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气固可压缩湍射流中颗粒扩散的直接数值模拟

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摘要　A numerical method was developed to directly simulate the compressible, particle-laden turbulent jets.The fourth order compact finite difference schemes were used to discretize the space derivatives. The Lagrangian method was adopted to simulate the particle motion based on one-way coupling. It is found that the turbulent intensity profiles attain self-similar status in the jet downstream regions. At the Stokes number of 1, particles are concentrated largely in the outer boundaries of the large-scale vortex structures with the most uneven distribution and the widest dispersion in the lateral direction. Particles at the much smaller Stokes numbers are distributed evenly in the flow field, and the lateral dispersion is also considerable. Distribution of particles at much larger Stokes numbers is more uniform and the lateral dispersion becomes small. In addition, the inflow conditions have different efects on the particle dispersion. The direct numerical simulation (DNS) results accord with the previous experiments and numerical studies.

关键词　数字模拟技术　离子分散体系　气-固压缩紊流　稳定性　流体　计算方法
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Direct Numerical Simulation of Particle Dispersion in Gas-Solid Compressible Turbulent Jets

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Abstract A numerical method was developed to directly simulate the compressible, particle-laden turbulent jets.The fourth order compact finite difference schemes were used to discretize the space derivatives. The Lagrangian method was adopted to simulate the particle motion based on one-way coupling. It is found that the turbulent intensity profiles attain self-similar status in the jet downstream regions. At the Stokes number of 1, particles are concentrated largely in the outer boundaries of the large-scale vortex structures with the most uneven distribution and the widest dispersion in the lateral direction. Particles at the much smaller Stokes numbers are distributed evenly in the flow field, and the lateral dispersion is also considerable. Distribution of particles at much larger Stokes numbers is more uniform and the lateral dispersion becomes small. In addition, the inflow conditions have different efects on the particle dispersion. The direct numerical simulation (DNS) results accord with the previous experiments and numerical studies.

Key words direct numerical simulation; compressible turbulent jet; coherent structure; particle dispersion

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