A FEM-DEM model for analysis of particulate flows

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ABSTRACT

The study of multidisciplinary engineering problems involving fluid-particles-structures interaction is relevant in many practical cases involving particulate flows emanating from natural hazards and in very different industries. Examples are common in the study of landslides and their effect on reservoirs and adjacent constructions, off-shore and harbour structures under large waves, constructions hit by debris flows due to floods and tsunamis, soil erosion and stability of rockfill and embankment dams in overspill situations or under earthquakes, and in widespread industries like the oil drilling industry, pharmaceutical or agriculture.

The authors have developed in previous works a particular class of Lagrangian formulation for solving multidisciplinary problems involving complex interactions between fluids and solids. The so-called Particle Finite Element Method (PFEM, www.cimne.com/pfem [1]), treats the mesh nodes in the fluid and solid domains as particles which can freely move and even separate from the main domain representing, for instance, the effect of water drops or soil particles. A mesh connects the nodes discretizing the domain and the governing equations are solved on that mesh using a stabilized FEM.

The effect of erosion and transport of small particles would require a very detailed discretization if every single particle was treated as a structure with a boundary fitted mesh or an immersed body technique. Instead, these small sized particles interacting with both the fluid and the structures are calculated using the Discrete Element Method (DEM, [2]).

The resulting DEM-FEM technique is able to deal with complex free surface flows with interaction with structures and small particles [3] (see Figure 1).

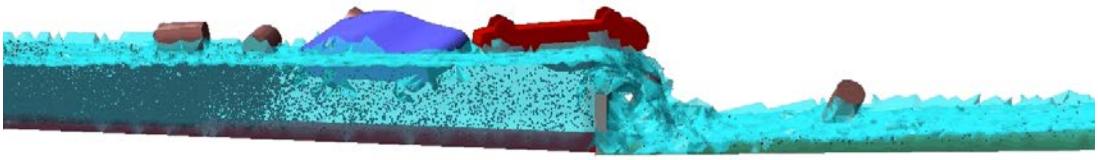

Figure 1. Cars, barrels and small particles dragged by a water current

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