems, it is better to divide a PDE into some ODEs and incorporated the Sinc method with other methods[4]. Now it is known that the Sinc-collocation method based on DE transformation converges more rapidly for some class of equations under proper conditions[3, 5].

2 Notation and background

Definition 2.1. [1]. Let h be a positive constant which represents mesh size of discretization and $k = 0, \pm 1, \pm 2, \dots$. The Sinc basic functions is defined for all $x \in \mathbb{R}$ by

$$Sinc\left(\frac{x - kh}{h}\right) = S(k, h) = \begin{cases} \frac{\sin\pi\left(\frac{x - kh}{h}\right)}{\pi\left(\frac{x - kh}{h}\right)} & x \neq kh \\ 1 & x = kh \end{cases} \quad (1)$$

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