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Stability of bed particles near the critical threshold of motion JULIAN SIMEONOV, JOSEPH CALANTONI, Marine Geosciences Division, Naval Research Laboratory, Code 7434, Stennis Space Center, MS 39529, USA — The unsteady flow above a rough bed of mobile spherical particles is investigated with Direct Numerical Simulations. The velocity and pressure are resolved at sub-particle scales using a Cartesian grid numerical method based on a discontinuous extension of the pressure Poisson equation across particle boundaries. The hydrodynamics is fully resolved everywhere except in the gap between colliding particles when the latter becomes smaller than the grid step. To correctly predict momentum dissipation due to the viscous flow in the unresolved gap between colliding particles, we add analytical lubrication forces to the numerically resolved hydrodynamic force. The normal and tangential forces due to mechanical contact are modeled using a linear elastic-plastic law (soft-sphere) and a history dependent friction law, respectively. The collision model is validated against experimental data for normal and oblique immersed collisions of spherical particles. The lubrication effects during weak collisions are essential for damping out the flow-induced vibrations of bed particles confined in surface pockets. The results from our numerical simulations for the initiation of motion are compared with existing laboratory data.

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