Raytracing
Version 1: Nov 6, 2017

Basics, algorithms, specific examples of implementation, history, advantages/disadvantages, show self-made references images/animations using raytracing and comparing with & w/o,

History:
- Descartes' "Dioptrics" and "Optics" in *The Cambridge Descartes Lexicon* by Jeffrey McDonough
    - Descartes introduces the idea of plotting light rays and calculating their interactions with various surfaces in the early 17th century in one of his earliest works, *Dioptrics.* The paper also discusses reflection and refraction. Essentially, the ideas that Descartes presents in this paper serve as the foundation of modern ray casting.
- *Some techniques for shading machine renderings of solids* by Arthur Appel (1968)
    - This paper presents the first ray casting algorithm used for rendering objects in a scene.
- An Improved Illumination Model for Shaded Display by Turner Whitted (1980)
    - This paper introduces a recursive ray tracing algorithm. When a ray intersects an object, it may generate up to three more rays which are used to simulate reflection, refraction, and shadows. This algorithm is more expensive than its predecessors, but it results in very realistic images.
- *Distributed Ray Tracing* by Robert L. Cook, Thomas Porter, Loren Carpenter (1984)
    - This paper discusses the technique of Distributed Ray Tracing, sometimes referred to Stochastic Ray Tracing. The idea of Distributed Ray Tracing is that instead of using a single calculation, multiple calculations are averaged together to produce the final value. This process is called over-sampling, and the effect is that there are less artifacts and smoother shading. This effect is used in a variety of different applications and commonly referred to as anti-aliasing.
- *Backward Ray Tracing* by James Arvo (1986)
    - This paper discusses backward ray tracing, a technique introduced in order to better simulate diffuse reflection of indirect light. This technique differs from traditional ray casting in that not only are rays emitted from the eye but also from the light sources present in the scene. This technique is much more efficient than forward ray tracing because, when the rays that are emitted from the eye are subsequently reflected or refracted, they rarely ever hit the light sources, revealing nothing about how the light hits that point of reflection or refraction. Therefore, a small proportion of the rays reach the destination, resulting in wasted computations in an already expensive process.
- *High Quality Rendering using Ray Tracing and Photon Mapping* by Henrik Wann Jensen, Per Christensen (2007)
    - [...]

The problem notes
- Imagine our 1000 x 1000 screen. That's now 1 million rays shot out per frame!
- We then must check each object to see if the ray intersects it, and figure out which object is the first to be intersected!
- With 1000 objects, that's already a billion operations per frame!

Shadows notes

- Shadows were an unsolved problem. Then go over text on slide

Reflection notes

- Reflection was also an unsolved problem. Then go over text on slide.
- When the slide mentions the reflection raying hitting another object, mention that If we hit another object that is also reflective, then have to recursively continue!
- After the whole slide
- For influencing the color of the pixel, we usually use some reflection factor to weaken the color. Some constant value to multiply how much the object's color has an effect on the pixel.