High-resolution Capturing of Discontinuities of Multi-component Flows

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Abstract

In this study, a robust MUSCL type AUSMD [1] along a approximated Riemann solver along with the Tangent of Hyperbola for Interface Capturing (THINC) [2] technique to reconstruct the solution function for both smooth profile and discontinuity. The basic ideais to reconstruct the solution functions so that the jumps at cell boundaries are minimized, which effectively reduces the numerical dissipation in the resulting schemes. Here, to consider the multi-component flow equations, the two-fluid model of the reduced five equations in [3] is regarded as a model equation. The transport equation for each volume fraction is expressed in quasi-conservative form. numerical model is not only demonstrated to maintain pressure equilibrium over contact discontinuities using conservative pressure update, but also AUSMD are shown to enhance pressure being continuous across the contact discontinuity. This test case show the MUSCL type AUSMD with THINC idea allows us to achieve the sharp capturing of the evolution of interfaces and shock-bubble interactions and demonstrate less numerical dissipations than the original MUSCL type AUSMD scheme did. The results of test cases show a remarkable improvement in the solution quality to the problems of interest. Compared with the high-order shock-capturing schemes, the new scheme shows competitive or even better numerical results but with less computational cost. This work provides an effective but simple approach to simulate compressible interfacial multiphase flows.

Keywords: multi-component flows, interface, BVD, shock, bubble

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