A GPU based polyhedral particle DEM transport code

Motivation
- Prediction of GM dynamics important for industrial engineering applications.
- No consistent theory to describe dynamics as GM can behave as a liquid or solid.
- Numerical simulation using DEM has been the most successful in prediction of GM dynamics.

Current Challenges
- Limitation in number of particles.
- Simple estimations of particle shape.
- Long computational run times.
- Large scale simulations only possible on expensive clusters.

Goals
- Allow for a larger number of particles.
- Polyhedra match actual GM (corn, gravel, rocks) very well.

DEM Algorithm
- Convex polyhedra can be defined as an intersection of planes (Figure 1). These planes partition space into 2 distinct regions.
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- Polyhedra match actual GM (corn, gravel, rocks) very well.
- However collision detection between polyhedra is major bottle neck (Phase 2).

Can we go from TO ?

Blaze-DEM simulation framework

Spherical particles (GTS 780)

Longmore [2] simulates 256K particles @8FPS. We simulate 16 million @8FPS.

Performance

Polyhedral particles (GTS 780)

There are no GPU implementations for polyhedra. Nausser [3] simulate 800 polyhedral @1FPS.

Conclusion
We have achieved a new performance level in DEM simulations albeit to limited applications where the assumptions we made can expose the parallelism DEM.

References