CMSC 435/634

Global Illumination
Global Illumination

- Local Illumination
  - light – surface – eye
  - Throw everything else into ambient

- Global Illumination
  - light – surface – surface … – eye
  - Multiple bounces
Global Illumination

- Ambient illumination
- No ambient illumination
- Global illumination
“Backward” algorithms

- Follow light transport: eye to light
  - Traditional ray tracing
    - Follow primary reflection
  - Path tracing
    - Follow other rays
    - Monte-carlo integration
“Forward” algorithms

- Follow light transport: light to eye
  - Lights are emitters
  - Everything else both emitter & receiver
  - Integrate bounce to bounce
    - All surfaces for each bounce (radiosity)
    - All bounces for one photon (photon map)
Radiosity Approach

- Assume all surfaces are ideal diffuse reflectors; light sources all diffuse emitters
- Consider all interactions between lights and surface elements
- Based on theory from radiative heat transfer
PROGRESSIVE SOLUTION

The above images show increasing levels of global diffuse illumination. From left to right: 0 bounces, 1 bounce, 3 bounces.
Progressive Solution
Cohen, Chen, Wallace, and Greenberg '88
More Radiosity Topics

- Participating Media
  - Rushmeier and Torrance ‘87

- Specular Reflections
  - Immel, Cohen, and Greenberg ‘86
  - Wallace, Cohen, and Greenberg ‘87
  - Sillion ‘89

- Discontinuity Meshing
  - Baum, Mann, Smith, and Winget ‘91
  - Lischinski, Tampieri, Greenberg ‘92
Participating Medium

Rushmeier 1993
Participating Medium
Radiosity + Specular

Wallace, Cohen, and Greenberg '87
Discontinuity Meshing

Lischinski, Tampieri, Greenberg '92
More Global Illumination

Topics

- Monte Carlo Methods
  - Lafortune and Willems '93
  - Veach and Guibas '97

- Error Estimates
  - Arvo, Torrance, and Smits '94
  - Lischinski, Smits, and Greenberg '94
Bidirectional Path Tracing & Metropolis Light Transport
The Cornell Box
More Cornell Boxes
Interactive Rendering

- Diffuse surfaces only
  - viewpoint independent
- Pre-compute and store radiosity
  - As patch/vertex colors
  - As texture
- Separate solution for each light
  - Linear combination to change lights
Two pass

- Radiosity for diffuse
- Ray tracing for reflection
- Doesn’t handle radiosity of specularly reflected light