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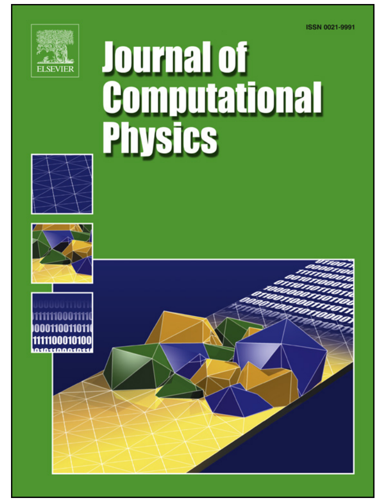

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A new nonlinear finite volume scheme preserving positivity for diffusion equations

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Abstract

In this paper we present a new nonlinear finite volume scheme preserving positivity for diffusion equations. The main feature of the scheme is the assumption that the values of auxiliary unknowns are nonnegative is avoided. Two nonnegative parameters are introduced to define a new nonlinear two-point flux, in which one point is the cell-center and the other is the midpoint of cell-edge. The final flux on the edge is obtained by the continuity of normal flux. Numerical results show that the accuracy of both solution and flux for our new scheme is superior to that of some existing monotone schemes.

Keywords: Positivity, finite volume, nonlinear, cell-centered unknowns.

1. Introduction

Positivity-preserving is one of the key requirements to discrete schemes for diffusion equation, which will also be called as monotonicity for simplicity. In the context of heat conduction a scheme without preserving positivity can lead to negative temperature or non-physical oscillation. For solving Lagrangian radiation hydrodynamic problems, diffusion schemes on distorted meshes must be monotone in order to avoid non-physical negative temperature. There are many literatures devoted to finite volume schemes of diffusion equation, e.g., [4, 7, 10, 16, 17, 23, 24, 25, 27]. However, they do not preserve positivity of a continuum solution, i.e., are not monotone and then do not

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