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Numerical Simulation of Bubble Jet Based on Compressible Multiphase Flows

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Extended Abstract

The numerical study of compressible multiphase flows has been a hot topic. In the diffuse-interface models, the interface is solved as a numerical diffusion zone. These models are solved on a fixed grid with the same type of numerical scheme for all computational cells. However, their numerical implementation with interface-capturing numerical methods tends to produce solutions that exhibit excessive numerical diffusion [1]. The numerical diffusion leads to the material interface unclear and affects the numerical results. This problem is particularly obvious in the simulation of bubble jet. This abstract is focused on the preliminary results of an anti-diffusion interface sharpening model for bubble jet.

The five-equation model is used as the numerical model to simulate the bubble jet process. Under the assumption of isobaric closure, the general EOS is adopted to describe each phase [2]. The multi-dimensional problem can be split into multiple one-dimensional problems using the Strang splitting. The MUSCL–Hancock Method (MHM) is employed to solve the governing equations in one-dimensional space. The HLLC (Harten–Lax–van Leer contact) scheme is adopted to solve the Riemann problem approximately. The volume-fraction transport equation is solved using the chain ruler. To suppress the numerical diffusion, an anti-diffusion interface sharpening model proposed by Shyue is adopted [3]. The model is solved using a fractional step method. On the basis, the bubble jet process is simulated. The numerical results show that the anti-diffusion interface sharpening model can effectively suppress the numerical diffusion in the simulation of bubble jet.

References

[1] R. Saurel and C. Pantano, "Diffuse-interface capturing methods for compressible two-phase flows," *Annu. Rev. Fluid Mech.*, vol. 50, pp. 105–130, 2018.
[2] T. S. Lee, J. G. Zheng and S. H. Winoto, "An interface-capturing method for resolving compressible two-fluid flows with general equation of state," *Commun. Comput. Phys.*, vol. 6, no. 5, pp. 1137–1162, 2009.
[3] K. M. Shyue, "An anti-diffusion based Eulerian interface-sharpening algorithm for compressible two-phase flow with cavitation," in *Proceedings of the 8th International Symposium on Cavitation*, Singapore, 2012, pp. 7–12.