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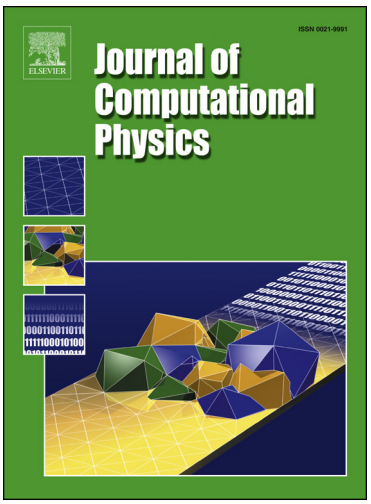

Error analysis of flux limiter schemes at extrema

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Error analysis of flux limiter schemes at extrema

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Abstract

Total variation diminishing (TVD) schemes have been an invaluable tool for the solution of hyperbolic conservation laws. One of the major shortcomings of commonly used TVD methods is the loss of accuracy near extrema. Although large amounts of anti-diffusion usually benefit the resolution of discontinuities, a balanced limiter such as Van Leer's performs better at extrema. Reliable criteria, however, for the performance of a limiter near extrema is not readily apparent. This work provides theoretical quantitative estimates for the local truncation errors of flux limiter schemes at extrema for a uniform grid. Moreover, the component of the error attributed to the flux limiter was obtained. This component is problem and grid spacing independent, and may be considered a property of the limiter that reflects the performance at extrema. Numerical test problems validate the results.

Keywords: Flux limiters, TVD, Finite volume methods, Accuracy, Extrema

1. Introduction

Total variation diminishing (TVD) schemes have proven to be very successful in the solution of hyperbolic conservation laws, especially in the presence of discontinuities. The underlying theory is well developed and can be found in most standard books such as [1], [2] and [3].

One of the major drawbacks of commonly used TVD schemes is the reduced accuracy at extrema. A reduction to first order accuracy was shown in [4]. A weaker but sufficient stability condition for a scheme to be convergent is total variation boundedness (TVB). This condition, in theory, allows uniformly high order accuracy. The disadvantage of this condition is that it permits

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