Drag coefficient of spherical particles in turbulent channel flow

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ABSTRACT

Coupled problems like the large eddy simulation and the discrete element method are usually applied to study particle–laden turbulent flows. In these cases the CFD part simulates the velocity field and the DEM part calculates impacts of the particles and forces acting on the particles. To calculate the drag forces mostly the standard equations of the drag coefficient are used. But such values were determined for nearly ideal flow conditions and for example an influence of near wall turbulence was not taken into account.

The presentation will be focused on the calculation of the drag coefficient of large spherical particles in an open water channel. Two cases will be studied - the particles are fixed in different positions above a rough bottom and the particles impact and rebound the channel bottom. For the simulation both the Ansys Fluent and LBM-LES methods will be applied. The channel bottom is covered by one layer of the circular rods which are placed perpendicularly to the flow direction. The PIV experimental method will also be used to verify the velocity field around the particles. The non-dimensional size of the particles, D/H (particle diameter to channel depth), varies from 1/10 to 1/3 and the particle densities are from 1060 to 1360 kgm^{-3}. Some preliminary results are shown in Fig. 1 and 2. Fig. 1 shows contours of vortical structures behind the sphere of the diameter 25.4 mm placed 4.3 mm above the bottom. Mean flow velocity was 0.5 m/s. The vortices were calculated by the λ_2 criterion (λ_2=-1000). Fig. 2 shows time series of the drag coefficient calculated form the surface force and the velocity at a centre of the particle.

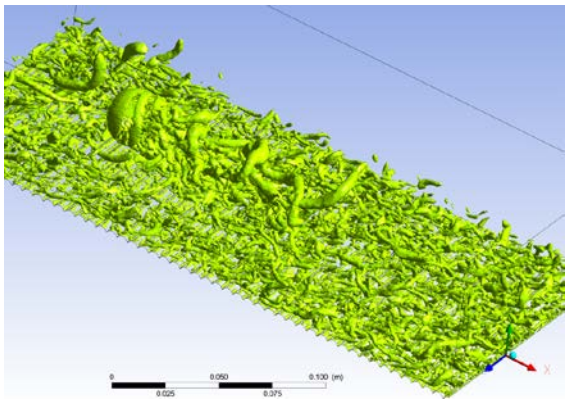

Fig. 1 Contours of the λ_2=-1000, t=0.8 sec

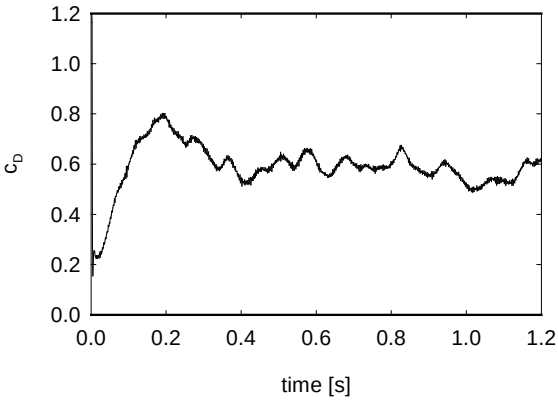

Fig. 2 drag coefficient c_D