

A large time step weighted essentially non-oscillatory (LTS-WENO) scheme for the advection equation

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Various phenomena concerning flow are well described by hyperbolic conservation laws. In general, since the hyperbolic conservation laws may have discontinuous solutions, a number of numerical methods that suppress numerical oscillations around discontinuities have been developed so far. Higher-order interpolation methods such as weighted essentially non-oscillatory (WENO) scheme [1] have been proposed to obtain highly accurate numerical solutions with realistic computational time, that is, realistic grid points. However, an explicit method severely limits the size of the time step because the Courant-Friedrichs-Lewy (CFL) condition as a necessary condition for the stability must be satisfied. Although an implicit method is not restricted by the CFL condition, we need to efficiently solve a large-scale system of linear equations in every time step.

The large time step (LTS) scheme [2] was introduced as an explicit method to overcome the CFL condition. In the higher-order interpolation methods, information on a wide stencil is used for higher-order accuracy in space. On the other hand, in the LTS scheme, that contributes to the stability in time with the time step exceeding the CFL condition. However, a practical spatially higher-order LTS scheme has not yet been examined sufficiently. In this paper, a new numerical scheme for the advection equation is constructed combining the LTS scheme and the WENO scheme, and accuracy and efficiency of its scheme is discussed.

[1] G.-S. Jiang, C.-W. Shu, *J. Comput. Phys.*, 126, 202-228, 1996

[2] R. J. LeVeque, *SIAM J. Numer. Anal.*, 19, 1091-1109, 1982

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