Overview

Accurate prediction of the particle-gas and liquid-bubble turbulent two-phase flows is important in many engineering applications. Heat exchanger and ventilation systems are some typical examples. These physical systems involve the interaction of two phases: the fluid phase (gas or liquid) and the dispersed phase (particles or bubbles). Prediction and analysis of particle-gas turbulent flow and liquid-bubble flow by means of Computational Fluid Dynamics (CFD) pose one of the great challenges in fluid dynamics. Currently, three approaches are commonly used for prediction of the turbulent flow field of the fluid phase: Reynolds-averaged Navier-Stokes (RANS), large eddy simulation (LES), and direct numerical simulation (DNS). Particles or bubbles as a dispersed phase are tracked by Lagrangian approach or Eulerian approach.

Accurate prediction of particle and bubble transport is strongly dependent upon a realistic description of the turbulent flow field encountered along particle and bubble trajectories. Traditionally, the prediction of turbulent flow field based on the RANS equations has not been completely successful for a number of cases. Alternatively, DNS is expensive and requires large computational resources and this approach is not feasible to resolve practical engineering flows at least for the coming decades. More realistically, from a computational standpoint, LES approach has become more popular.

Case study

The performance of three turbulence models, i.e. standard k-ε model, and Re-Normalization Group (RNG) k-ε model and RNG-based Large Eddy Simulation (LES) model to simulate indoor airflow in a model room has been investigated. The measured air phase velocity is used to validate the simulation results. All three models provide results being good agreement with the experimental data, while RNG-based LES gives evidently best comparison with measurement.

Figure 1. Geometry of the model room
Figure 2. Simulated and measured air phase velocity along line 1 in Figure 1.