Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Modeling enduring contact in Direct Numerical Simulations of incipient motion of granular beds JULIAN SIMEONOV, JOSEPH CALANTONI, Naval Research Laboratory — A boundary integral method for fast Direct Numerical Simulations of particle-laden flow on Cartesian grids is used here to model the incipient motion of particle beds forced by a steady current. The particle hydrodynamic force is determined numerically by resolving the flow around individual particles. Analytical lubrication force corrections are added during collisions when the interstitial gap becomes smaller than the grid step. The mechanical force normal and tangential to the contact between particles is modeled by a linear elastic-plastic law and a history dependent friction law, respectively. Resolving fluid-structure interaction effects during collisions is numerically expensive because the collision time scale is two orders of magnitude smaller than the maximum time step for numerical stability of the viscous flow. We improve the numerical efficiency with an acceleration-based control of the time step so that the maximum time step is used for enduring contacts with low particle acceleration. Quantitative comparison for sediment motion initiation is made with laboratory data.

Julian Simeonov
Naval Research Laboratory

Date submitted: 04 Aug 2011 Electronic form version 1.4