Dynamics of Droplets Impulsively Accelerated by Gaseous Flow: A Numerical Investigation

Shaoping Quan*
Large-Scale Complex Systems
Institute of High Performance Computing
1 Fusionopolis Way, #16-16 Connexis, Singapore 138632

Abstract

The dynamics of droplets in gaseous flow is of importance in nature and in engineering application, such as rain, sprays, and combustions. The most fundamental interactions in such flows are the coupling between the droplet and the gas, and the interaction between droplets. However, the knowledge of these interactions is very limited. In this paper, two droplets, which stand side by side along the free stream direction, subjected to impulsive acceleration by the surrounding gaseous flow are simulated using a moving mesh interface tracking scheme coupled with finite volume method. This numerical method was used to simulate a single droplet impulsively accelerated by gaseous flow, and the results compared well with the existing experimental work ("Direct numerical study of a liquid droplet impulsively accelerated by gaseous flow", *Phys. Fluids*, **18**, 2006). By varying the distance between the two droplets, the interaction between drops are examined. It is found that for small distance, the two droplets' shapes are much different from the single droplet case. The front drop is even more deformed, and the rear one has a cone shape. This can be explained by the fact that for these small distances, the back droplet is in the wake of the front drop. The back droplet slows down the acceleration of the front drop, resulting in a smaller drag. The wake of the front drop pulls the front of the back drop, and thus a bell shape is formed. Finally, the two drops form a mushroom shape.

Key words: Modeling; Drops; Drag Coefficient; Deformation; Unsteady.

*Corresponding author. Email: quansp@ihpc.a-star.edu.sg (S. P. Quan)