

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.

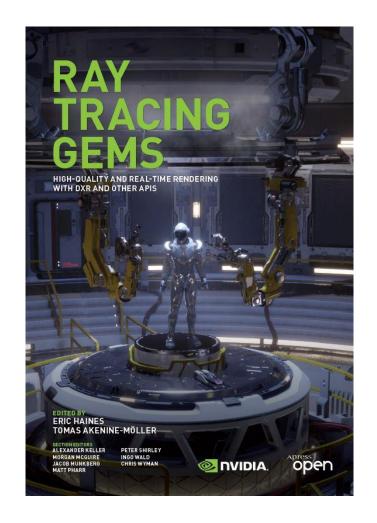
Proposed by Tomas Akenine-Möller, co-editor, in Spring 2018.

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.

Open Access: Articles can be freely redistributed (non-commercial, and attribute the source). Kindle, Google Play.



OTHER RAY TRACING (GEMS) EVENTS

Talks about seven chapters:

Wednesday 2pm - 5:15pm, Room 501AB, Ray Tracing Gems 1.1

Book signing:

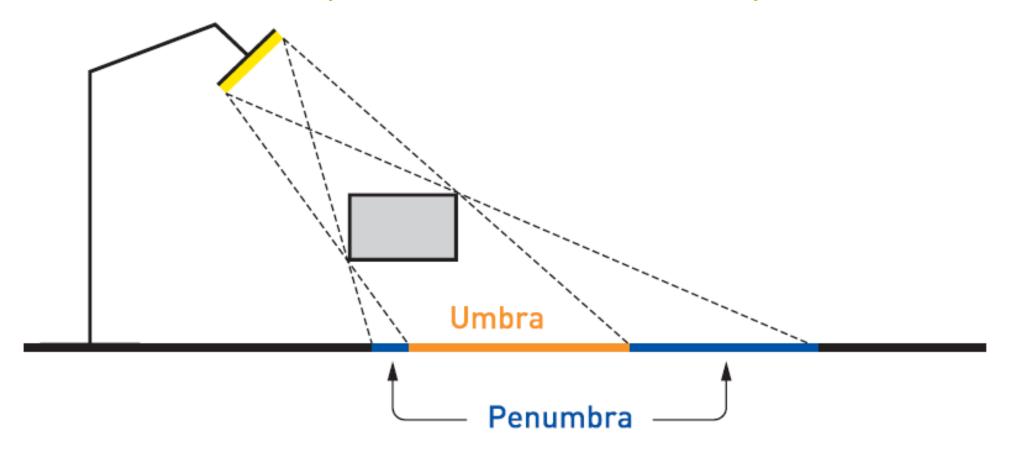
Wednesday 5:30pm - 6pm, SIGGRAPH bookseller, outside Room 403

All ray-tracing related events: http://bit.ly/rtrt2019



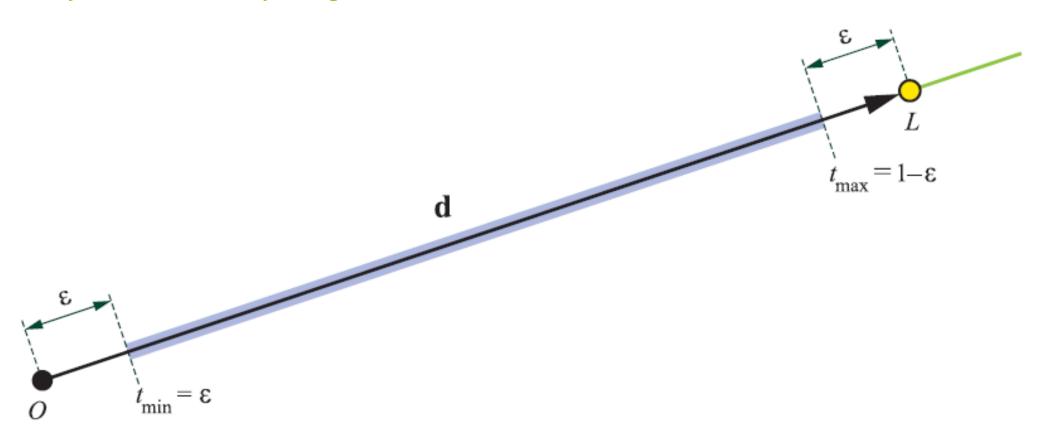
RAY TRACING TERMINOLOGY

by Eric Haines and Peter Shirley



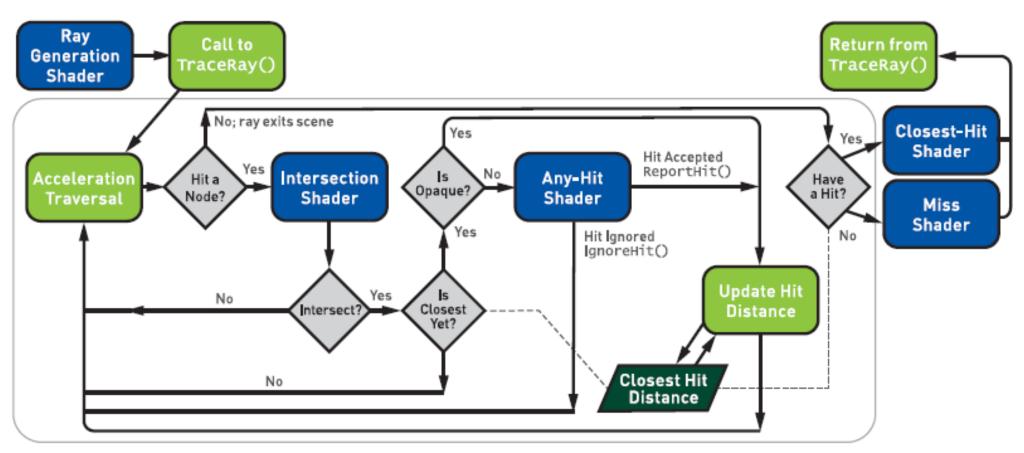
WHAT IS A RAY?

by Peter Shirley, Ingo Wald, Tomas Akenine-Möller, and Eric Haines



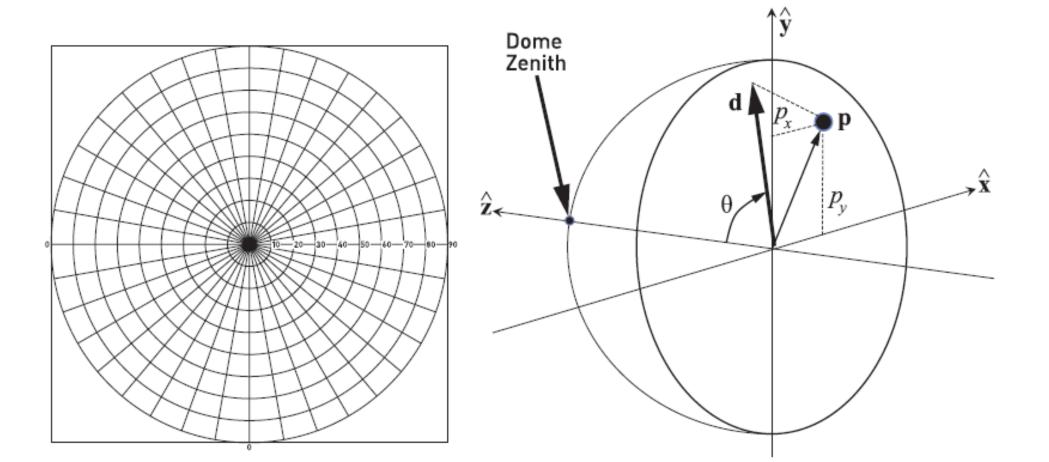
INTRODUCTION TO DIRECTX RAYTRACING

by Chris Wyman and Adam Marrs



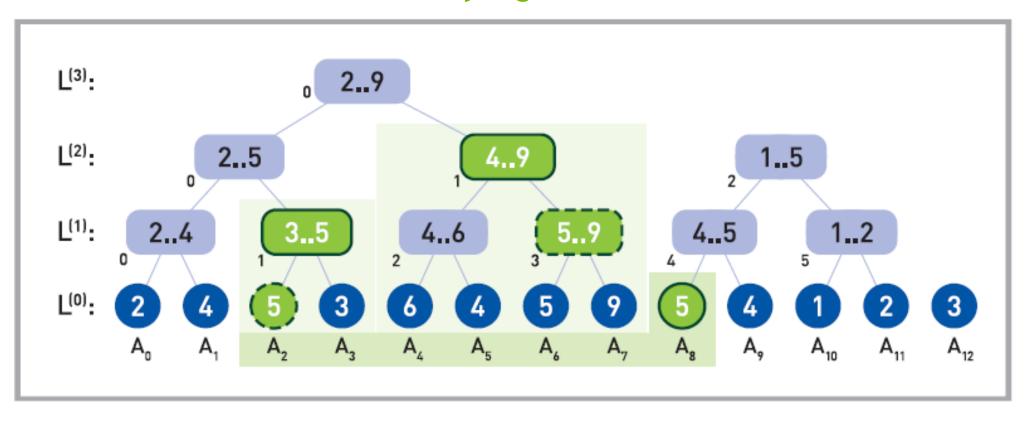
A PLANETARIUM DOME MASTER CAMERA

by John E. Stone



COMPUTING MINIMA AND MAXIMA OF SUBARRAYS

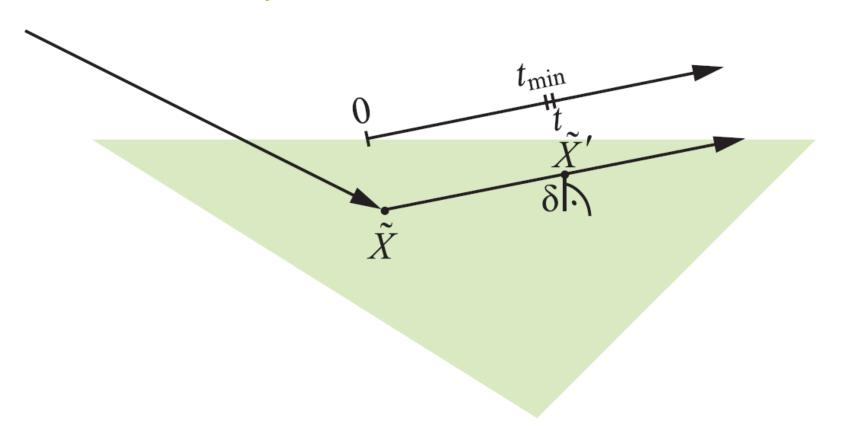
by Ingo Wald





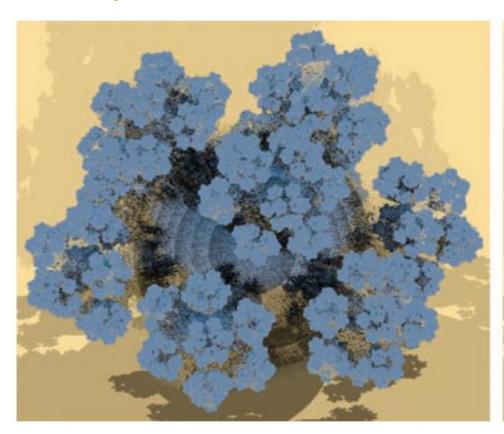
A FAST AND ROBUST METHOD FOR AVOIDING SELF-INTERSECTION

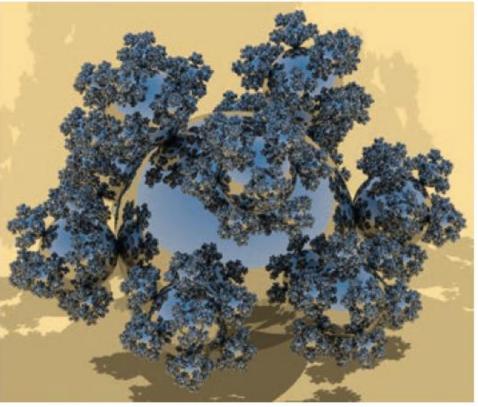
by Carsten Wächter and Nikolaus Binder



PRECISION IMPROVEMENTS FOR RAY/SPHERE INTERSECTION

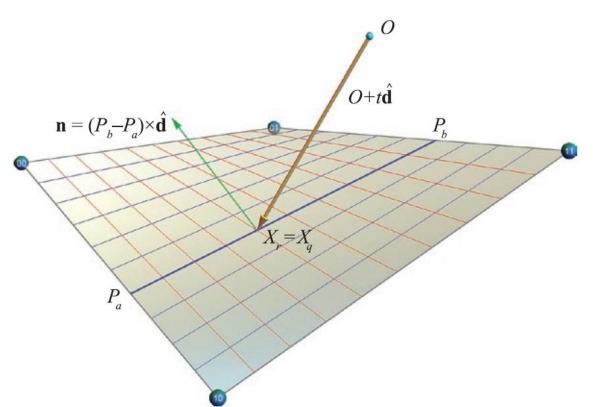
by Eric Haines, Johannes Günther, and Tomas Akenine-Möller





COOL PATCHES: A GEOMETRIC APPROACH TO RAY/BILINEAR PATCH INTERSECTIONS

by Alexander Reshetov

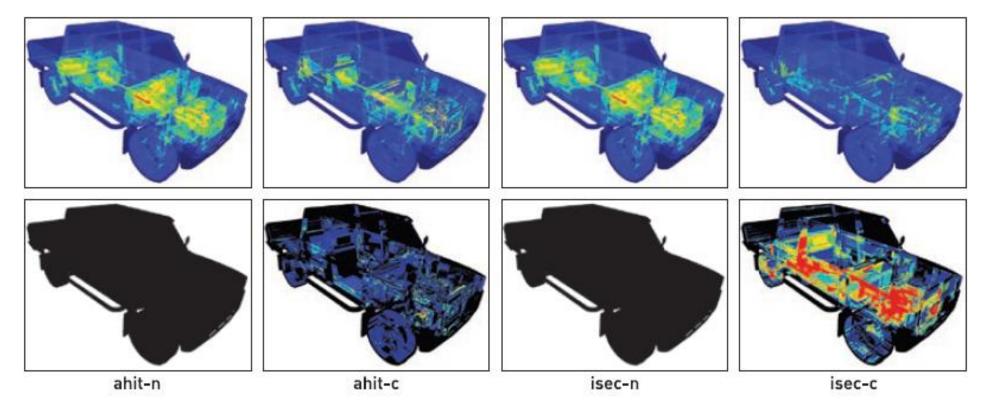


```
1 RT_PROGRAM void intersectPatch(int prim_idx) {
 2 // ray is rtDeclareVariable(Ray, ray, rtCurrentRay,) in OptiX
    // patchdata is optix::rtBuffer
    const PatchData& patch = patchdata[prim_idx];
    const float3* q = patch.coefficients();
    // 4 corners + "normal" qn
    float3 q00 = q[0], q10 = q[1], q11 = q[2], q01 = q[3];
    float3 e10 = q10 - q00; // q01 ----- q11
    float3 e11 = q11 - q10; //
    float3 e00 = q01 - q00; // | e00
    float3 on = q[4]:
                            // | e10
    q00 -= rav.origin:
                                                               q01-q11)
    q10 -= ray.origin;
    float a = dot(cross(q00, ray.direction), e00); // the equation is
    float c = dot(qn, ray.direction);
                                                   // a + b u + c u^2
    float b = dot(cross(q10, ray.direction), e11); // first compute
    b -= a + c;
                                                   // a+b+c and then b
    float det = b*b - 4*a*c:
    if (det < 0) return; // see the right part of Figure 5
    det = sqrt(det);
                             // we -use_fast_math in CUDA_NVRTC_OPTIONS
    float u1, u2;
                            // two roots(u parameter)
    float t = ray.tmax, u, v; // need solution for the smallest t > 0
   if (c == 0) {
                                       // if c == 0, it is a trapezoid
      u1 = -a/b; u2 = -1;
                                       // and there is only one root
                                       // (c != 0 in Stanford models)
      u1 = (-b - copysignf(det, b))/2; // numerically "stable" root
      u2 = a/u1;
                                       // Viete's formula for u1*u2
      u1 /= c:
29
   if (0 <= u1 && u1 <= 1) {
                                          // is it inside the patch?
      float3 pa = lerp(q00, q10, u1);
                                          // point on edge e10 (Fig. 4)
      float3 pb = lerp(e00, e11, u1);
                                          // it is, actually, pb - pa
      float3 n = cross(ray.direction, pb);
```

Will be presented Wednesday 2:30 pm, Room 501AB

MULTI-HIT RAY TRACING IN DXR

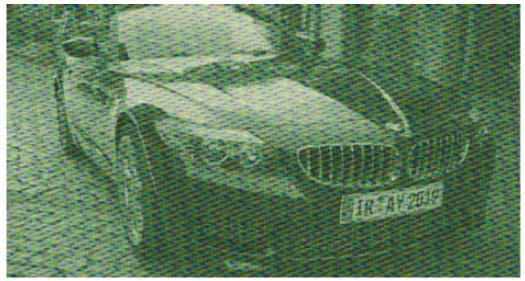
by Christiaan Gribble



A SIMPLE LOAD-BALANCING SCHEME WITH HIGH SCALING EFFICIENCY

by Dietger van Antwerpen, Daniel Seibert, and Alexander Keller



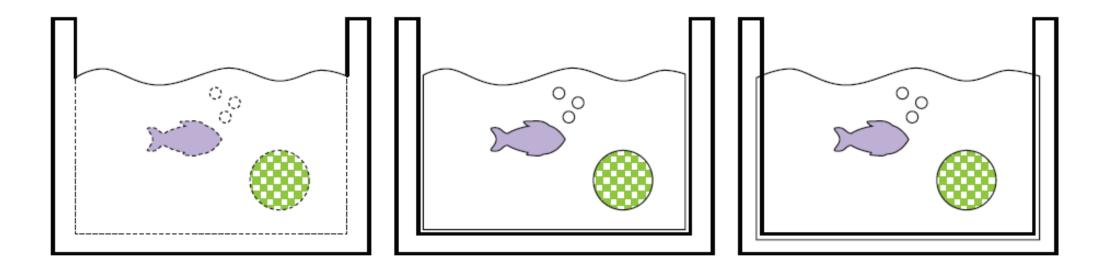


Will be presented Wednesday 2:05 pm, Room 501AB



AUTOMATIC HANDLING OF MATERIALS IN NESTED VOLUMES

by Carsten Wächter and Matthias Raab



A MICROFACET-BASED SHADOWING FUNCTION TO SOLVE THE BUMP TERMINATOR PROBLEM

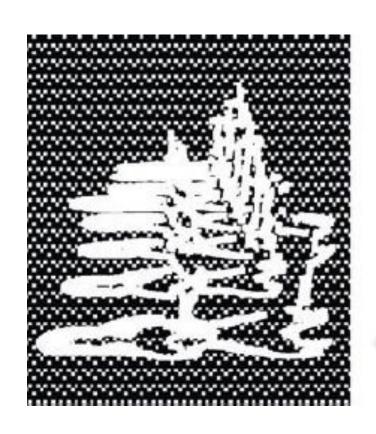
by Alejandro Conty Estevez, Pascal Lecocq, and Clifford Stein



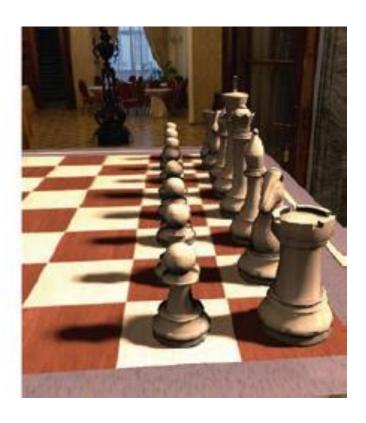
Will be presented Wednesday 2:50 pm, Room 501AB

RAY TRACED SHADOWS: MAINTAINING REAL-TIME FRAME RATES

by Jakub Boksansky, Michael Wimmer, and Jiri Bittner







RAY-GUIDED VOLUMETRIC WATER CAUSTICS IN SINGLE SCATTERING MEDIA WITH DXR

by Holger Gruen







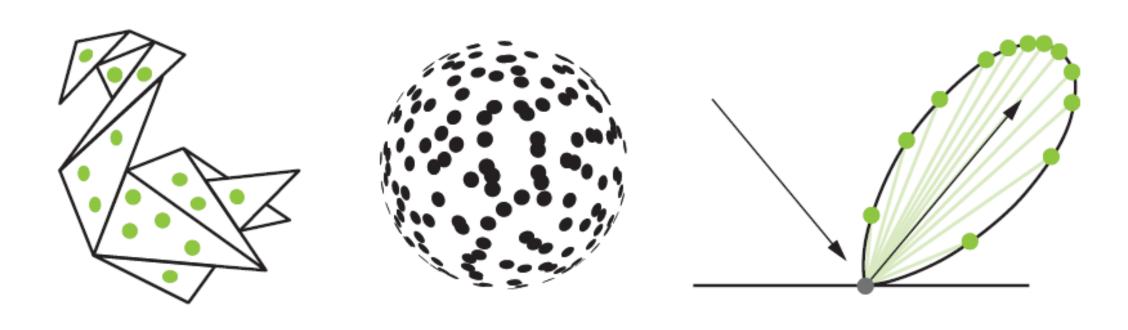
ON THE IMPORTANCE OF SAMPLING

by Matt Pharr



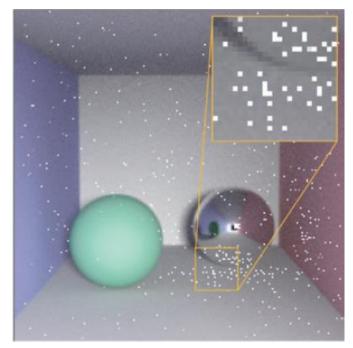
SAMPLE TRANSFORMATIONS ZOO

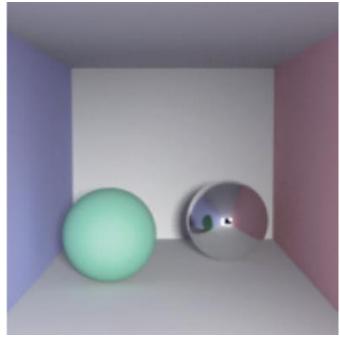
by Peter Shirley, Samuli Laine, David Hart, Matt Pharr, Petrik Clarberg, Eric Haines, Matthias Raab, and David Cline

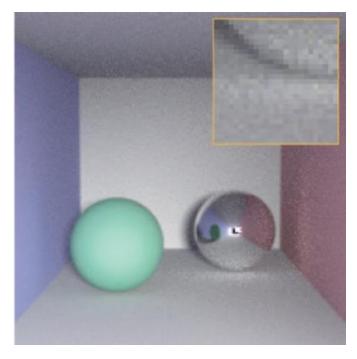


IGNORING THE INCONVENIENT WHEN TRACING RAYS

by Matt Pharr

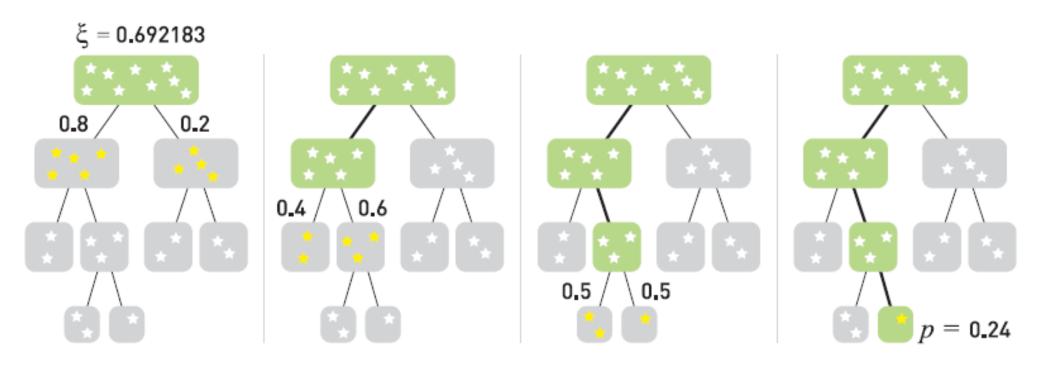






IMPORTANCE SAMPLING OF MANY LIGHTS ON THE GPU

by Pierre Moreau and Petrik Clarberg



Will be presented Wednesday 3:10 pm, Room 501AB



CINEMATIC RENDERING IN UE4 WITH REAL-TIME RAY TRACING AND DENOISING

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



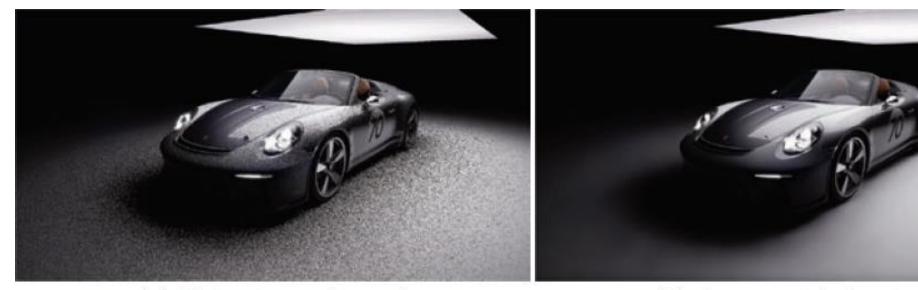
(a) Ray traced shadows

(b) Shadow maps

Will be presented Wednesday 3:55 pm, Room 501AB

CINEMATIC RENDERING IN UE4 WITH REAL-TIME RAY TRACING AND DENOISING

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



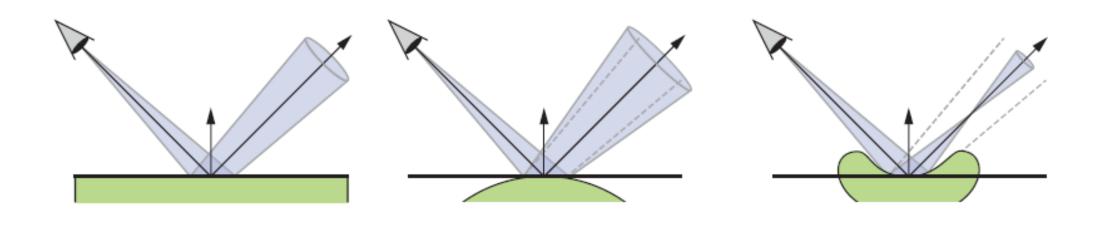
(a) Noisy input (1 spp)



(b) Our spatial denoiser

TEXTURE LEVEL OF DETAIL STRATEGIES FOR REAL-TIME RAY TRACING

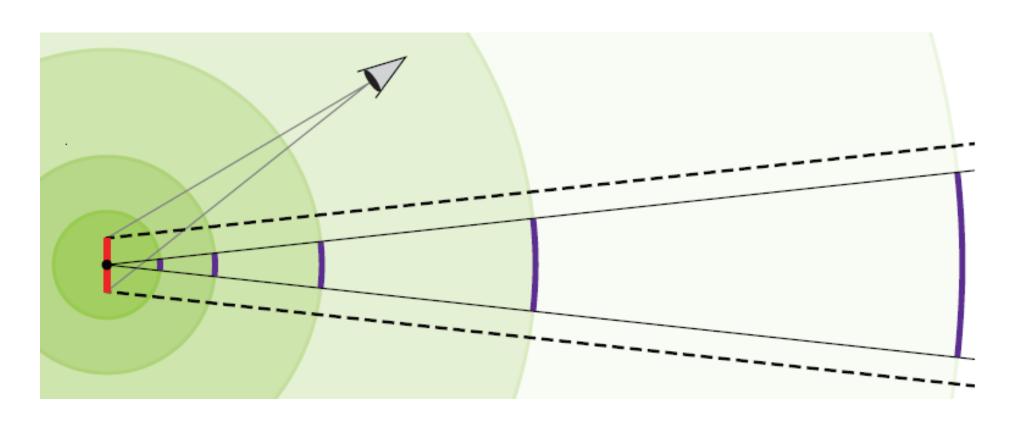
by Tomas Akenine-Möller, Jim Nilsson, Magnus Andersson, Colin Barré-Brisebois, Robert Toth, and Tero Karras



Will be presented Wednesday 4:25 pm, Room 501AB

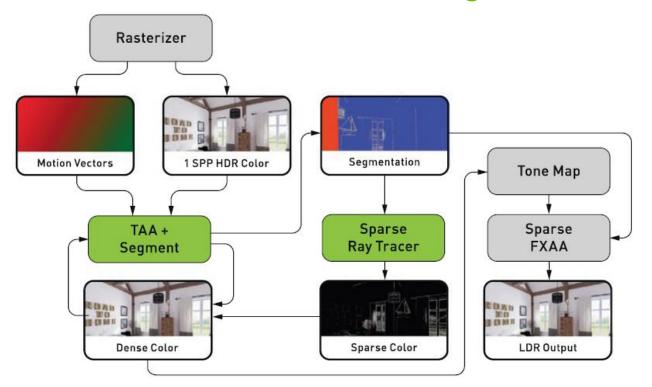
SIMPLE ENVIRONMENT MAP FILTERING USING RAY CONES AND RAY DIFFERENTIALS

by Tomas Akenine-Möller and Jim Nilsson



IMPROVING TEMPORAL ANTIALIASING WITH ADAPTIVE RAY TRACING

by Adam Marrs, Josef Spjut, Holger Gruen, Rahul Sathe, and Morgan McGuire



	SSAA	ATAA-C	Speedup
2×	6.30	1.47	4.29×
4×	12.60	2.70	4.67×
8×	25.20	5.32	4.74×

Will be presented Wednesday 4:50 pm, Room 501AB



INTERACTIVE LIGHT MAP AND IRRADIANCE VOLUME PREVIEW IN FROSTBITE

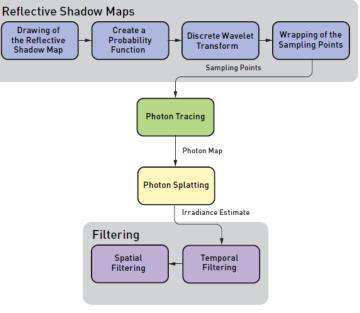
by Diede Apers, Petter Edblom, Charles de Rousiers, and Sébastien Hillaire



REAL-TIME GLOBAL ILLUMINATION WITH PHOTON MAPPING

by Niklas Smal and Maksim Aizenshtein





HYBRID RENDERING FOR REAL-TIME RAY TRACING

by Colin Barré-Brisebois, Henrik Halén, Graham Wihlidal, Andrew Lauritzen, Jasper Bekkers, Tomasz Stachowiak, and Johan Andersson



G-Buffer (Raster)



Direct Shadows
(Ray Trace or Raster)



Direct Lighting



Reflections (Ray Trace or Compute)



Global Illumination
(Ray Trace and Compute)



Ambient Occlusion (Ray trace or Compute)



Transparency & Translucency (Ray Trace and Compute)



Post-Processing (Compute)

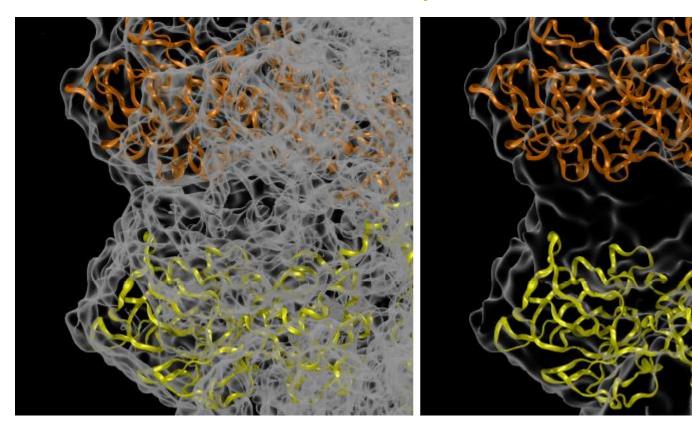
DEFERRED HYBRID PATH TRACING

by Thomas Schander, Clemens Musterle, and Stephan Bergmann



INTERACTIVE RAY TRACING TECHNIQUES FOR HIGH-FIDELITY SCIENTIFIC VISUALIZATION

by John E. Stone





RAY TRACING INHOMOGENEOUS VOLUMES

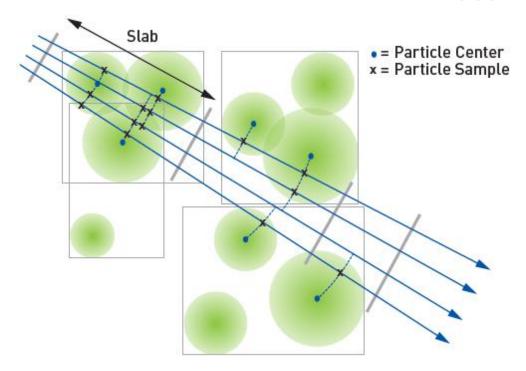
by Matthias Raab

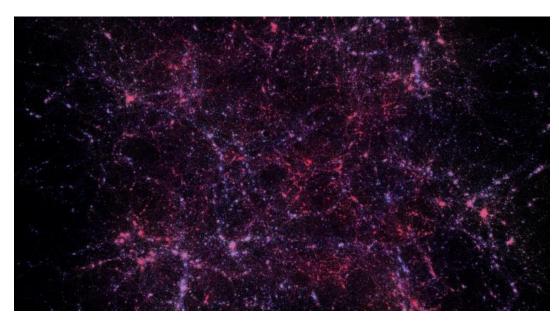




EFFICIENT PARTICLE VOLUME SPLATTING IN A RAY TRACER

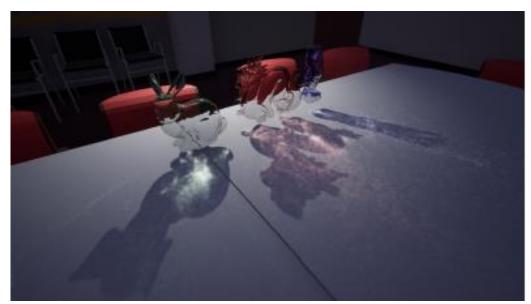
by Aaron Knoll, R. Keith Morley, Ingo Wald, Nick Leaf, and Peter Messmer





CAUSTICS USING SCREEN SPACE PHOTON MAPPING

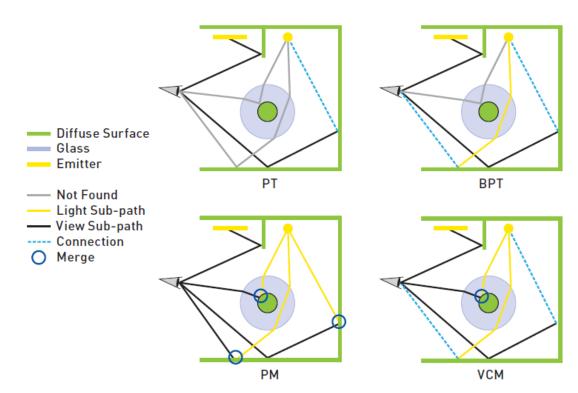
by Hyuk Kim





VARIANCE REDUCTION VIA FOOTPRINT ESTIMATION IN THE PRESENCE OF PATH REUSE

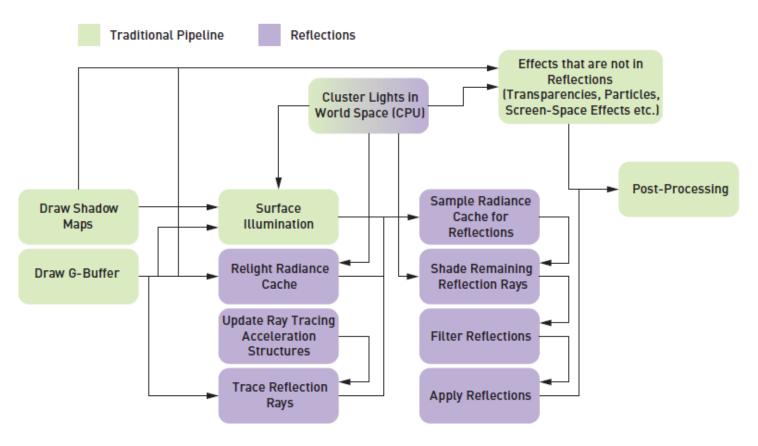
by Johannes Jendersie





ACCURATE REAL-TIME SPECULAR REFLECTIONS WITH RADIANCE CACHING

by Antti Hirvonen, Atte Seppälä, Maksim Aizenshtein, and Niklas Smal



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**

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