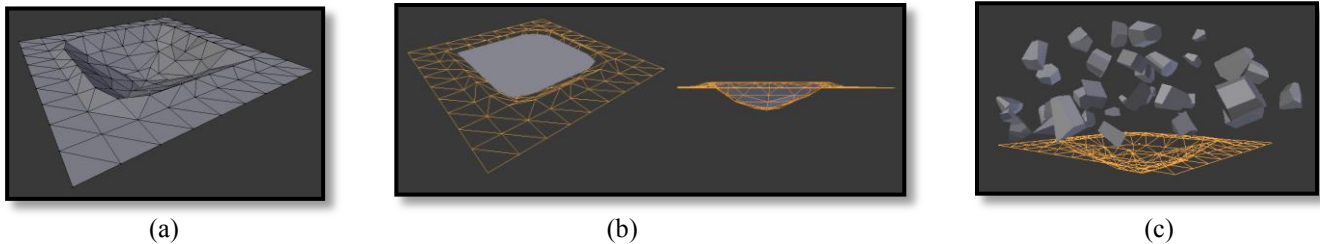


# Real Time Physics Applied to Shrapnel on a Destructible Generated Terrain



**Figure 1:** (a) Represent the ground with the pit linked, (b) Generation of the shrapnel block, (c) Explosion of the shrapnel block

## 1. Introduction

In the video games world, ground destruction has always been something complex but looked for at the same time. In order to do so, it is necessary to have a good ground mesh (shaped as a surface and not a volume).

A lot of research has been carried out for terrain generation such as Terragen or World Machine, but for the destruction part, the Voronoi algorithm will be used to generate the ground shrapnel.

The main aim of the program will be to generate and deform the ground in real time after the explosion of an object (i.e. bomb). Digging the ground to simulate, for example the crash of plane is not the main purpose. In addition, to making it more realistic, the general rules of physics will be applied to the shrapnel.

## 2. Exposition

The first step of our application is to get the data from an auto-generated ground composed of triangles, set and ordered by Delaunay's triangulation. The mesh of the ground is not a volume, but just a surface that has no size limit. Once the ground mesh is in place, it is ready for deformation. When an object (i.e. bomb) hits the ground, it generates a pit (a).

This pit is defined by several parameters: impact position, power blast and its range of action. Regarding these settings, the depth and diameter are calculated and the final shape is defined by a paraboloid with a couple of deformations on a few vertices.

According to the pit just generated, we create an object that perfectly fills the hole and which will represent the shrapnel (b). The epicenter of the explosion is then applied to the center of gravity of the shrapnel object. In order to create a nice explosion effect through the use of a 3D Voronoi function, the shrapnel is broken up into many little pieces, which will all fly in the air using a force vector applied between the epicenter previously set and the center of gravity of each piece of shrapnel (c).

Basic rules of gravity and forces of explosion are applied to every piece of shrapnel. To make it more realistic, the pieces of shrapnel will be able to collide with one another.

## 3. Deepening

To create the pit, the ground mesh has to be reshaped. The main process is to merge the ground with a mesh representing the hole.

The first step is to create the hole; to do so, random points are placed on and in a circle the size of the radius of action. Then the algorithm of Delaunay's triangulation is used to create a well-organized structure. After this, the vertices of the triangles are projected on a paraboloid surface. Thus the pit is created and is composed of irregular faces.

The second step is to place a circle the same size as the one used for the pit, and to place it where the explosion has to take place.

Finally, the pit can be merged with the ground. The vertices on the perimeter of the pit are linked with those from the ground's circle. All the main vertices from the ground where the pit has to be put are removed.

## 4. Future work

The main project is to calculate the pit from an angle of  $90^\circ$ . The next step would be to calculate it from any angle, and to adjust the pit accordingly.

## References

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