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Jon Peddie's
TECH WATCH

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RENDERING

Photorealism for the masses gets closer

With increased performance and clever algorithms

By Jon Peddie

Ray tracing has been one of the white whales of computer graphics. Since its introduction in the early 1980s, ray tracing has promised to bring photorealistic rendering on a broadscale, and it's always been two-years in the future. In those years, we have nonetheless seen it get faster, while screen resolutions have also increased. In the 1990s if you could render a ray-traced 512 × 512 image in five to ten seconds you thought you really had something. We did just such a thing using 16 transputers, a 32-bit processor configured in a SIMD, cost a mere $10,000.

The movie studios use ray tracing extensively as special effect using CG becomes prevalent, so much so you no longer know when you are looking at a simulation and the real thing. Those images are rendered in 5K or 8K and scaled down to 4K for digital projectors in modern theaters—and one day your home. In addition to super high-resolution, the film industry operates in a minimum of 10-bits per color channel, and most of the time in 12-bit color (30 or 36-bit RGB or YCbCr) up to 16-bits, with a server that supports the DCI DCP. Rendering time at such a scale can take an hour and half per frame.

But what about more everyday is-

See Rendering page 3

Rendering continued from page 1

sues? The next step down could be a PC game being displayed on a nice widescreen 3440 × 1440 monitor, which currently is limited to 8-bit color. Many games, in particular racing games, are using hybrid ray tracing where just a portion (the shiny car bits) are ray-traced, and they manage to run at 30 to 45 fps, which is quite satisfying. But racing games are in very constrained worlds with limited FOV and scope.

Ray-tracing can however, be employed in realtme in a more practical application, one that is near and dear to my heart—augmented reality. However, for AR, you can't use the brute-force techniques that are used in other applications.

For some AR applications the visual quality and full integration of augmented content is critical for an immersive user's experience. The superimposed content over the real world must appear so realistic and integrative to be part of the real-world scene. Unfortunately, with the conventional graphics, the photo-realistic AR visualization is still in its infancy. "*People are using today AR primitive tools because we're still early on the journey to creating better tools. Tomorrow, AR is going to help us mix the digital and physical in new ways*" Mark Zuckerberg, April 2017.

Our friends at Adshir in Tel Aviv have developed a new approach to an AR/VR oriented ray tracing. If judiciously applied to an augmented object, it delivers realtme photorealistic ray tracing. It offers speedup of over 150x that of conventional approaches.

Similarly, to traditional ray-tracers, it uses path-tracing, which can provide physically accurate results.

The most basic operation in path tracing is the solving for visibility between each ray and millions of 3D scene polygons.

The cost of testing each ray against each polygon is prohibitive, therefore accelerating structures are used to reduce the number of ray/polygon intersection tests. But still, traversals of billions of rays are the most expensive tasks in path tracing, making it one of the most complex applications.

The human way of solving visibility is different. A simple sight toward an object can tell whether it is visible or obstructed. The human sight can be simulated by the prevalent graphics pipeline. Adshir invented a unique technology to exploit the graphics pipeline in path tracing for visibility, replacing the expensive accelerating structures. It has been applied in their LocalRay technology.

Adshir has developed a technique they call Dynamically Aligned Structures, and productized it into a toolkit they call LocalRay.

In LocalRay the costly traversals and reconstructions of acceleration structures are replaced by Dynamically Aligned Structures (DAS), a proprietary software mechanism based on graphics pipeline, for radical reduction of complexity.

The DAS structure is a novel method for seeking ray/polygon intersections, specifically adjusted to augmented and virtual reality. It is based on a proprietary handling of hundreds of rays, enabling high utilization of the massive parallelism of the GPU graphics pipeline. Random samples assist in correctness of global illumination.

Key Points of Adshir's AR/VR Path

Tracing Technology are:

1. Path Tracing. Proprietary quasi Monte-Carlo ray tracing technology, implementing global illumination, produces photo-realistic integration of augmented objects in real life environment.

2. No traversals. The conventional traversals of accelerating structures are replaced by a novel, software based, ray hit mechanism (Dynamically Aligned Structures), gaining reduced computational complexity, high performance and low power consumption.

3. Fast animation.There is no need to reconstruct acceleration structures for frequent scene changes

4. Image convergence.Fast image convergence of milliseconds replaces the typical image convergence of seconds and minutes.

5. Data space parallelism.Processing rays in data space, rather than in image space, takes advantage of GPU parallelism.

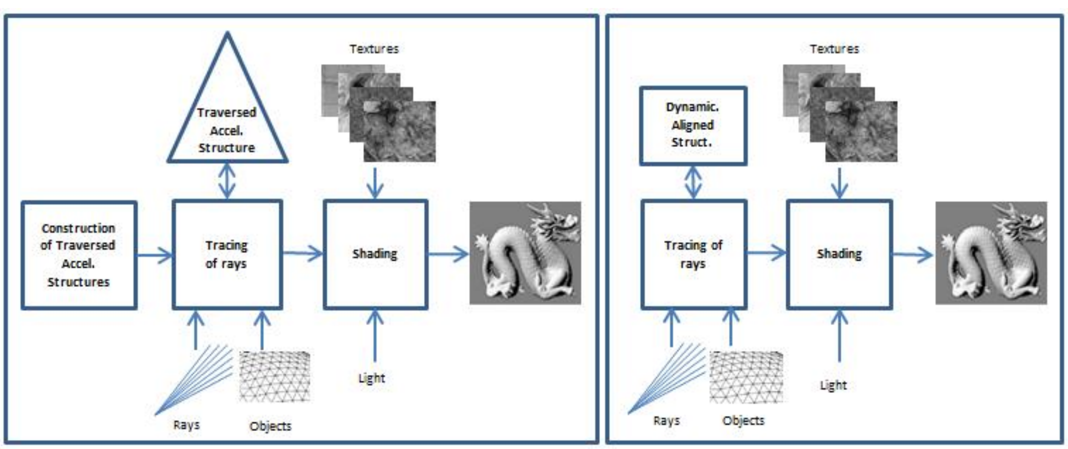
6. Performance.The performance increases by two levels of magnitude over commercial ray tracers, on consumer class computing devices.

7. Power consumption. The energy consumption drops down, matching the power budget of consumer devices.

Adshir's technology is a Software Development Kit, that will be available in Q3 2018, and will function as a plug-in to leading graphics platforms (Unity, Unreal, ARcore, ARKit, etc.), enabling the developers to create an immersive user's experience in VR/AR applications. It runs 100% on the GPU.

What do we think?

Soon you will be able to wear a pair of AR smart glasses, or use your phone and see photorealistic superimposed images in real time. When that happens, which BTW will coincide nicely with the AR developments and new products coming out in 2018, we will begin to enjoy the promise of consumer AR. I can't wait.



Conventional ray tracing *LocalRay™ ray tracing*

DYNAMICALLY ALIGNED Structures vs conventional path tracing