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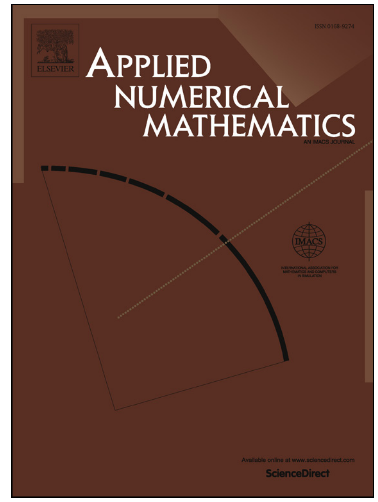

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A Fully Discrete Pseudospectral Method for Fisher's Equation on The Whole Line

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Abstract. In this paper, a fully discrete pseudospectral scheme for Fisher's equation whose solutions behave differently as $x \to +\infty$ and $x \to -\infty$ is presented using generalized Hermite interpolation. The convergence and the stability of the proposed scheme are analyzed. Numerical results coincide well with theoretical analysis and show efficiency of our algorithm.

Keywords. Fisher's equation, pseudospectral method, generalized Hermite interpolation, problem on the whole line.

Mathematics Subject classification MSC. 34B40, 41A30, 55K61, 65M70.

1 Introduction

Introduced by R. A. Fisher in 1937, Fisher's equation always plays important roles in many fields, such as population dynamics, tissue engineering, autocatalytic chemical reactions, combustion, and neurophysiology, ect., see [1, 2, 6, 7, 19, 26] and the references therein. For simplicity, let $\partial_z u = \frac{\partial u}{\partial z}$, etc.. The Fisher's equation defined on the whole line can be reformulated as follows:

$$\begin{cases} \partial_t U(x,t) - \partial_x^2 U(x,t) = F(U), & x \in R, 0 < t \le T, \\ U(x,t) \to 0, & x \to +\infty,\ 0 \le t \le T, \\ U(x,t) \to 1, & x \to -\infty,\ 0 \le t \le T, \\ U(x,0) = U_0(x), & x \in R, \end{cases} \tag{1.1}$$

where t is the time, x is the distance and $U(x,t)$ is the population density. $F(U)$ is a nonlinear function of U (cf. [17, 22]). Some numerical algorithms were proposed for Fisher's equation (1.1)

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