A further work on multi-phase two-fluid approach for compressible multi-phase flows

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Abstract

This paper is to continue our previous work Niu (Int. J. Numer. Meth. Fluids 2001; 36:351–371) on solving a two-fluid model for compressible liquid–gas flows using the AUSMDV scheme. We first propose a pressure–velocity-based diffusion term originally derived from AUSMDV scheme Wada and Liou (SIAM J. Sci. Comput. 1997; 18(3):633—657) to enhance its robustness. The scheme can be applied to gas and liquid fluids universally. We then employ the stratified flow model Chang and Liou (J. Comput. Physics 2007; 225:240–873) for spatial discretization. By defining the fluids in different regions and introducing inter-phasic force on cell boundary, the stratified flow model allows the conservation laws to be applied on each phase, and therefore, it is able to capture fluid discontinuities, such as the fluid interfaces and shock waves, accurately. Several benchmark tests are studied, including the Ransom’s Faucet problem, 1D air–water shock tube problems, 2D shock-water column and 2D shock-bubble interaction problems. The results indicate that the incorporation of the new dissipation into AUSM+-up scheme and the stratified flow model is simple, accurate and robust enough for the compressible multi-phase flows. Copyright q 2008 John Wiley & Sons, Ltd.

Keyword：AUSMDV; two-fluid model; multi-phase flow; pressure-velocity coupling; shock waves;
material interfaces