

## Discrete Particle Model for Granular Flow Physics and Sediment Transport Simulation

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I will present a discrete particle model (DPM) that simulates a collection of individual Lagrangian particles in dynamic contact. The computational domain can be bound, unbound (periodic), or partially bound, although most simulations incorporate a free surface such as those found in river and coastal sand beds and manufacturing, mining, or agricultural processing. Stress is provided to the bed by a one-dimensional Eulerian fluid model component or through gravitational gradients or both. The grain rheology is adjustable to simulate a wide range of materials. Newton's 2<sup>nd</sup> law (translational and rotational forms) are solved for each grain at each time step – domains normally contain 1000 to 500,000 grains. Primary funding has led to the application of the model to fluvial and coastal sediment transport modeling. I will present some of these applications and a new fundamental theoretical formalism for bimodal transport that has emerged from the model. Current work includes the development of an entropic description of naturally occurring sorting behavior, grain shape-dependent modifications to current sediment transport equations, and full coupling to 3-D Navier-Stokes fluid engines (U. of Florida) and beach wave and current models (ERDC). I will show several movies that capture interesting model results culminating from over 25,000 hours of CPU time on a Cray T3E or equivalent.

