CS - 775

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Problem Statement

Graphical Modeling and Animation of Brittle Fracture. In other words, animating objects breaking under application of stress. For instance, a bowl that breaks when dropped, walls that crack because of wrecking balls, etc. We hope to build this simulation model and simulate a basic phenomenon which leads to brittle fracture. Since breaking objects and explosions go hand-in-hand,we want to implement a combination of explosions and brittle objects (time permitting). We hope to build a part of
http://graphics.berkeley.edu/papers/Obrien-GMA-1999-08/

Challenges in Solving the Problem

A couple of

1. **Criterion for Collisions** - Node Penetration vs Volume Overlap
2. **Ill-Conditioned Tetrahedra**

Key Ideas

In the paper Finite Element Method has been used. The entire 3D object has been discretized as a mesh of tetrahedrons. All material properties are approximated as linear polynomials in each individual element. The elastic potential density function is integrated over the volume of an element to object a set of tensile and compressive forces acting on each node. Finally, a "separation tensor" has been studied to decide fracture formation. An element is cut along a fracture plane passing through one node in case the "separation tensor" for that node has a positive eigenvalue greater than the material's toughness.

Result Summary

(The set of results we hope to reproduce are outlined in the problem statement given above)

Implementation Approach

We first intend to setup a basic framework which can read and draw 3D tetrahedral meshes. We have to make sure that these meshes are in some standard mesh file format to allow easy rendering in the next part of the project.

Once we've done this, we will move to the simulation. We'll start by setting up the barycentric coordinates, then the forces (internal). We'll then move on to collisions.