Numerical model for the motion of a large object in dense gas-solid flows

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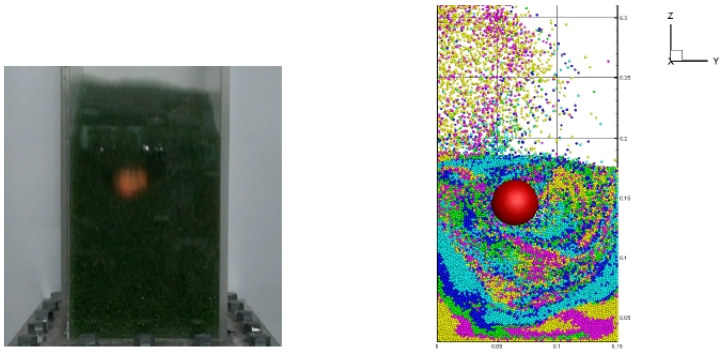
Tsuji et al. [1] proposed a DEM-CFD coupling method in which DEM for the simulation of particles motion is coupled with locally averaged Navier-Stokes equation to simulate the flow in gas-fluidized bed, and well predicted the formation of bubbles observed in the experiment. In this coupling method, the space resolution of fluid motion is taken to be larger than the particle size but smaller than the meso-scale structures such as bubbles formed in gas-fluidized bed. In many practical applications of fluidized bed, solid objects much larger than the particles of fluidized medium exist in the beds. These systems can not be treated by the original DEM-CFD coupling method and require a new model for the large objects.

In the present study, we propose a numerical model which expresses the motion of a large object in fluidized bed based on the DEM-CFD coupling method. The model is highly inspired by the volume penalization method and the interaction force between the fluid and large object is expressed by assuming that the large object is composed of dense small virtual particles. In this study, the motion of a sphere in a bubbling fluidized bed is numerically simulated by using the present model and the results are compared with the corresponding experiments. It was found that the present model well expresses the behavior of the sphere observed in the experiment (FIG. 1).



(a) Experiment (b) Simulation

Figure 1: Snapshots of the motion of a large sphere in gas-fluidized bed.

References

[1] Tsuji, Y., Kawaguchi, T. and Tanaka, T., Powder Technology **77**, 79 (1993).

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