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Large Eddy Simulation (LES) of Laboratory Scale Suspended Sediment Transport

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Environmental and hydraulics engineers did numerical studies of suspended sediment transport (SST) in laboratory scale to find out how highly turbulent alluvial channels convey suspended matter and to see whether the flow turbuelnce is abated or intensified by suspended particles.

In this study, the LES-COAST code which implements LES in the Euler-Euler single phase framework and in the case of low volumetric concentration of particles (two-way coupling) is used in which the larger 3D unsteady turbulent motions are directly represented, whereas the smaller and more isotropic and dissipative motions are commonly modeled by means of a subgrid-scale (SGS) closure model like dynamic Smagorinsky model (MGM).

Water and sand particles with specific gravity of 2.65 and fall velocity of 0.024m/s are chosen as the base fluid and sediment, respectively, in a turbuelnt open channel flow at a Reynolds number of 17670 with the volumetric concentration of 0.00046. The mean streamwise velocity, Reynolds stresses and volumetric concentration along the channel height are validated against the experimental data provided by Muste et. al (2005).

Low volumetric concentration case having smallest bed-like layer in the experiments is chosen for validation because it is said that one-phase flow (mixture) perspective using the advection-diffusion equation cannot capture the phenomenon called moving roughness on the bottom wall and also the particle-particle interactions when the volumetric concentration exceeds the value of 0.001.

Due to uncertenties in treating boundary condition of concentration at the wall and free surface, special attention may be given to satisfy the conservation of concentration in the channel. Also, to validate the concentration profile, we may be inclined to consider an optimised profile particularly close to the bottom wall. The interactions between suspended particles and flow turbulent structures are analyzed in terms of mean streamwise velocity and the von Karman constant.