CS450/550

Graphics Systems and Models

Adapted From: Angel and Shreiner: Interactive Computer Graphics 6E © Addison-Wesley 2012
Objectives

Physical and Synthetic Imaging Models
Imaging Systems
  Pinhole
  Human Eye
Synthetic camera model
Basic Pipeline
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

What do we need to create a synthetic image?
Image Formation Elements

(a) B

(b) C

(c)
Image Formation Elements

Light source(s)
Material properties

Attributes that govern how light interacts with the materials in the scene

Note the independence of the objects, the viewer, and the light source(s)
Imaging Model

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.
Light

X rays

Light

Radio

λ (nm)

Blue Green Red

350 λ (nm) 780

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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 match these three values

Need only three primary colors
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
Synthetic Camera Model

projector

p

image plane

projection of p

center of projection

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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, attributes
  Let implementation determine image

Leads to fast hardware implementation