**Investigating a real-time Hydraulic Erosion Simulation to be used for terrain generation in games**

1 Introduction

This portfolio project will contain an investigation into real-time hydraulic erosion when creating realistic terrain in video games and a program that will use techniques found in the investigation to create a real-time hydraulic erosion simulation. Terrain is one of the most important aspects of emulating a realistic virtual experience whether it’s in a computer game that requires a large-scale terrain for an open world experience, a movie that requires a fantasy style location that might be too dangerous to film in or a training simulation that requires the most realistic environment to help train people.

1.1 Aims and Goals

What needs to be achieved

2 Literature Review

2.1 Terrain Generation

Generating realistic terrain for games is a long and time-consuming process. To solve this problem developers have found quicker and more effective ways for generating realistic terrain. When talking about terrain generation the first step is how that data is represented. Terrain data can be represented with two main models. These being a volumetric model and an elevation model.

The elevation model can be described with either an elevation function or a discrete heightfield. The most commonly used method is the discrete heightfield. The discrete heightfield uses a two-dimensional grid to represent the altitude of each position. This means that it is unable to recreate suspended materials like overhangs, caves, and arches. But it is a lot less data heavy which allows a simulation to be ran a lot faster with more data to work with. The elevation function uses a formula that can generate a point of altitude of any point in terrain. This method is mostly used when procedurally generating terrain. The most used elevation functions are Perlin noise or Simplex noise.

The volumetric model is similar to the elevation model but instead of using two-dimensional space it uses voxels which allow for a three-dimensional space where each cell represents a material at a particular position. This allows for the use of features like overhangs, caves, and arches. Volumetric models are very data heavy which makes them slower to run. There are ways to optimize the data structure by using compression techniques like Sparse Voxel Octrees to reduce the memory cost. This is done using an octree. An octree is where a three-dimensional space gets recursively divided into subspaces of children nodes until each voxel only contains one point or multiple point of similar data. This technique can be used in open world games which require real time interaction.

The next step is the talk about how the terrain data can be acquired. This can be done user inputting premade data or by a program generating its own data also known as procedurally generated data. What we are going to talk about is different method for procedurally generated data. These methods include, subdivision based and fractal noise methods such as Perlin noise.

2.2 Water/Fluid Simulation

INTRO TO WATER. There are two main methods for simulating water. These are grid based and particle based. Both grid-based and particle-based methods have their own advantages and disadvantages that make them better suited for different scenarios.

(FIRST TALK ABOUT PARTICAL BASED METHODS).

(NOW GRID BASED METHODS)

2.3 Erosion Algorithms

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3 Design