Optical Information

ICS 280: Visual Perception
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Visual Perception

- Depends on three factors
  - Light
  - Interaction of light with surfaces
  - Human visual system
    - Observes light both before and after the interaction with surfaces
Light

- Made of small packets
  - Photons
  - Travel at 186,000 mph
  - Travels in straight line
  - Behaves like particles
  - Behave like waves
    - Important for color vision

Light source

- Anything that emits light
- Point light source
  - Sharp shadows and shading effects
  - Unrealistic
- Extended light source
  - Blurred shadows and shading effects
  - Diffused illumination
  - Most real sources are extended
Illumination

- Light strikes another surface
  - Reflected – Most of the time we see this
  - Transmitted
  - Absorbed

Diffused and Specular Surfaces

- Diffused
- Specular
Diffused Surfaces

Specular Surfaces

Relative amount of light reflected

Shape of the reflectance
Illumination

- Light source
- Reflected off the surface
- Reflection again
  - Secondary source
- Again and again and again ...
- Different amount of light coming from different directions help us distinguish objects
- Equal amount of light from all directions
  - Gray Ganzfeld

Ambient Optic Array

- Proposed by famous psychologist J. J. Gibson
- Light coming towards a given observer from all directions
Ambient Optic Array

- Changes with changing view point – Optic flow
- Used to detect motion, depth and size

Image Formation

- Distal and proximal stimulus
- Size depends on the visual angle
- Depth is lost
- Occlusion
  - Light from non-occluded surfaces reach the eye
Projective Geometry

- Mathematics that guide 2D image formation of 3D world
  - Pin-hole camera model
  - Perspective Projection

Perspective and Orthographic Projection

- A. Perspective Projection (Close)
- B. Perspective Projection (Far)
- C. Orthographic Projection
Graphics Problem

- Graphics deals with
  - How 2D images are created from 3D information?
- Rendering
  - 3D Model of the Scene
    - Locations of lights, Surface reflectance properties
    - Color at every 3D point can be calculated
  - Geometric Model, Viewpoint
    - Projection of the objects from the eye
    - Use the colors to create the 3D image

Inverse Vision Problem

- Vision deals with
  - How to get back 3D information from 2D images?
  - Underdetermined problem
  - How does the visual system solve this problem?
Photons with wavelengths

Spectrum

Reflectance

Relative Energy

Wavelength

Wavelength (nm)