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Abstract

This paper presents recent work on modelling of industrial particle and multiphase flows using combinations of DEM for resolved particle flow and either grid based CFD or meshless SPH for gas-particle and free surface fluid-particle flows respectively. Current examples of such modelling for dry industrial granular flows (DEM only applications) focuses on mixing and digging of non-ideal shaped particles in complex moving geometries. For the mixer, increasing the number of plough blades improves the rate of mixing due to a larger overlap of the swept paths of the blades with the bed and reduces the size of the dead zones between the blades and between the blades and the end of the mixer. For the dragline filling, the impact with a large mostly submerged boulder creates lateral forces and yawing components to the torque but the rock flow and dragline motion is collectively able to force the boulder into the dragline indicating that that boulders of up to 2 m length can still be easily be excavated. Industrial application of coupled DEM-SPH to fluid-particulate free surface flows is shown for both SAG and tower mills. In the SAG mill, the slurry largely follows the motion of the particulate phase of the charge. However, near the shoulder where the charge dilates the slurry is much more mobile leading to a lower slurry shoulder and the formation of a small slurry pool above the toe. For a tower mill, this coupled model is able to identify the viscosity controlled transition from the slurry being able to support itself with a largely hydrostatic pressure gradient to one where the slurry is supported by the grinding media and with pressure that is independent of height. For gas-particulate flows the important impact of grain shape in fluidised beds, pneumatic conveying and flow generated by high speed gas injection into granular beds are examined. These examples highlight the inability of simple spherical particle models to adequately resolve the complex granular dynamics of such gas driven systems for realistic shaped particulates. The generation and transport of dust in an industrial flow context is also demonstrated for a realistic hood-and-spoon conveyor transfer chute.

Keywords

DEM; CFD; SPH; multiphase flow; industrial applications