
• Prerequisite - CS248
• This course is about appearances
  – Why do things look the way they do?
  – How can we get similar appearances on a display?
  – Photorealism, and beyond?
• Instructors: Frank Crow, Don Greenberg, and friends
• TA Yelena Vileshina
Administrivia

- http://www-graphics.stanford.edu/courses/#cs348b
- Series of projects building on one another
- Grading on projects and a few written assignments
- Projects run on Sweet Hall SGIs for grading
More Administrivia

• Office hours - after class on 3rd floor
• TA office hours TBD
• Rendering Competition?
Motivation - Why Care?

- **Entertainment**
  - Bug’s Life, Antz, Star Wars, etc.
  - Video games, etc. Myst, Riven
- **Simulation**
  - Industrial Design
  - Scientific Visualization - Photorealism?
- **Illustration**
  - Medical - visible human
  - Site planning
Introduction

- Shading, Displaying shade
- Light transport
- Light-surface interaction
- Algorithm classes
Shading

- How do we get the color at a point on a surface?
- Gather all incoming light
- Calculate interaction of surface with light
Displaying Shade

- Find light emanating in view direction from surface
- Express light in color characteristics of display
- View display with eyeball
- Convert incoming signal to perception
Light transport

- Light source characteristics
  - color frequencies, directionality, strength, flicker
- Transport medium, diffusion
  - fog, dust, etc.
Light-Surface interaction

- Diffuse and specular reflection
- Reflection-absorption spectrum
- Pigments, filters, etc.
- Iridescence

- Informal assignment: Go look at something interesting. What makes it look that way?
Algorithms for light transport

- Traditional methods (Gouraud, Phong)
  - Commercial hardware
- Ray tracing from the light source
- Ray tracing from the view point
- Diffuse reflections - radiosity
- Wavefront propagation?
Effects

- Texture, Bumps
- Shadows
- Refraction
- Caustics
Texture vs. Geometry
Beyond Texture

- Bump mapping
  ~ Use image to perturb local surface orientation

- Displacement mapping
  ~ Use image to perturb surface (while subdividing)
Sampling and Aliasing
Shadows

Note contrast between shadow geometry and filtered texture

- Shadows, umbra and penumbra
- Point sources vs. area sources
- Shadow plane algorithms
- Fake shadows quite effective

Shadow on face is wrong
Refraction
Caustics

- Caused by concentrated refracted light
Image-Based Rendering

- Re-use the pixels you already have

- For available natural images

- For expensive synthetic images
Quality vs. CPU Speed

- **Real time**
- **Interactive**
- **Practical**
- **Possible**
- **Fanatical**

- 1 mo.
- 1 week
- 1 day
- 1 hour
- 1 min.
- 3 s.
- 1/6 s.
- 1/60 s.

- 1 MIPS
- 10 MIPS
- 100 MIPS
- 1 GIPS

- 1 MIP
- 10 MIP
- 150 MIP
- 250 GI
- 14 GI

- 1 mo.
- 1 week
- 1 day
- 1 hour
- 1 min.
- 3 s.
- 1/6 s.
- 1/60 s.
Course Topics

• Introduction
  – Shading
  – Light transport
  – Algorithm classes

• Texturing
  – State-of-the commercial hardware art
  – Mip-mapping, etc.
  – Bump-mapping, Displacement mapping

• Sampling
  – Fourier basis for Nyquist limit, etc.
  – Discrete convolution for graphics, TV, etc.
  – Sampling in time
  – Algorithmic implications - multidimensional distributed sampling
Course Topics

• Color
  – Display device gamuts
  – Human color perception, simultaneous contrast, surface effects, etc.
  – Color space conversion and gamut transforms
  – Color standards?

• Ray Tracing
  – forward and reverse
  – transparency, refraction, diffraction, caustics, shatoynancy
  – Algorithms - spatial subdivision, memory access issues

• Radiosity
  – Light gathering, shooting
  – Hierarchical approach
Course Topics

- Image-based rendering
- Volume-based rendering
- Perceptually-based rendering
  - Dynamic range
  - Color and frequency issues
  - Temporal issues and interaction
- Non-realistic rendering
  - Painterly effects
  - Reduction to essentials
  - Artificial emphasis