Objectives

Explore Imaging Models
Explore Physical Imaging Systems
  Pinhole camera
  Human Eye
Introduce the synthetic camera model
Image Formation

In computer graphics, we form *synthetic* images which are generally two dimensional using a process analogous to how images are formed by *physical imaging systems*.

- Cameras
- Microscopes
- Telescopes
- Human visual system

Review: What do we need to create a synthetic image?

Image Formation Elements: Objects and Viewers
Describe light and attributes that govern how light interacts with the materials in the scene.

One way to form an image is to follow rays of light from a point source finding which rays enter the lens of the camera. However, each ray of light may have multiple interactions with objects before being absorbed or going to infinity, or reaching the camera.
Imaging Models: Physical Approaches

**Ray tracing**: follow rays of light from center of projection until they either are absorbed by objects or go off to infinity

- Can handle global effects
  - Multiple reflections
  - Translucent objects
- Slow
- Must have entire DB available

**Photon Mapping**: Similar approach to deposit light in the scene

Imaging System: Pinhole Camera

Use trigonometry to find projection of point at \((x,y,z)\)

\[
\begin{align*}
x_p &= -x/z/d \\
y_p &= -y/z/d \\
z_p &= d
\end{align*}
\]

These are equations of simple perspective
Human Imaging System

Human visual system has two types of sensors

Rods: monochromatic, night vision

Cones
- Color sensitive
- Three types of cones
- Only three values (the *tristimulus* values) are sent to the brain

Need only three *primary* colors

Shadow Mask CRT

Blue gun
Green gun
Red gun
Shadow mask

Vertical grid

Light emitting elements

Horizontal grid

Angel and Shreiner: Interactive Computer Graphics © Addison-Wesley 2012
Synthetic Camera Model

Advantages

Separation of objects, viewer, light sources

Two-dimensional graphics is a special case of three-dimensional graphics

All objects rendered independently of one another

Leads to simple software API
- Specify objects, lights, camera, material attributes
- Let implementation determine image

Leads to fast hardware implementation