Animating Sand as a Fluid

Abstract: The paper presents a physics-based simulation method for animating sand as fluid. It consider sand as continuum material rather than individual grain. It can be implemented by extending an existing water simulation as water simulation is already implemented.

Problem Statement:

In this paper, they provided   a physics-based simulation method for animation of sand. Basically it provides a way to : render sand in each frame of animation, know how sand flows and also how it gets stabilized, to animate large volumes of sand(For small volume of sand, it is possible to simulate each one as an individual rigid body).

Challenges in Solving the Problem:

1.   As there are two methods :Grid-based methods and particles-based methods for fluid simulation .And both the methods have pro and cons,so which one to use?
2.   How to reconstruct a surface that wraps around the particles.the method used have artifacts in concave regions.

Key Ideas:

1. Frictional Plasticity : to define the continuum behaviour of sand in terms of plastic yielding

2. Frictional stress: the point on the yield surface that most directly resists the sliding.

3. Friction between the sand and other objects and cohesion

4. Particle-in-Cell Methods : to simulating fully three-dimensional water in computer graphics.

5. Surface Reconstruction from Particles

Result Summary:

In this paper, they have presented

1.   a method for converting an existing fluid solver into one capable of plausibly animating granular materials such as sand.
2.   a new fluid solver that combines the strengths of both particles and grids, offering enhanced flexibility and efficiency.
3.   a new method for reconstructing implicit surfaces from particles

Implementation Approach:

In this paper, they provided two ways to implement animation of sand:

1.   It can be implemented by extending an existing water simulation as water simulation is already implemented.We have to add and update code of an existing water simulation.
2.   It also provides a new method for fluid simulation.