A FAST FORWARD THROUGH RAY TRACING GEMS

Eric Haines, Distinguished Engineer | March 21, 2019 | Talk S9872
There is an old joke that goes, “Ray tracing is the technology of the future, and it always will be!”

- David Kirk, March 2008
RAY TRACING GEMS

http://raytracinggems.com

- Table of Contents, links, and what this talk is mostly about.

Proposed by Tomas Akenine-Möller, co-editor, in Spring 2018.

Like other “Gems” books: provide tools and case studies.

32 papers accepted, 64 authors, 652 pages.

Tight schedule: papers received October 15, finished book proof done February 12. 121 days.

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PART I
RAY TRACING BASICS

Edited by Chris Wyman
RAY TRACING TERMINOLOGY

by Eric Haines and Peter Shirley
WHAT IS A RAY?
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INTRODUCTION TO DIRECTX RAYTRACING

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INTERSECTIONS AND EFFICIENCY

Edited by Ingo Wald
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by Carsten Wächter and Nikolaus Binder
With a trembling arm shoot an arrow at a coin - so are ray and sphere.
PRECISION IMPROVEMENTS FOR RAY/SPHERE INTERSECTION

by Eric Haines, Johannes Günther, and Tomas Akenine-Möller
COOL PATCHES: A GEOMETRIC APPROACH TO RAY/BILINEAR PATCH INTERSECTIONS

by Alexander Reshetov

```c
1 RT_PROGRAM void intersectPatch(int prim_idx) {
2    // ray is rtDeclareVariable(ray, ray, rtCurrentRay,) in OptiX
3    // patchdata is optix:rtBuffer
4    const PatchData& patch = patchdata[prim_idx];
5    const float3* a = patch.coefficients();
6    // 4 corners = "normal" qn
7    float3 o00 = a[0], q10 = a[1], q11 = a[2], q01 = a[3];
8    float3 e10 = q10 - q00; // q01 --------- q11
9    float3 e11 = q11 - q10; // q10
10    float3 e00 = q01 - q00; // | e00 e11 | we precompute
11    float3 qn = q[4]; // | e10 |
12    float q00 = ray.origin; // q00 0 q01 q01-q11
13    q00 = ray.origin +
14    float a = dot(cross(q00, ray.direction), e00); // the equation is
15    float c = dot(qn, ray.direction); // a = b u + c u^2
16    float b = dot(cross(q10, ray.direction), e11); // first compute
17    b = a + c; // abc & and then b
18    float det = b*b - 4*a*c;
19    if (det < 0) return; // see the right part of Figure 5
20    det = sqrt(det); // we -use_fast_math in CUDA_NVTC_OPTIONS
21    float u1, u2; // the roots(u parameter)
22    float t = ray.tmax, u, v; // need solution for the smallest t > 0
23    if (c == 0) {
24        u1 = -a/b; u2 = -1; // and there is only one root
25    } else {
26        u1 = (-b - copySign(det, b))/2; // numerically "stable" root
27        u2 = a/u1;
28        u1 /= c;
29    }
30    if (0 <= u1 && u1 <= 1) {
31        float3 pa = lerp(q00, q10, u1);
32        float3 pb = lerp(q00, q11, u1);
33        float3 n = cross(ray.direction, pb);
34        det = dot(n, n);
35        n = cross(n, pa);
36        float t1 = dot(n, pb);
37        float v1 = dot(n, ray.direction);
38        if (1 > t1) return; // no need to check t1 < t
39        if (t1 > 0 && 0 < v1 && v1 < det) {
40            t = t1/det; // if t1 > ray.tmax,
41            t = t/det; // it will be rejected
42        }
43    }
44}
```
MULTI-HIT RAY TRACING IN DXR
by Christiaan Gribble
A SIMPLE LOAD-BALANCING SCHEME WITH HIGH SCALING EFFICIENCY

by Dietger van Antwerpen, Daniel Seibert, and Alexander Keller
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by Matt Pharr
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by Pierre Moreau and Petrik Clarberg
CINEMATIC RENDERING IN UE4 WITH REAL-TIME RAY TRACING AND DENOISING
by Edward Liu, Ignacio Llamas, Juan Cañada, and Patrick Kelly

(a) Ray traced shadows
(b) Shadow maps
CINEMATIC RENDERING IN UE4 WITH REAL-TIME RAY TRACING AND DENOISING

by Edward Liu, Ignacio Llamas, Juan Cañada, and Patrick Kelly

(a) Noisy input (1 spp)  
(b) Our spatial denoiser
TEXTURE LEVEL OF DETAIL STRATEGIES FOR REAL-TIME RAY TRACING

by Tomas Akenine-Möller, Jim Nilsson, Magnus Andersson, Colin Barré-Brisebois, Robert Toth, and Tero Karras
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by Tomas Akenine-Möller and Jim Nilsson
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by Johannes Jendersie
ACCURATE REAL-TIME SPECULAR REFLECTIONS WITH RADIANCE CACHING

by Antti Hirvonen, Atte Seppälä, Maksim Aizenshtein, and Niklas Smal
“RT is the future of gaming, so the main focus is now on RT either way.”

- Ben Archard, Metro Exodus programmer

Ray Tracing Gems 2?

raytracinggems.com
THE DANGERS OF RAY TRACING

CAUTION: OBJECT CONTAINS CAUSTICS
QUESTIONS?
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