Project: Quantum Procedural Generation of Video Game Maps

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Project Motivation and Proposal

- Computer graphics of natural phenomenon oftentimes suffer from an overly "machine-like" appearance. Mountain ranges, for example, may appear more rigid or blocky than one would normally expect, while ripples of water appear too structured or pattern-like. For video games that procedurally generated worlds for players to explore, the ability to generate random but natural looking terrain maps is essential.
- The classic solution to this problem of creating graphics for natural systems is to add procedural noise to the rendering of such visual effects. There are several algorithms for adding such complexity to the textures of graphical surfaces, including Worley noise (1), Perlin noise (2), and Simplex noise (3). Perlin noise was the first of these noise algorithms to be invented and the most computationally complex (running in exponential time with respect to the dimensions of the grid used to generate the noise). Perlin noise was superseded by Simplex noise, which takes a slightly different computational approach to noise generation and is thus able to achieve exponential speed-up on a classical computer. The trade-off is that this speed-up results in slightly different noise patterns, however, and also precludes the possibility of directly modifying Perlin's original algorithm to achieve different textural patterns. For example, a 2015 study which examined actual elevation data in the U.S. modified the distributional assumptions of Perlin's algorithm to an exponential distribution and therefore was able to more accurately model the texture of real-world terrain (4).
- Thus, for our project we hope to use quantum algorithms to speed up Perlin's original exponential-time algorithm, as well as the various "spin-offs" of Perlin's algorithm that more accurately model the real world, i.e. the version of Perlin's which uses an exponential distribution to model noise, as well as other potential distributions for terrain that have been identified in geological literature (5).
- With these speed-ups we hope to procedurally generate an island map for a hypothetical video game. If successful, we could thereby demonstrate how quantum speed-ups allow for faster and less resource-intensive graphics generation, and potentially allow for more interesting and natural-looking terrains since classical computers must often take shortcuts that lead to less natural-looking noise.
- As a final deliverable, we hope to create a Jupyter Notebook that can procedurally generate a natural-looking island map faster than a classical computer could accomplish.

References

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