An Investigation into the Effects of Environmental Deformation Over Time Using Node-Based River and Sediment Simulation

## Rationale

Simulation of rivers has always proven difficult when creating a virtual landscape. Several models exist to mimic the flow of water (The Lattice-Boltzman algorithm(1) is a commonly used example.) Many approaches to water simulation stray away from particle-or-node based systems, favouring vector-based approximations to calculate both path and flow(2).

A node-based flow simulations allow simulation of deformation of landscape features, and the transfer of sediment(3). Such a system could, over time, allow for the creation of complex geographical features found in rivers (such as ox-bow lakes(4)) and allow for natural-looking landscapes to be created by running the simulation on any terrain.

In this portfolio project, I will create a tool that allows for the generation of a landscape, which is then deformed over time by the movement of water- simulating both natural springs and rainfall. This should provide an environment for the natural generation of real-world features that are sparsely seen in digital representations of rivers. Features like bank erosion and sediment transfer(5) are rarely present due to their complexity(6) and computational intensity(7).

## Literature Review

Various studies into the potential paths of rivers exist for flooding avoidance(8). As flooding poses a significant risk in some areas, they are regularly monitored and simulated to prevent damage to infrastructure(9). While my aim is not to simulate existing rivers and instead focus on the landscape deformation over many years, pre-existing tools for flood avoidance can prove to be useful sources for my investigation, as they tackle similar concepts(10).

A study into the erosion of landscape by Nicholas McDonald(3) tackles some similar concepts to my investigation. However, this study lacks a soil map to allow for different densities of soil and sediment for its nodes. I intend to use a soil map for increased real-world accuracy, tracking different forms of sediment and their transfer(11).

Studies into fluid dynamics can tackle simulation of a range of issues(12). Editors have been created to simulate physics in games through real-time editing(13), studies into terrain generation based on pre-existing river splines exist(14), and forms of fluid dynamics models have existed for centuries, since the time of Archimedes(15).

Studies also exist into the usage of real-time terrain creation and destruction, and the effect of it on water flow. However, I intend to use pre-generated landscapes as opposed to real-time generation, so this is not something to consider for this project(16).

## Aims and Objectives

# References

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