AN EFFICIENT STRATEGY OF PARCEL MODELING FOR POLYDISPERSED MULTIPHASE TURBULENT FLOWS

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The Eulerian-Lagrangian method is the best-suited for dispersed multiphase flows with a flow regime ranging from the very dilute up to relatively dense and with thousands or millions of particles. The Eulerian part is used for the continuous phase and the Lagrangian one for tracking the dispersed phase. This method can be applied in industrial applications, like the fuel injection of combustion chambers, cyclone separators, evaporative cooling, and dispersion of pollutants. In order to reduce the computational costs due to tracking all the individual particles, one approach consists of tracking parcels instead of particles where each parcel represents the specified number of particles with the same properties.

Watanabe et al. [1] studied polydisperse systems with a specified particle-size distribution where two methods for arranging the particles in parcels were examined: the number fixed method, NFM, in which each parcel has the same number of particles and the volume fixed method, VFM, in which each parcel has the same volume. Employing the parcel model coupled with the particle-In-Cell method generates some discrepancies in the interaction between phases, affecting particle dispersion and interphase momentum transfer. These discrepancies grow with increasing the number of particles per parcel.

In order to achieve an optimal trade-off between accuracy and computational cost, a hybrid approach is proposed. This approach is a combination of the previous two methods. The particles above the Sauter mean diameter, SMD, are arranged with the VFM and the rest with the NFM. Therefore, in addition to decreasing the computational costs, the accuracy remains appropriate. This approach is studied for the particle-laden turbulent flow benchmark case of Boreé et al. [2] with a mass loading of 22% by using large eddy simulation through two-way coupling between continuous and polydispersed phases.

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