# Final Project
# (3D Terrain Mapping Software)

## Design of System

Our program uses fractal geometry and recursion to dynamically create a terrain. A recursive function populates an array with elevation values which are then given to a 63x63 mesh, which is displayed in the two windows (Figure 1.0).
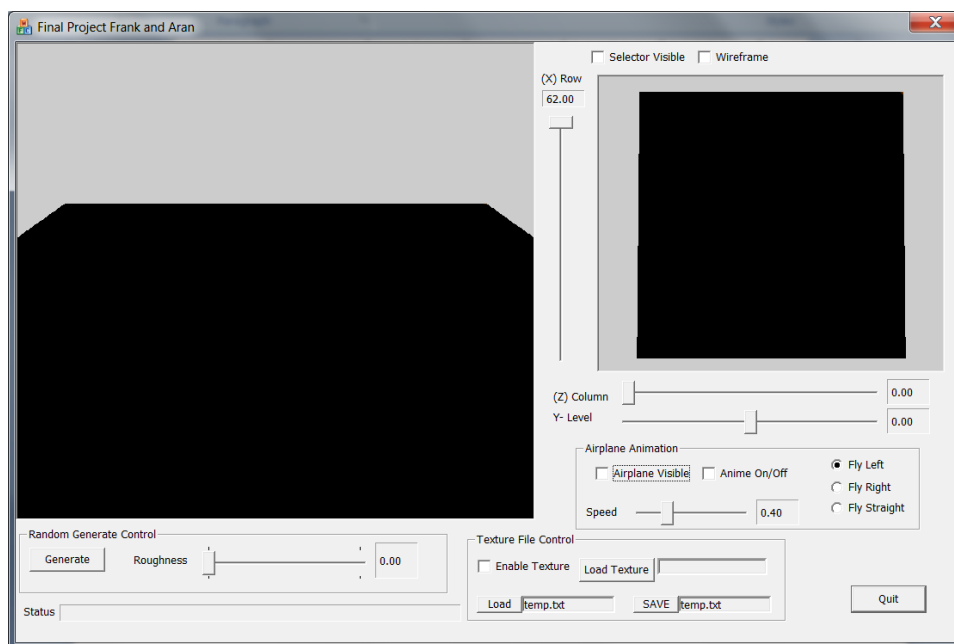


Figure 1.0 (System User Interface)

System allows user to edit individual vertex to change the elevation values. We have implemented a save and load feature allowing a user to save a custom terrain for future use (Figure 1.1).
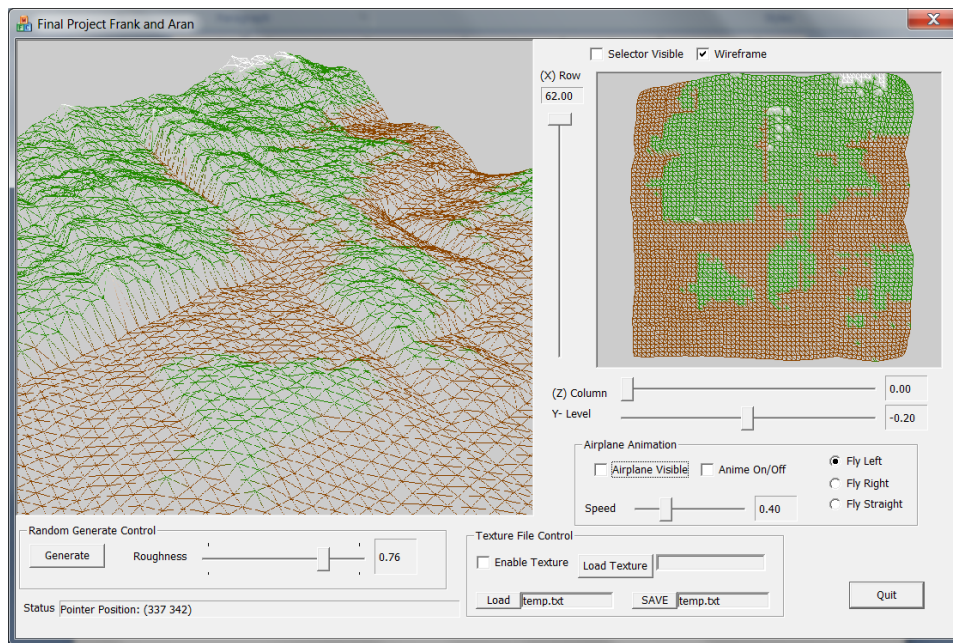
Figure 1.1 Wireframe for Terrain editing

We added a small biplane animation to add scale to our terrain, making it feel more like a mountain and less like a pile of dirt (Figure 1.2).
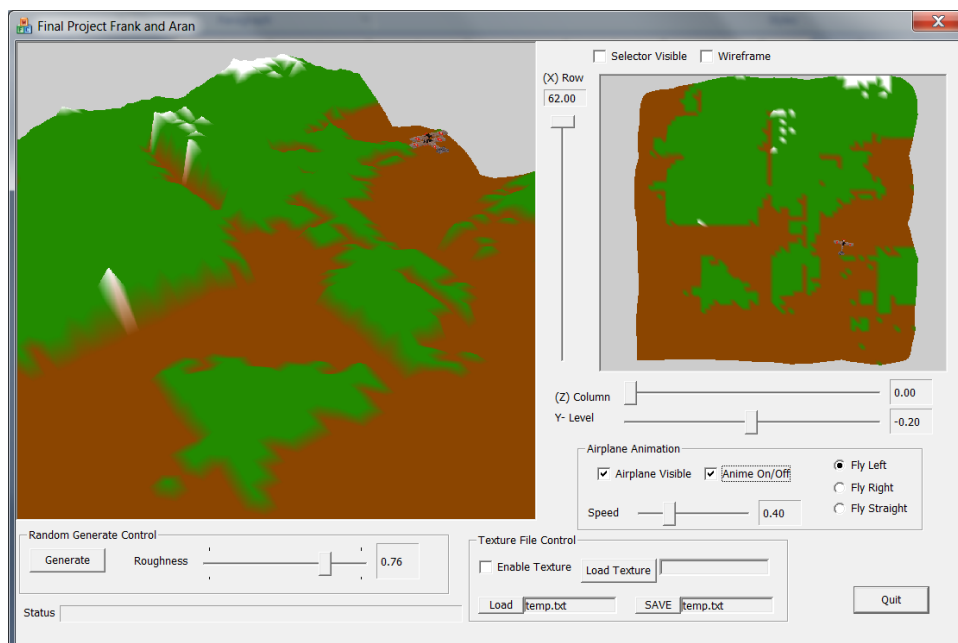


Figure 1.2 Animations

## Recursive Fractal Generation

The recursive function uses the diamond-square algorithm. In figure 2.0, the black values are generated by averaging the four surrounding gray values, and adding a random offset to the average elevation. The four corners of figure 2.0 (a) have randomly seeded values.  And when you move on to figure 2.0 (b) have the midpoint for randomly seeded values. And move on to figure 2.0 (c), (d), and (e).
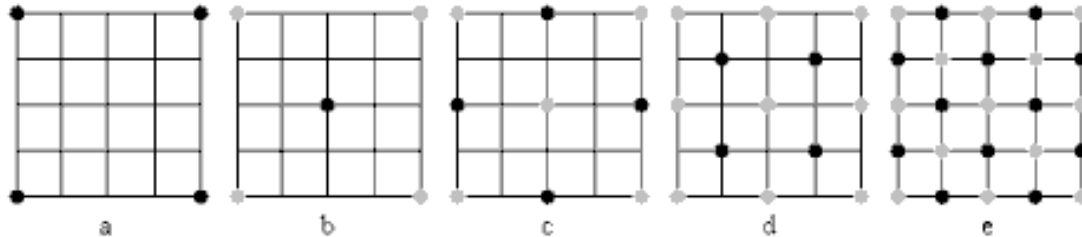


Figure 2.0 -- courtesy of http://www.gameprogrammer.com/fractal.html

Every pass when it ran through the terrain it will break into more vertex points in terrain and it will give more detail information on the terrain.

## Save and Load

Our Saving and loading system is simple; we output all elevation values as floats to a text file (Figure 3.0). The saved file size is 36kb.
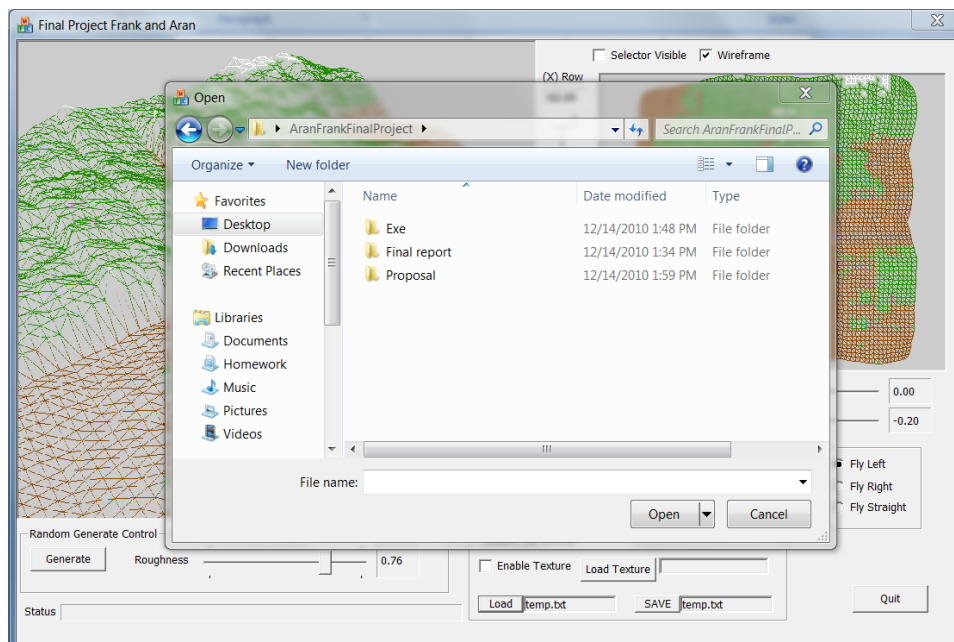


Figure 3.0 Save and Load Function

# Evaluation of System

## Known Bugs

The airplane can fly through the mesh if the elevation is high enough and end up either inside of or under the terrain.

## Expansion

Our program has a lot of room for expansion. Some ideas include:

- Add water to the terrain
- Choose different fractal algorithms to use
  - Linear interpolation
  - Cubic interpolation
  - Fourier transform
- Animate the terrain to simulate flying
  - Friendly UI control for remote control flying plane experience on 3D terrain environment.
- Enable lights and shading with color to simulate the sun rising and setting
- Improve the editing tools for the Terrain editing experience.
  - Leveler tool to change all the selected point to same locked Y-Level (Heights).
  - Selector to select more than one point at the time.

## Manual

| Create terrain | • Using the *Roughness* slider bar, select the desired level of "roughness" -- level 0 will be nearly flat, level 1 will be very chaotic (best values are close to .8)<br>• Click on the *Generate* button to create the terrain |
|---|---|
| **Modify terrain** | • Check the *Selector Visible* checkbox<br>• Check the Wireframe to show the wire frame of the Terrain. Easy for the user to see during modify the Terrain.<br>• Using the *Row* and *Column* slider bars around the auxiliary view, select the point to modify – the moving circle indicates which point is selected. The Y-Level will reflect the current value of the selected point in Terrain.<br>• After selecting a point, modify its elevation (y-position) with the *Y-Level* slider bar |
| **Load terrain** | • Click on the *Load* button and choose a saved file |
| **Save terrain** | • Click on the *Save* button and choose a filename<br>• ".txt" will be automatically appended to the filename |
| **Fly plane** | • Make the airplane is visible by checking the *Airplane Visible* checkbox<br>• Enable the plane's animation by checking the *Anime On/off* checkbox<br>• Speed up or slow down the plane's velocity with the *Speed* slider bar<br>• Use the radio buttons to control the plane's direction (left, right, straight) |
| **Change large main view** | • With the left mouse button, click and drag in the main window to rotate the terrain along any axis<br>• With the right mouse button, click and drag left and right to zoom in and out |
| **Change small aux. view** | • With the left mouse button, click and drag in the small auxiliary to pan the view left-right and up-down<br>• With the right mouse button, click and drag left and right to zoom in and out |
| **Texture mapping** | • Check the *Enable Texture* checkbox<br>• Click on *Load Texture* and select a texture file<br>• To remove texture, uncheck the *Enable Texture* checkbox |