README

FLUIDIZED_BED_DES

MFIX_DES Coupled Simulation of a 2D Bubbling Fluidized bed

In this tutorial a 2D fluidized bed of 15 cm width and 90 cm height is simulated. The static bed height is 22 cm. A single central jet of air is injected from the bottom wall. 2400 spherical particles of 4 mm diameter have been used with a minimum fluidization velocity of about 1.85 m/s. The superficial gas velocity is 2.8 m/s. Other simulation parameters are listed in Table 1. The flow field was divided into 15X45 rectangular cells of 10X20 mm (width and height) each. In a packed condition roughly about 9 particles would fit in each cell. MFIX drag correlation is used for the purpose. To calculate the void fractions in the computational cell, the depth of the computational domain is taken to be equal to the diameter of the spherical particle. Both the gas and the solid particles are confined to move only in the plane of the calculation. For more details about the MFIX_DEM coupling techniques, simulation methods, simulation case set up, results and discussion refer to Jay Boyalakuntla's PhD thesis (Dec 2003) (http://www.mfix.org/open_citations/citation_page.php?citation_id=51).

The LOG, RES and other SPX files are generated by MFIX. This is not an axisymmetric problem and considers the whole bed in the simulation. The animate_mfix and post_mfix can be used as with other mfix simulations. The animation window shows the void fraction by default. The gas and solid void fraction, velocities, pressure and other mfix variables can be seen in the animation window. The solid variables are cell volume averaged values. Apart from the data files generated by MFIX, the DES code generates

another set of files starting with 'des_' to plot individual particle information like particle position, particle velocity, radius, granular temperature and also to plot the pressure/pressure drop in the bed. The "des_all_particles*.out" files contain the particle information like the position, velocity, density, radius etc., and are stored at regular intervals. Fig. 1 plots the locations of the individual particles in the bed. Currently the data files are tecplot compatible and the user can easily change the data files to suit to available plotting device by changing the writing section in "des_time_march.f," in model/des directory. The DES section also generates the "des_pressure,out" file which contains the pressure values across cross-sections at different heights in the system. These heights can be specified in the corresponding file in model/des. The "des_pressure_drop.out" file contains the pressure drop between different heights in the system. And the "des_granular_temperature.out" contains the time averaged granular temperature in each fluid cell in the system, written at regular intervals. Currently, all these files are written in a format compatible to tecplot and can be easily changed to suit the users plotting software.

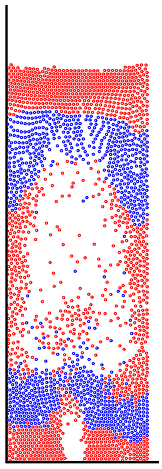

Figure 1. Bubbling fluidized bed simulation results showing the particle position

Table 1. Simulation parameters

Bed Dimensions (W X H)	150 mm X 900 mm
Fluid mesh size	15 X 45
Cell dimensions	10 mm X 20 mm
Particle bed height at rest	220 mm
Minumum fluidization velocity	1.8 m/s
Inlet jet velocity	2.8 m/s
Number of Particle: N	2400
Particle diameter: d	4mm
Particle density: ρ_s	2700 kg/m^3
Gas density: ρ_g	1.205*10^{-3} kg/m^3
Gas viscosity: μ_g	1.80*10^{-5} N/m^2
Particle coeff. Of restitution: ε	0.9
Particle stiffness coeff: k	800 N/m
Particle damping coeff: v	0.18 (N.s)/m
Particle friction coeff: μ_f	0.3
Ratio of fluid time step to particle time step: $\frac{\Delta t_f}{\Delta t_s}$	$\frac{5*10^{-3}}{2*10^{-4}} = 25$