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On the accuracy and efficiency of point-value multiresolution algorithms for solving scalar wave and Euler equations

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Abstract

This paper concerns the use of a point-value multiresolution algorithm and its extension to three-dimensional hyperbolic conservation laws. The proposed method is applied to a high-order finite-differences discretization with an explicit time integration. The fluxes are evaluated on the adaptive grid using a fifth-order high-resolution shock capturing scheme based on a WENO solver, while the time is advanced using a third-order Runge-Kutta scheme. The multiresolution prediction operators are presented for one-, two- and three-dimensional problems. To assess the efficiency and the accuracy of the method, a new tolerance-scale diagram is introduced. This diagram enables to properly choose the adequate value of the tolerance in order to maintain an optimal multiresolution quality. Numerical examples based on advection and Euler equations are carried out to show that the proposed method yields accurate results.

Keywords: multiresolution algorithm, grid adaption, finite differences
method, shock waves

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