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Improved production implicit continuous-fluid Eulerian method for compressible flow problems in Uintah. (English) Zbl 1253.76084

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Summary: The implicit continuous-fluid Eulerian (ICE) method is a successful and widely used semi-implicit finite-volume method that applies to flows that range from supersonic to subsonic regimes. The classical ICE method has been expanded to problems in multiphase flow, which spans a wide area of science and engineering. The ICE method is utilized by the Center for the Simulation of Accidental Fires and Explosions code Uintah written at the University of Utah to simulate explosions, fires and other fluid and fluid-structure interaction phenomena. The ICE method used in Uintah (referred to here as Production ICE) is described in many papers by Kashiwa at Los Alamos National Laboratory and Harman at University of Utah. However, Production ICE does not perform as well as many current methods for compressible flow problems governed by the Euler equations. We show, via examples, that changing the nonconservation form of the solver in Production ICE to a conservation form improves the numerical solutions. In addition, the use of slope limiters makes it possible to suppress the nonphysical oscillations generated by the ICE method in conservation form. This new form of ICE is referred to as IMPICE, the IMproved Production ICE method. The accuracy of IMPICE for one-dimensional Euler equations is investigated by using a number of test cases.

MSC:

76M20	Finite difference methods applied to problems in fluid mechanics
76M12	Finite volume methods applied to problems in fluid mechanics
65M06	Finite difference methods for initial value and initial-boundary value problems involving PDEs
76N99	Compressible fluids and gas dynamics, general

Keywords:

implicit continuous-fluid Eulerian (ICE) method; numerical method for compressible flow problems; improved ICE method using limiters; IMPICE method for compressible flows; `Uintah`; IMPICE spatial and temporal errors

Software:

HE-E1GODF; HLLE

Full Text: DOI

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