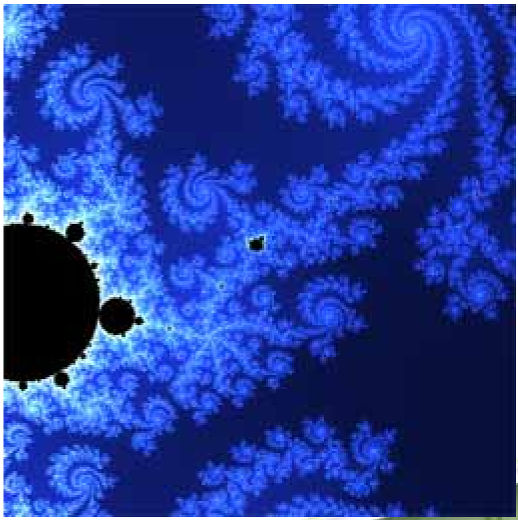
NVIDIA

Technical Report

Mandelbrot



DEVELOPMENT

Mandelbrot Sample

The latest generation of programmable graphics processors can render to and read from floating-point precision render target textures. This allows the iterative calculations which give rise to fractal images to be performed on the GPU. Microsoft's Direct3D pixel shaders 3.0 support conditional branching, which can be used during the iterative calculations to skip execution on portions of the image that are finished.

In this sample, two FP32 render-target textures are used alternately as the source and destination for the results of the computations. The red and green components of the texture hold the orbit point, blue holds the iteration count, and alpha is set to 0 or 1 depending on whether or not the orbit point has escaped to a large radius. Each rendering pass computes several iterations of the fractal-generating algorithm in order to increase the benefit of conditional branching and to increase the number of iterations performed relative to the texture fetch and rasterization costs. The program could generate the images faster if the iteration count per rendering pass were increased and also if the frequency of visualization passes were reduced.

To visualize the fractal, a simple pixel shader calculates a color ramp based on the blue channel iteration count. This is done repeatedly after every few iterations, so you can see the fractal image emerge over time. The sample can generate Mandelbrot set and Julia set fractals. See the references below for more information about fractal images.

Bibliography

1. Heinz-Otto Peitgen, Dietmar Saupe, ed., “The Science of Fractal Images,” Springer-Verlag, New York, 1988, p. 198
2. NVIDIA Developer Web site: 2003. http://developer.nvidia.com

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