Animated Water with Perlin Noise

Arik Coats and Evan Dye

Project Description

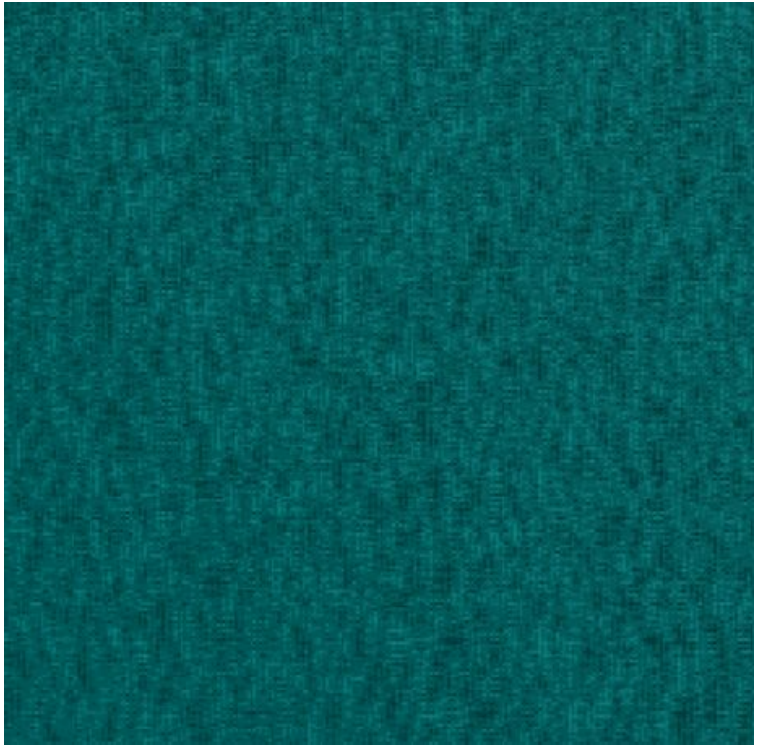
The purpose of our project is to create a scene modeling a shifting water surface. To do this, we used perlin noise to:

- Animate a dynamic height map
- Animate a dynamic normal map.

The height map and normal map are applied to a reflective, semi-transparent light blue plane to simulate the water. The scene also includes a skybox, directional light and island to simulate an environment.

Perlin Noise

- Generate a “random” value for each (x,y) pair.
  - Map to the four integer corners.
    - (i.e. (x,y), (x+1,y), (x,y+1), (x+1,y+1))
  - Compute the dot product with the gradient mapped to each corner.
    - For 2D, gradients are on the unit circle.
  - Interpolate based on the fractional values.
- Repeat for the desired number of octaves and sum the results, factoring in persistence.
- Generate a normal map from these values.



Height Map

Adjust individual vertex heights to simulate small waves and turbulence.

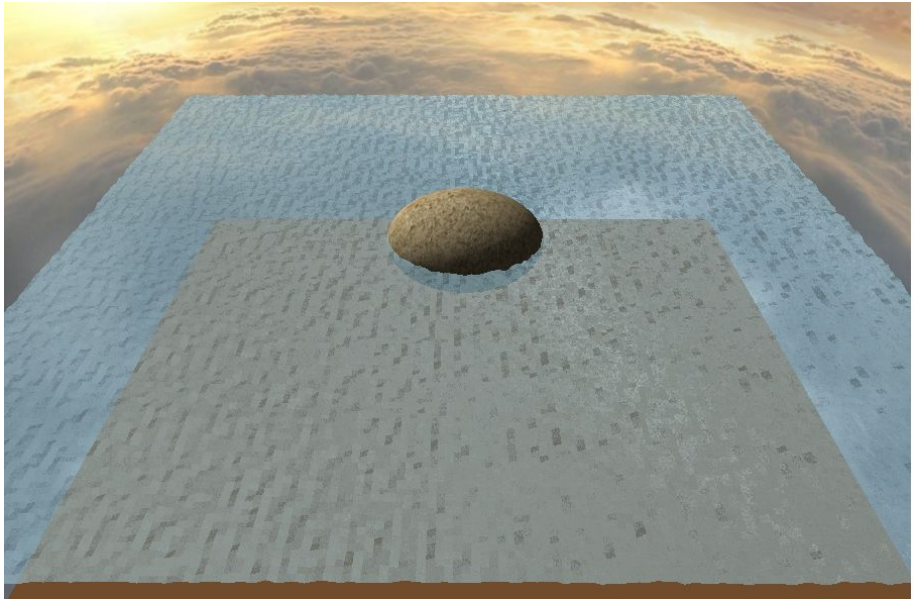
- Map a vertex height to a value in Perlin noise array using its index and an offset.
  - Increment the offset to get continuous dynamic values.
- Smooth transition between vertices.
  - Define minimum and maximum height for a vertex and a maximum transition range.
    - Calculate change in vertex height by interpolating between 0 and the maximum transition range.
    - e.g. A vertex could have a height from -2 to 2 but can only move 0.5 units maximum at a time.
  - Use a weighted average for the new vertex height favoring the new generated value over the height value of the previous vertex.

Normal Map

Adjust normal vectors to simulate water on a 2-dimensional surface

- Used Perlin noise array to build an array of vertex normals
  - Used the same index + offset strategy to generate continuous dynamic values.
- Used new array to construct a DataTexture to use as a normal map.
- Generate new normal map each frame to simulate flowing water.

Putting it all Together



No external textures used for water. The water is generated from an array of perlin noise.

A dynamic height map.

A dynamic normal map.

Potential Improvements

Advanced water motion, like waves.

Move calculations to shaders to improve performance.

Normal map only versions.

Questions?