The OpenRT Real-Time Ray-Tracing Project

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Project Summary

- **Origin**
  - RTRT realtime-raytracing project of the University of Saarbruecken (http://graphics.cs.uni-sb.de)

- **Goal**
  - To develop ray that offers an alternative to the current rasterization based approach for interactive 3D graphics.

- **Consists of**
  - Highly optimized ray-tracing core.
  - OpenRT-API, similar to OpenGL.
  - Many applications.
Interactive Caustics

- Real-time photon mapping
  - Real-time ray tracing.
  - Optimized and improved photon mapping algorithms.
  - Efficient parallelization across commodity PCs.
- Performance of up to 22 fps
Interactive Caustics
Dynamic Scenes

Three classes of objects

- Static objects are treated as before.
- Objects undergoing affine transformations are handled by transforming rays.
- Objects with unstructured motion are rebuilt whenever necessary.
Dynamic Scenes
Computer Games

- Transparenly hides the actual implementation of the ray tracer.
- SaarCOR is a first prototype of a graphics board purely based on ray tracing.
Interactive Global Illumination

- More than 20 fps for simple scenes.
- Support lighting simulation in complex scenes with more than 50 million triangles.
Interactive Global Illumination
The MassiveRT Project

I Render "Boeing 777" model containing more than 350 million triangles at several frames per second even on a single PC.
Physically-Correct Lighting Simulation
Volume Ray Tracing

- Up to 7 fps on a standard PC for mid-sized volume models (say $256^3$) and resolution of $512 \times 512$. Three techniques
  - Isosurface Rendering.
  - Maximum Intensity Projection.
  - Direct Volume Rendering.
Volume Ray Tracing
Related Publications

- Interactive Rendering with Coherent Ray Tracing (2001)
  - Present a highly optimized implementation.
  - Better use of computational resources such as caches and SIMD instructions.
  - Better exploits image and object space coherence (Multiple rays in parallel).
  - Brief overview of the benefits of ray tracing over rasterization algorithms.

- Interactive Distributed Ray-Tracing of Highly Complex Models (2001)
  - Coherent ray tracing.
  - Caching of BSP voxels.

- Offers an extended OpenGL-like API.
- Interactive Performance, Plug-in Shaders, Distributed Computing, Dynamic Scenes, Commodity Equipment.

Interactive Global Illumination (2002)

- Monte Carlo-based global illumination algorithm.
- Efficiently simulates direct and mostly-diffuse interreflection as well as caustic effects.
Related Publications

  11 21 fps on 8 18 dual-AMD AthlonMP 1800+ PCs.

Realtime Ray Tracing and Interactive Global Illumination (2005)
  Efficiently combines realtime ray tracing.
  Optimized and improved photon mapping algorithms.
  Efficient parallelization across commodity PCs.
  Preprocessing: Photon Map Generation.
RPU: A Programmable Ray Processing Unit for Realtime Ray Tracing (2005)

- Describe the architecture and a prototype implementation of fully programmable Ray Processing Unit (RPU).
- Combines flexibility of general purpose CPUs with the efficiency of current GPUs for data parallel computations.

And many application papers. (2005, 2006)
OpenRT Product

- NOT Open Source Project nor Open Source.
- Noncommercial Version is released.
- Only academic usage is allowed without support.
- Commercial Version is available with support.