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CPSC 4780

6 December 2020

Marched Fractals

Our project combines two algorithms, Fractal Flames and Marching Cubes, to create meshes of fractals generated from parameters. While typical fractals have geometry emphasizing repeated patterns, Fractal Flames uses a “chaotic attractor” to create geometry with common features (Draves).

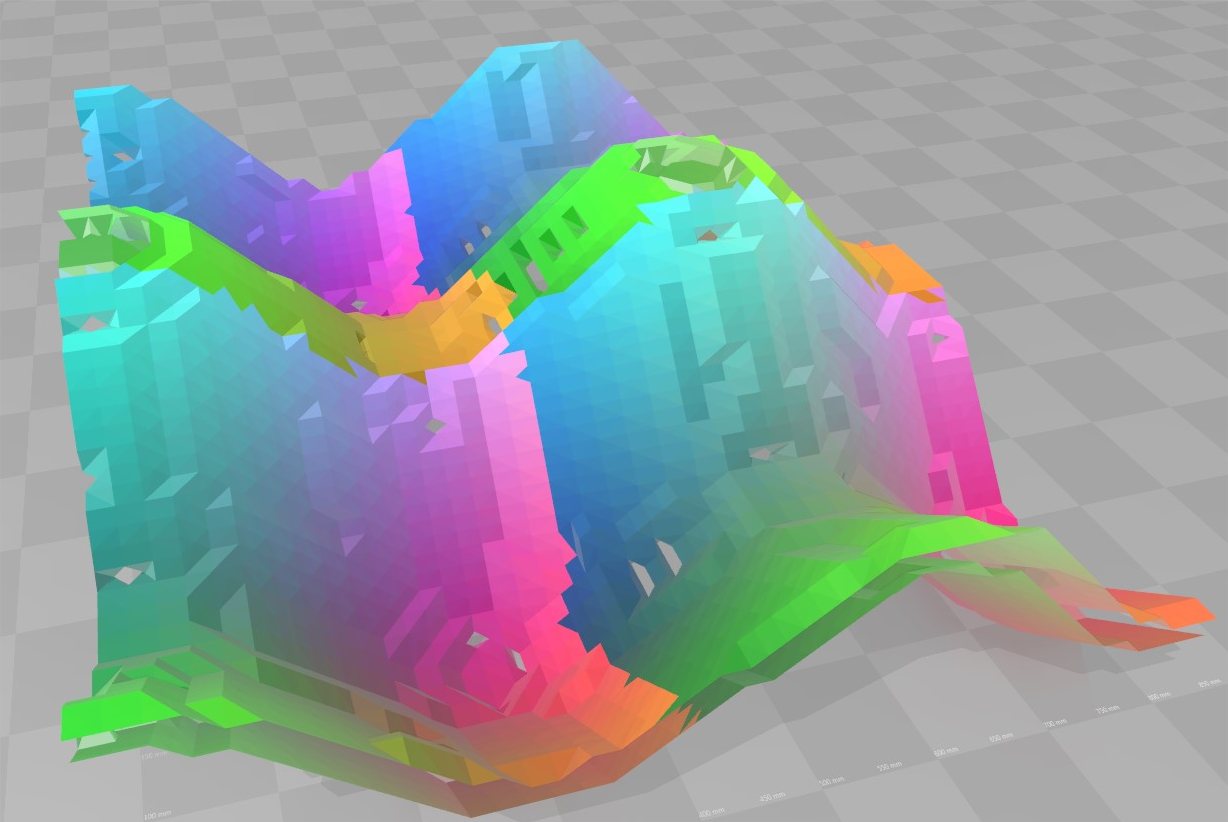
In 2 dimensions, Fractal Flames is able generate a flame-like, organic image by randomly selecting from a list of parameterized functions. We apply this algorithm in 3 dimensions to create a point cloud with color information. Once the colored point cloud has been created, we move to the visualization process, which requires the creation of a mesh. Marching Cubes is commonly used to acquire a polygonal mesh from a scalar field. In our project, this scalar field is a 3d grid containing points which are either on or off. The randomly distributed points from the Fractal Flames algorithm are then matched to the nearest grid point. This process activates the matched grid points into an on state and inscribes color alongside it.

The Fractal Flames implementation does this.

The Marching Cubes implementation converts unorganized vertices into a grid and grid points into cubes, or cells. Faces are calculated for each of these cells in parallel. These faces represent the surface of the defined shape. A list of triangles and edges are used to compute the individual faces inside a cell by evaluating the on/off state of each cell corner vertex. The final product is a mesh with vertices, triangles dictating the connection between vertices, and unique colors per face.

In order to parallelize the Marching Cubes algorithm, the information must for a cell must be transferred to the device. In my implementation, the cell information was transferred on the host and immediately run on the device to get the faces. A more optimal way to accomplish this would be passing the entire grid to the device as the global problem size and having the size of a cell as the local problem size. Due to indexing errors, however, achieving this optimal method was highly challenging.

The following images are were created by marching:



sin(x) + cos(z)

Works Cited

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