Procedural Terrain

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# Overview:

Presentation.pdf contains the presentation.  
For the presentation, I would like to show the video “Movies/ Final Rendering HQ.mkv” at the end, if this is possible. For the main part of the presentation, I only need these slides.

Paper.pdf contains the write-up

The folder Movies/ contains all movies

The sources are under the src/ folder, the required libraries in the lib/ folder. If you are using netbeans, the nbproject folder contains the project settings, you should be able to open the project folder directly. The sources are also hosted on <https://github.com/shamanDevel/ProceduralTerrain>. All classes in the org.shaman.terrain-packages are written by me.

There are three entry point in the program:   
Launch Main.bat  
Build tree database.bat  
Create and edit trees.bat

Create and edit trees.bat is independent from the other two, it launches the tree creation tool. Give it a try!

# First start:

For the last step, the vegetation, we have to build the trees first. This is started with the “Build tree database.bat” script. Warning: this requires about 3GB of RAM, 1GB of hard drive and ca. 2 minutes.

After that, with “Launch Main.bat”, the main program is started, see next chapter.

# How to use the program:

## Start:

Start the main program with the “Launch Main.bat” script.

When the program is started, a dialog is displayed where you can load saved files. After each step, the current state is saved automatically (with the filename <LastStep>\_<DayOfYear>\_<Hours>\_<Minutes>\_<Seconds>.save). This was introduced for testing later steps because some steps take a long time.

If you load a saved file, the program starts there. If you choose cancel, the process starts at the first step (PolygonalMap)

After this dialog, another dialog appears where you can select the display options. I don’t recommend a lower screen resolution than 1280x800.

The program is closed with pressing escape or the normal closing buttons.

## General Controls:

### 3D-Navigation

I built the program with my 3d mouse in mind. So if you have a 3d mouse from SpaceNavigator, the navigation in the 3d world is very comfortable, but without, it is a little bit challenging: Because I need the left and right mouse button for editing the terrain, navigation works the following:

Control-Key (left and right side): mouse pointer is hidden and you rotate the camera by moving the mouse without pressing a mouse key

Alternative-Key / Meta-Key / Menu-Key (the key directly left to the space bar): mouse pointer is hidden and you can move forward, backward and sideways by moving the mouse without pressing a mouse key

### Misc

The statistic view in the left lower corner can be toggled with the F5-key

Screenshots can be taken with the print-key (normally right to F12). The screenshots are saved to <UserDir>/.jme3/ . For me, this is C:\Users\Sebastian\.jme3

With F10, you start the recording. The file is saved in the user directory.

## Step 1: Polygonal Map

The seed text shows the seed used to generate the voronoi regions. You can edit it, copy and paste from the clipboard and so on. Use it to reproduce a specific map. Use the “New”-button to generate a new random seed.

The point count specifies the number of cells to be generated. The more you select, the longer the generation of the voronoi regions takes.

Relaxation specifies the number of relaxation steps

With coastline you can select the algorithm for coastline generation: Perlin noise as described in the paper, or circular, a simpler approach without smaller side-islands.

Pressing the “Generate Elevation”-Button assigns elevations to corners and centers. After that (after that) you can edit the height when the “Show+Edit Elevation” checkbox is selected. When you move over the map you see the brush in shape of a star. Pressing the left or right mouse button and dragging the mouse around increases or decreases the elevation.

After that the biomes are assigned with the “Generate Biomes” button. You can edit temperature and moisture as you’ve done it with the elevation and view biomes.

Note: when you generate a new map by chaning the seed, point count or so on, you need to press the “Generate Elevation” and “Generate Biomes” buttons again to see the changes.

At the bottom, you trigger then the generation of the final heightmap. After you pressed “Generate”, the polygonal map disappears and the heightmap is shown. From now on, you can navigate through the 3d scene with the 3d mouse or the controls as described in the previous chapter.

With “Next Step” you proceed to the next step.

If you want to skip the entire first step and start the terrain feature step with an empty map, press “Skip this step”.

## Step 2: Terrain Features

Please wait a little bit after switching to the next step so that they can initialize.

With the middle mouse wheel, the distance of the sketch plane is modified.

When the “Add curve” check box is selected, a new feature curve is started with selecting a point on the sketch plane. The next points are added by clicking on the plane again, the last point is added using a double click (within 0.2sec). A curve must contain at least 2 control points. If you want to cancel the new curve, just switch into the editing mode.

The editing mode is triggered with the “Edit curve” checkbox. Then you can select control points by clicking the spheres representing the control point. Now the edit buttons, checkbox and sliders are enabled.

The solver is started by the “Solve”-button. (The solver is not very optimized, it produces many temporary matrices). While the solver is running, the camera is locked.

After solving, switch to the next step with the “Next Step” button (as the name suggests ☺ )

## Step 3: Erosion

Because the hydrology simulation works better on more detailed maps, you can upscale the map first. Do this as the first step only! It will overwrite all changes to temperature and moisture. I recommend a map size of 1024 or 2048 for the simulation.

With the checkboxes “Show+Edit Temperature” and Show+Edit Moisture”, the temperature/moisture is displayed and can be edited. As in the polygonal map, press left / right mouse button and drag it over the scene. The brush size is specified with the slider below.

You can also add river sources when the associated checkbox is selected. Then just click on the terrain to place a new river. It uses the intensity and radius settings from the sliders below. When the edit-checkbox is selected, the river sources are picked by clicking on the spheres indicating the river sources. You can the edit the radius and intensity afterwards.

The simulation is started with the “Run”-button. Note: unlike the feature solver, the camera is not automatically locked. Lock the camera with the L button. “Stop” stops the simulation, “Reset” resets it to the original state. When the “Show Erosion and Deposition” checkbox is selected after “Stop”, you can see the effect of the erosion (black: erosion, white: deposition). The checkboxes “Rain” and “River” toggle the increase of water due to rainfall or river sources. “Delete Water” deletes all current water and sediment in the running simulation.

## Step 4: Vegetation

In the last step you can edit the biomes and the vegetation.

I first recommend to distort the biome borders with the “Distort Borders” button and smooth them afterwards with “Smooth Borders”.

Then you can directly edit the biomes. You select the current biome by clicking at the associated cell in the biomes diagram. Then the biome is painted on the map by left-click the mouse and drag it. As always, the brush size can be customized.

With the checkbox “Show Textures” checked, the terrain is rendered using the final textures. Note that some biomes use the same texture. (I haven’t found good textures for every biome).

The slider “Plant size” specifies the size of the plants: a larger values generates larger trees and grass, a lower value smaller ones. This specifies a kind of heightmap-size <-> real-world-size factor.

With the checkboxes “Show grass” and “show trees”, grass and trees are rendered. It takes time to generate them, so please be patient. If you change the plant size or biomes afterwards, you have to regenerate grass and trees by deselecting the checkboxes and selecting them again.

# Movies

Instead of one single, big movie, I submitted multiple shorter movies showing the individual steps. This makes it easier for me to record. The movies are found in the movies/ folder. I hope you can open them. The recording was a mess and the compression is really bad (this is why they are so huge). Note: Except for the first step, they are not always realtime, especially the erosion solver is very slow.