

### Ray Tracing Script Revision 3

Raymond: Hello everyone, we are Team Array and we will be speaking about ray tracing. In computer graphics, ray tracing is a technique for calculating the color of a virtual pixel of an image by calculating the effects of light rays (coming from a virtual light source) on that particular pixel. A ray tracing algorithm involves tracing a path from some imaginary “eye” to each pixel of the image, and calculating the color of that pixel based on what object it represents, that object’s properties, and its position relative to the eye and light source.

Angel: Ray tracing first began in 1968 when Arthur Appel developed the first “ray casting” algorithm. For a long period in computer graphics, the terms “ray casting” and “ray tracing” were interchangeable, but more recently the field has distinguished between the two. Ray casting is a non-recursive algorithm which only deals with primary rays (never recursively generating secondary light rays), whereas ray tracing is a recursive algorithm which computes secondary light rays, such as those from reflection and refraction.

After Appel’s ray casting algorithm, Turner Whitted introduced reflection, refraction, and shadows into the ray tracing algorithm in 1979, aligning his algorithm more with what is considered today as true ray tracing. As time has passed, improvements have occurred in reflection, refraction, shadows, and time complexity as well as an increased realism and real-time ray tracing.

Rays that are reflected must be recursively computer after bouncing off of a reflective surface (i.e. a mirror), and the reflected light ray color must then also be determined by its intersection with other light rays. Refracted rays are quite similar, except instead of reflecting away from a surface/object, these rays enter the object/surface and can also exit this object. Shadows are computed by determining whether different light rays reach, and with what intensity they reach, a particular pixel.

Rebecca: Now, we will show you examples of images made with ray tracing algorithms (show images and diagrams). The ray tracing algorithm is comprised of basic knowledge of vectors, dot products, and cross products. Also, ray tracing algorithms contain intersections with basic and complex geometry. (Talk about forward/backward ray tracing, recursion, color and shading, and techniques).

Yu: (Conclude presentation: where to use ray tracing, considerations to remember, advantages and disadvantages of ray tracing).

The main advantage of ray tracing over other rendering algorithms is its realism, particularly its ability to compute reflected, refracted, and shadowed light rays. Ray tracing also computes each light ray separately and is able to simulate depth of a scene using adaptive depth control, which both allow for this more realistic rendering.

However, with these improvements comes the most serious disadvantage of ray tracing which is the heavy computation. Ray tracing in Whitted's simple 1979 algorithm does not offer

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such this heavy computation, but it also does not allow for the realism that more recent improvements provide. When implementing a ray tracing algorithm, one must consider the advantage of a particular improvement to the algorithm: how necessary or beneficial its effects will be compared to the potential computational cost.