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The Pseudospectral Method for Burgers Equation

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Abstract

In this paper, a Fourier Pseudospectral approximation with restrain operator is developed for solving Burger's equation. The generalized stability and convergence are proved respectively. The numerical results also presented.

Key Words: Burger's Equation, Fourier Pseudospectral method, Error Estimation.

1. Introduction

The numerical methods for solving Burger's equation can be found in [1-8]. The aim of this paper is to Combine Fourier Pseudospectral method with the second order time differencing technique to solving Burger's equation. The linear term is treated with Crank Nicolson method, while the nonlinear term with the second order Adams Bashforth method. The generalized stability and convergence is proved. The numerical results show the advantage of this method.

Now consider the Burger's equation as follows:

$$\begin{cases} \dfrac{\partial u}{\partial t} + u u_x - v u_{x_x} = f, & -\infty < x < \infty, \quad o < t \le T, \\ u(x,t) = u(x+1,t), & -\infty < x < \infty, \quad 0 \le t \le T, \\ u(x,0) = u_0(x), & -\infty < x < \infty, \end{cases} \tag{1.1}$$

2. Notations and Lemmas

Let I=(o,1)∈R.

$$(u,v) = \int_0^1 u(x)\overline{v(x)}d_x,$$

$$\|u\|^2 = (u,v), \qquad |u|_1 = \left\|\frac{\partial u}{\partial x}\right\|.$$

Let N be positive integer and n be any integer

$$v_N = span\left\{e^{n\pi ix} \Big/ |n| \le N\right\}.$$