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Direct numerical simulation of gravity-driven avalanches immersed in a viscous fluid THOMAS BONOMETTI, EDOUARD IZARD, LAURENT LACAZE, IMFT, Universite de Toulouse, CNRS/INPT/UPS, OTE TEAM — This work deals with direct numerical simulations of sediment transport at the scale of $O(10^3)$ grains. A soft-sphere discrete element method is coupled to an immersed boundary method in order to compute the flow around moving and colliding grains in an incompressible Newtonian fluid. A lubrication force is added for representing fluid-particles interaction near contact. The numerical method is shown to adequately reproduce the effective coefficient of restitution measured in experiments of the normal and oblique rebound of a grain on a wall. An analytical model is proposed and highlights the importance of the grain roughness and Stokes number on the rebound phenomenon. Three-dimensional configurations of gravity-driven dense granular flows in a fluid, namely the granular avalanche on an inclined plane and the collapse of a granular column, are performed. The granular flow regimes (viscous, inertial and dry) observed in experiments are identified as a function of the grain-to-fluid density ratio and the Stokes number. In particular, the simulations provide insights on the grain and fluid velocity profiles and force balance in each regime. In the second case, results agree well with experiments and the pore pressure feedback is observed for the first time in direct numerical simulations.

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