Rendering Hypercomplex Fractals

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Chaos

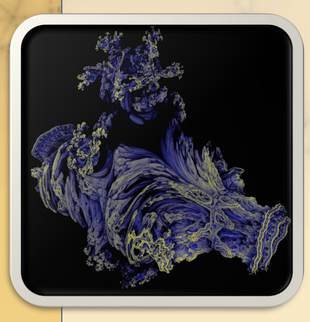
Fractal mathematics and geometry are useful for applications in science, engineering, and art, but acquiring the tools to explore and graph fractals can be frustrating. Tools available online have limited fractals, rendering methods, and shaders. They often fail to abstract these concepts in a reusable way. Chaos is an extensible, abstract fractal geometry rendering program created to solve this problem. Chaos is implemented in Java for PC and Android. It utilizes OpenGL 4.0 and OpenGL ES 2.0 to provide hardware acceleration. Chaos exports images and video.

Fractals

Recursive

The tree fractal and the Cantor set draw during each recursive call. The branches of the tree fractal get shorter with each recursion. Drawing stops when a threshold length is reached.

Iterative



Escape-time fractals test each point in a plane or space. Each iteration moves the point. When the point escapes a threshold distance from the origin the number of iterations is returned.

Rendering

Drawing

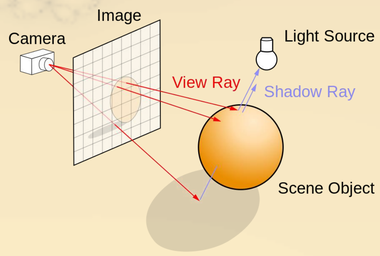
A drawing context is used to manipulate a fixed function pipeline.

Complex Plot

A function is graphed on the complex plot by first scaling, translating, and rotating a pixel to graph coordinates. Finally, the returned coordinate is used as input to a complex function.

Ray-Marching

Rays are iteratively extended from the camera through a viewing plane. Collisions with geometry in the scene are detected using signed-distance functions at each iteration.



Shading

Iterative

Pixels are shaded based on the escape-time or ray length. Variations can be created by using more information from the calculation and rendering processes.

Random

Pixels are shaded randomly, resembling television static.

Conclusions

Fractals, renderers, and shaders should be abstracted from each other to ensure maximum extensibility and code reusability. OpenGL shader programs should be written in layers that complete one task each and abstractly reference each other through an interface pattern.

Chaos is a useful application to test and model new and existing fractal systems. Chaos is also a useful tool for quickly creating high resolution computer generated artwork.

Gallery