Yang, L. M.; **Shu, C.**; **Wu, J.**

A three-dimensional explicit sphere function-based gas-kinetic flux solver for simulation of inviscid compressible flows. (English) Zbl 1349.76751

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Summary: In this work, a truly three-dimensional (3D) flux solver is presented for simulation of inviscid compressible flows. Like the conventional multi-dimensional gas-kinetic scheme, in the present work, the local solution of 3D Boltzmann equation at the cell interface is used to evaluate the flux. On the other hand, different from most of the existing gas-kinetic schemes, which are constructed from Maxwellian distribution function, the present flux solver is derived from a simple distribution function defined on the spherical surface in the phase velocity space. As a result, the explicit expression of flux vector at the cell interface can be simply given. Since the simple distribution function is defined on the spherical surface, for simplicity, it is termed as sphere function hereafter. In addition, to simulate fluid flow problems with strong shock waves, the non-equilibrium part of the distribution function is regarded as numerical dissipation and involved in evaluating the inviscid flux at the cell interface. The weight of the non-equilibrium part is controlled by introducing a switch function which ranges from 0 to 1. In the smooth region, the switch function takes a value close to zero, while around the strong shock wave, it tends to one. To validate the proposed flux solver, several transonic, supersonic and hypersonic inviscid flows are simulated. Numerical results showed that the present solver can provide accurate numerical results for three-dimensional inviscid flows with strong shock waves.

MSC:

76M28 Particle methods and lattice-gas methods
76L05 Shock waves and blast waves in fluid mechanics
76H05 Transonic flows
76J20 Supersonic flows
76K05 Hypersonic flows
76N15 Gas dynamics, general

Keywords:

sphere function; 3D flux solver; compressible flows; inviscid; switch function

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