A Procedural, Minimal Input, Natural Terrain Plug-in for Blender

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Abstract

This project uses methods of terrain representation, creation and realism described in literature. We find that using a combination of Fractional Brownian Motion and procedural formation of rivers via squig curves to form initial terrain, with hydraulic erosion for post processing, we have full control over the style of terrain: from jagged mountains to flat regions; and the phase of river from tightly rock controlled to flood plain regions.

1 Introduction

In an effort to increase the richness of virtual worlds, the goal of this project is to create realistic, natural terrain with minimal input, but yet to be as configurable as possible so as to allow for a multitude of scenes to be created. A Text-to-Scene converter also being developed, takes text as an input and can then derive a three dimensional world from this, with the ultimate goal of being able to fully automate movie production from scripts of text. This project aims to address the needs of the Text-to-Scene converter for terrain, by being able to configure areas for city placement and action areas while being able to fill in the rest. Procedural methods have been chosen for use with this project to fit with the minimal input paradigm, which means that no pre-existing data needs to exist for the terrain generation. The configurability of the procedural methods lies in the control through parameters.

2 Procedural Methods and their Implementation in Blender

Heightmaps were used to represent the terrain as a two dimensional matrix of coordinates in which the height of the terrain above the base level is represented as a number at each coordinate [Benes and Forsbach 2001]. We extend it to include the three erosion constants for each position so as to be able to model areas being harder than others [Musgrave et al. 1989].

Fractional Brownian Motion (fBm) is used to synthesize an inital heightmap. fBm is generated by sampling Perlin Noise at multiple frequencies and applying translation and scaling onto the values, and is entirely reproducible [Musgrave et al. 1989]. By altering parameters, we can control the formation of the terrain. Two values that we tweak are: the input vertex position, which can be scaled to create more rapidly or slowly changing terrain; and the scaling on the output value, which can make for higher, more jagged terrain with higher values.

Squig curves are used to create procedural rivers. The technique works by randomly assigning edges (entry, exit and neutral) to an initial triangle, subdividing and assigning edges according to a ruleset [Prusinkiewicz and Hammel 1993]. This process is repeated recursively. By tracing from the midpoint of entry to exit edges, it gives a fairly reasonable representation of a winding river [Prusinkiewicz and Hammel 1993].

In order to integrate with the Text-To-Scene and city creation project, areas need to be flattened for city placement and action areas in the scene. If a point is within a specified radius, a cosine function is used to create a flattened area. The values produced are between zero and one, which can then be used to smoothly interpolate flat areas with the rest of the terrain.

Hydraulic erosion is used as a post-processing technique to increase the realism of the terrain by distributing water and sediment contained therein proportionally to height differences [Musgrave et al. 1989]. The erosion method also implements evaporation with an exponential method to prevent pools of stagnant water building up [Benes and Forsbach 2002]. The method will continue to run after the amount of timesteps specified, until all the water has evaporated, as this gives the sediment contained in the water time to settle.

3 Conclusion

The project is capable of producing terrain with minimal input, and is very configurable yet very simple. A multitude of scenes can be created by altering parameters, in particular offsetting the fBm would create completely different regions, but also the squig curve river generation which is completely random within its ruleset. With erosion procedures as well as configurable control of all parameters the project is capable of producing realistic, natural terrain.

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