Course Goals

• Prototype tools for architectural daylighting to be used in the early stages of design
• Improve efficiency of iterative design
• Increase occupant comfort
• Reduce the need for electric lighting
• Put lighting engineers out of work
• Reduce fossil fuel usage & Save the world!
Skylight Material

matte white paint  reflective metal

Traditional Ray Tracing

Henrik Wann Jensen

Global Illumination

Indirect Illumination (global-direct)

Henrik Wann Jensen

Materials – BRDF & BTDF

from Marilyne Andersen

Measuring Materials

from Marilyne Andersen
Ray Grammar

Classify local interaction:

- E = eye
- L = light
- S = perfect specular reflection or refraction
- G = glossy scattering
- D = diffuse scattering

From Dutre et al.'s slides

Classic Ray Casting/Tracing

Ray casting: L D E

“Adaptive Radiosity Textures for Bi-directional Ray Tracing”
Heckbert SIGGRAPH 1990

Ray tracing: L D S* E

Photon Tracing

Radiosity: L D* E

Caustics: L S* D E
(or worse!)

“Adaptive Radiosity Textures for Bi-directional Ray Tracing”
Heckbert SIGGRAPH 1990

Artistic Illustration

Frank Lloyd Wright’s Fallingwater

Standard Computer Rendering

Non-Photorealistic Rendering (NPR)

Computer-generated pen-and-ink illustration
Winkenbach & Salesin 1996

Painterly rendering with curved brush strokes of multiple sizes
Hertzmann 1998

A non-photorealistic lighting model for automatic technical illustration
Gooch, Gooch, Shirley, & Cohen 1998

NPR for architectural daylighting
High Dynamic Range & Perception

Time-dependent visual adaptation for fast realistic display.
Pattanaik, Tumblin, Yee, & Greenberg 2000.

High Dynamic Range & Perception

• Does a room with a blue carpet really look this blue?
• Is the spot of the floor really this blindingly white?
• How can we tell if it’s bright enough or too bright?

Possible Topics to Explore [Barb]

• Improve algorithms
  – Use graphics hardware
  – Problem specific optimizations (material, etc.)
• Make interface to algorithms easier to use
  – preparing model
  – selecting rendering parameters
• Improve display of noisy/approximate results (NPR)
• High Dynamic Range (HDR) & Perception