A GKS-ALE Method For Multi-material Flows With General Equation Of State

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ABSTRACT

Based on a gas kinetic scheme (GKS) and the finite volume method, we propose a new Arbitrary LagrangianEulerian (ALE) method for compressible multi-material flow problems with general equation of state (EOS) on arbitrary computational grids. In the current ALE scheme, after a coordination transformation, the Riemann problems on moving grids can be transferred to fix grids, thus we can make use of a non-oscillatory gas kinetic scheme (the NOK scheme proposed in [1]), which can deal with general EOS, to evaluate the numerical flux, and this avoids constructing a Riemann solver for general EOS. Furthermore, material interfaces are tracked by requiring them to move with fluid (Lagrangian) velocity, while the internal nodes are rezoned to improve the geometrical quality. In the rezoning step, an optimization-based rezoning method on structured grids [2] is extended to arbitrary grids, the new method can preserve three good geometrical requirements: (1) convex, (2) smooth, (3) uniform. Figure 1 shows the numerical results of an underwater explosion problem, a typical multi-material problem with general EOS, computed by our new ALE scheme. It is clearly that the material interfaces can be sharply resolved, while the computational grid can be kept in good quality for a wide range of problems.

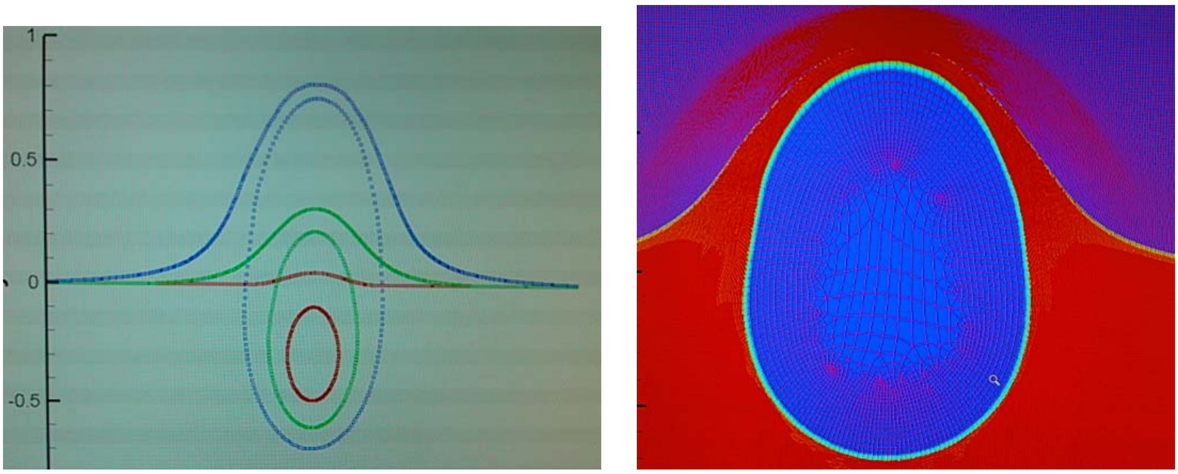

Figure 1: Numerical results of underwater explosive problem computed by new ALE method. Left: Evolution of material interface, right, the computational grid near the material interface.

References

[1] Y. Chen, S. Jiang, “A non-oscillatory kinetic scheme for multi-component flows with the equation of state for a stiffened gas”, *Journal of Computational Mathematics Vol.29*, No.6, 2011, 123.

[2] Y. Chen, S. Jiang, “An optimization-based rezoning for ALE methods”. *Communication in computational physics*. 4 (2008), 1216-1244.