Procedural generation of continuous roads on heightmaps

Introduction

Given two positions on a heightmap, it can be a useful tool to procedurally connect these two positions with a road that is steady in each height and curvature. By simulating rain on this heightmap, also called terrain, a path for the road can be found by following the simulated behaviour and flow direction of the warter.

Implementation

The first and trivial step will be the procedural terrain generation. As for a given 2D-position (x,y) the height can be calculated using a perlin noise function without regarding adjacent positions, this problem is easy to parallelize and therefore can be implemented pretty straightforward in OpenCL.

The interesting part is the generation of the road. To model the start and end points which should be connected by the road, the terrain can be lowered at these positions. To maintain the continuity of the terrain, the adjacent positions need to be altered in their height as well, which then affects their adjacent positions as well and so on. This problem is related to the cloth assignment, where particles were simulated.

As soon as the terrain has converged to a stable state, rain will be simulated on the altered terrain. Since water is affected by gravity, the rain should then fill the terrain with water, which eventually will reach the end-points of the road, since they were lowered in the first step. When establishing a path that the water particles take to reach these end-points, a continuous path should emerge connecting both the end-points of the road, which can then be replaced by a street connecting both points in a continuous way each in height and curvature.

In both steps, the terrain modification and the rain simulation, particle simulation will be used, which offers great use of massive parallel GPUs. The challenge in the first step will be the interaction of particles since they have local effect on other particles. The challenge in the second step will be an efficient access to the heightmap for each particles and calculating collisions.

Evaluation and Results

The expected result of this project is a algorithm to calculate a continuous road between two given positions on either a given or generated continuous terrain (heightmap).

To evaluate the project, it can be considered the speedup when using more particles for rain simulation, as well as the speedup for the terrain manipulation when more computational units are available.

Resources

- Modified Noise for Evaluation on Graphics Hardware - Olano, Marc