Particle Mesh Method(PMM) for Convection-Dominated Flow avoiding the Ringing Instability

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ABSTRACT

The particle-mesh method (PMM) is a powerful computational tool for the simulation of convection-dominated diffusion flows. The method introduces computational particles each of which is given a finite size and represents a large number of physical particles with the same properties. The convection part of the flow can be solved by moving the computational particles along the characteristics, while the diffusion part is carried out by utilizing a heat solver on a regular mesh. However, the method in practical applications shows the so-called ringing instability, an amplitude fluctuation in the computed solution. In this talk, we suggest a new numerical technique of particle movement, called the dual-mesh characteristics (DMC) of which the second mesh is formed by tracking back the cells along the characteristics.The particle movement is carried out by interpreting the particle positions (in the previous time level) in terms of the multi-linear coordinates of the second mesh. Strategies for the average velocity and interpolations are also suggested to move the computational particles accurately with a minimum numerical dissipation. The resulting algorithm, PMM-DMC, turns out to be mass-conservative, non-oscillatory, of negligible dissipation, and more efficient than the conventional schemes. Numerical results are shown to demonstrate its accuracy and efficiency.

REFERENCES

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