

On Accuracy of the Ghost Fluid Method

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ABSTRACT

When a high-resolution scheme such as TVD or ENO is directly employed to solve multi-medium flow unphysical oscillations can occur. Such oscillations are very severe and even cause computation breakdown when applied to two-medium flow with a very large density ratio. The recently developed Ghost Fluid Method (GFM) proposes us a simple and flexible way to treat the moving material interface. The GFM possesses the features of simplicity, easy extension to multi-dimensions and maintenance of a sharp interface. However, it has been found that the original GFM may produce inaccurate numerical solution when applied to the problems of strong shock impacting on a material interface. In this work, a systematic analysis will be carried out for the GFM based algorithm as applied to the compressible gas-gas Riemann problems. It is found that there are respective ranges of conditions for each type of solution where the original GFM, the new version GFM and the simplified GFM are unable to provide accurate results. I will further show that the above mentioned GFMs have no-order accuracy in the sense of approximating to the original Riemann problem when applied to gas-gas Riemann problem if the material interface is not in normal motion initially. Our modified GFM (MGFM) can overcome those difficulties well, and I will show that the MGFM is indeed second-order accuracy to the original Riemann problem.