Image Synthesis

Denis Zorin

Image Synthesis

Web page: http://www.mrl.nyu.edu/dzorin/rend05

(also linked to the CS class list)

Class time: Wed, 1:30-3:20pm

Prerequisites: strong programming skills, basic geometry, vector algebra, calculus; some familiarity with computer graphics assumed.

Requirements: 2 written assignments, a final project, 2 class presentations.

Programming

Final project

- **implement an interesting rendering technique**
- **a list of possible projects will be provided**

Rendering

Different aspects of rendering:

- CS and engineering: algorithms, output devices
- Physics: modeling appearance, light propagation
- Perception: what artifacts are most objectionable, what can we get away with

Visual Cues

- Geometry
  - Occlusion
  - Perspective
- Color
  - Shading
  - Shadows
  - Transparency
  - Aerial perspective
- Stereo
  - Motion parallax
  - Stereopsis

History of Rendering

60-70s: mostly geometry

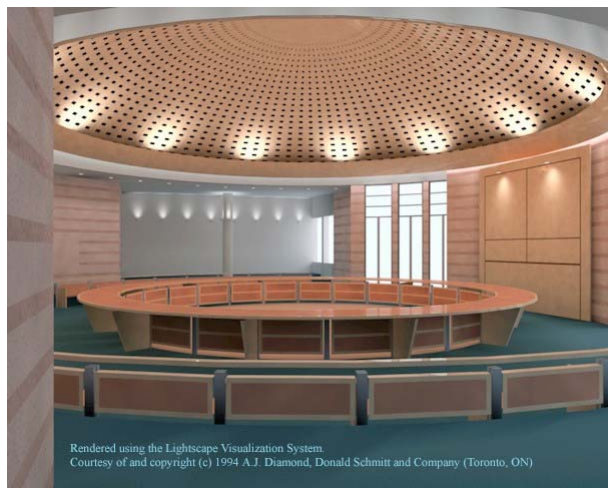
- Transformation
- Hidden line algorithms
- Simple shading and texturing
  - Gouraud, Phong shading

Now most of this can be done in real time in hardware

History of Rendering

80-90: Optics

- Better reflection models
  - Cook and Torrance, He
- Illumination
  - Ray tracing
  - Radiance
- Capture of real data
  - Image-based rendering



History of Rendering

Nonphotorealistic rendering

Close to reality is not always the best for a particular purpose

- Architectural drawings, medical atlases, repair manuals use nonrealistic styles
- Artistic uses: fewer constraints on expression
- Visualization: see the invisible

Rendering Hardware

1st generation (mid 80s)

- acceleration for 3d line rendering

2nd generation (end of 80s)

- lighting, Z-buffer

3d generation (early 90s)

- textures, antialiasing

4th generation– programmable

- revolutionary, bridging the gap between off-line high-quality and interactive techniques

Physically-based Rendering

- Physics of light
  - geometric optics
  - radiative transfer
- Some perception
  - what is color
  - how many colors are necessary

Topics

- Basic ray tracing -- review
- Light properties, radiometry
- Reflection models
- Advanced ray tracing (Monte Carlo, bidirectional, Metropolis...)
- Radiosity
- Nonphotorealistic rendering
- Algorithms for programmable hardware

Ray tracing

by Martin Moeck, Siemens Lighting

Classical ray tracing

Artifacts: perfectly sharp shadows, ideal reflections, no diffuse interreflections

Light around the corner

images by Eric Veach

Caustics

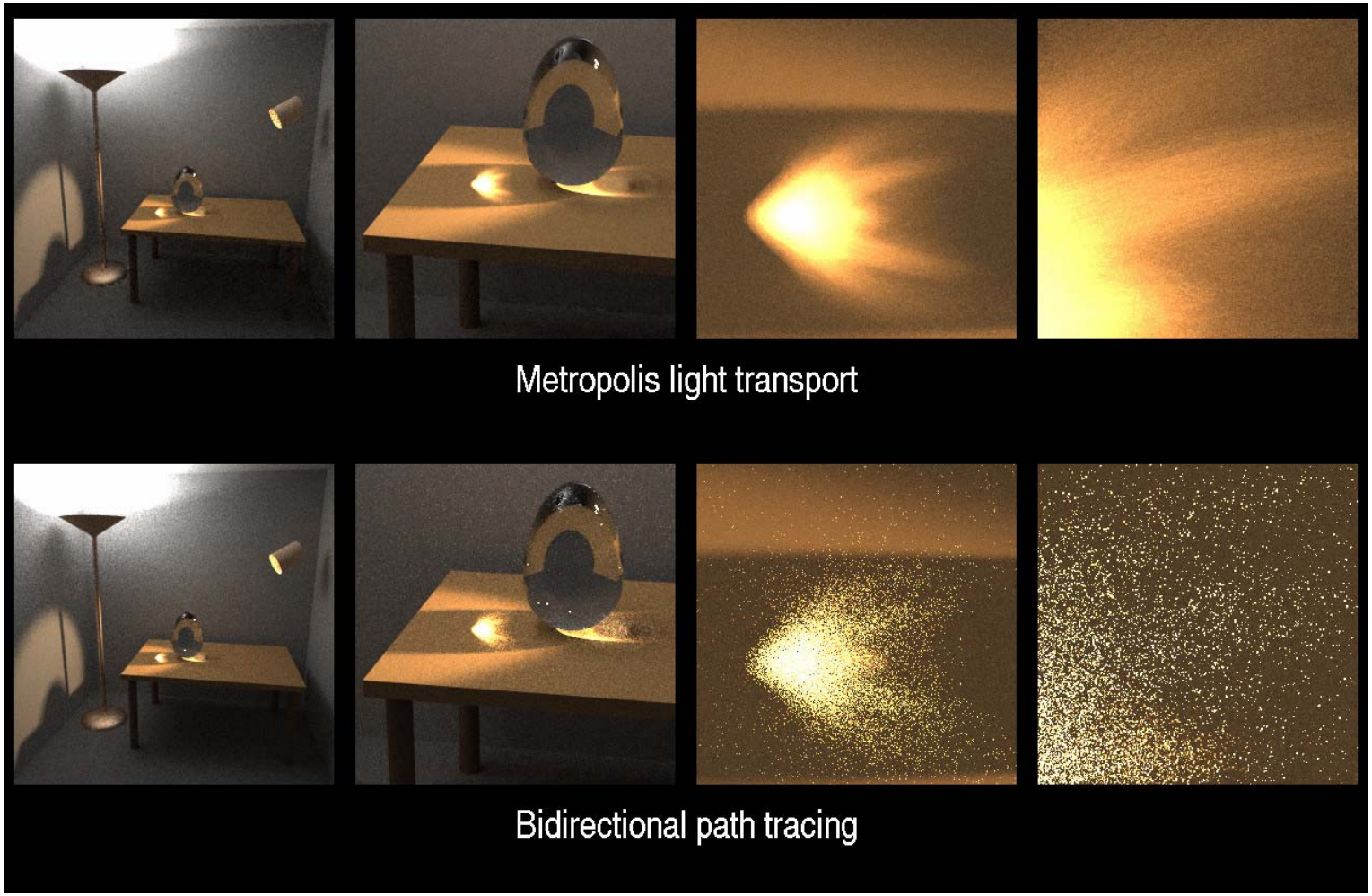
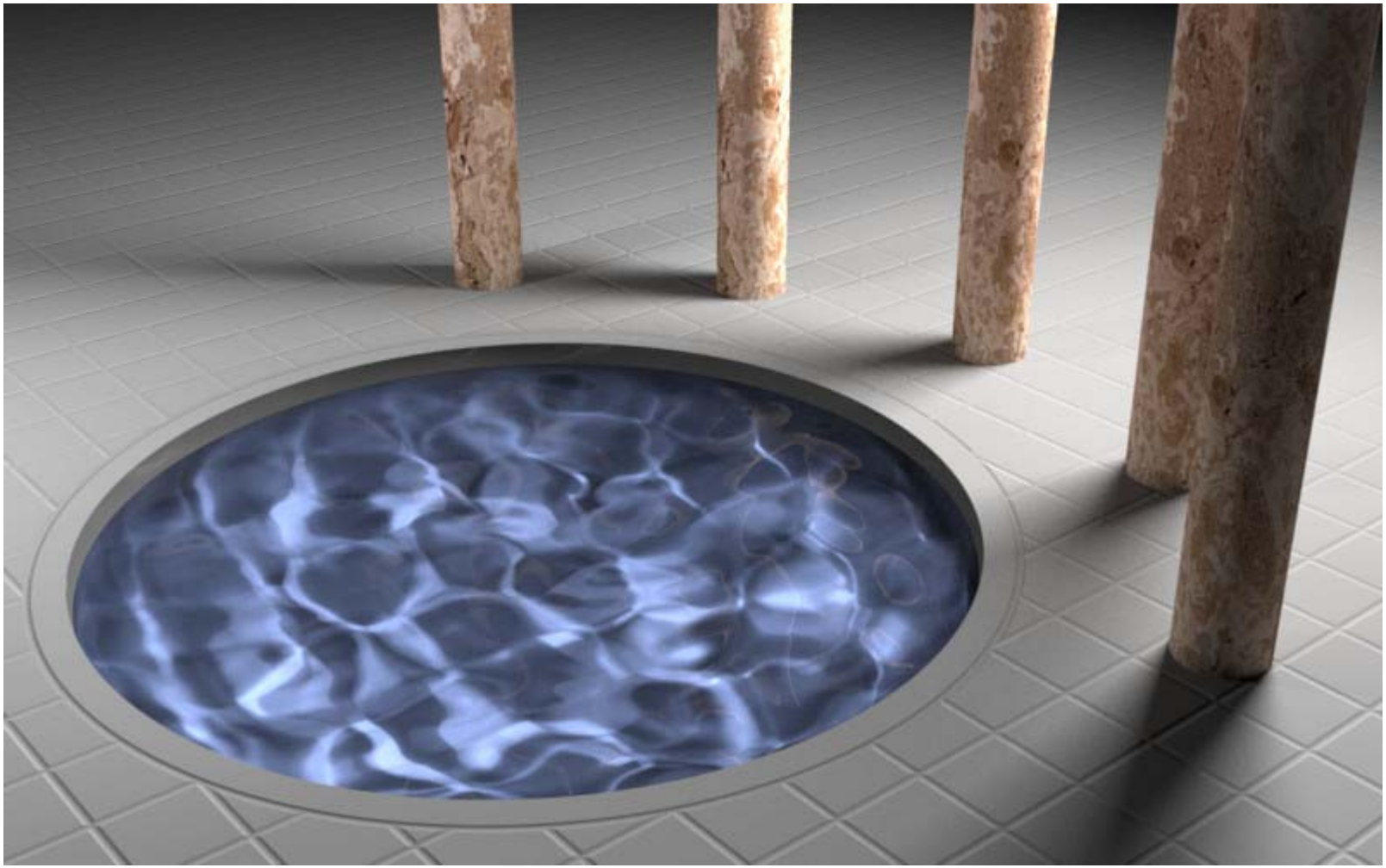


image by Eric Veach

Caustics



Radiosity

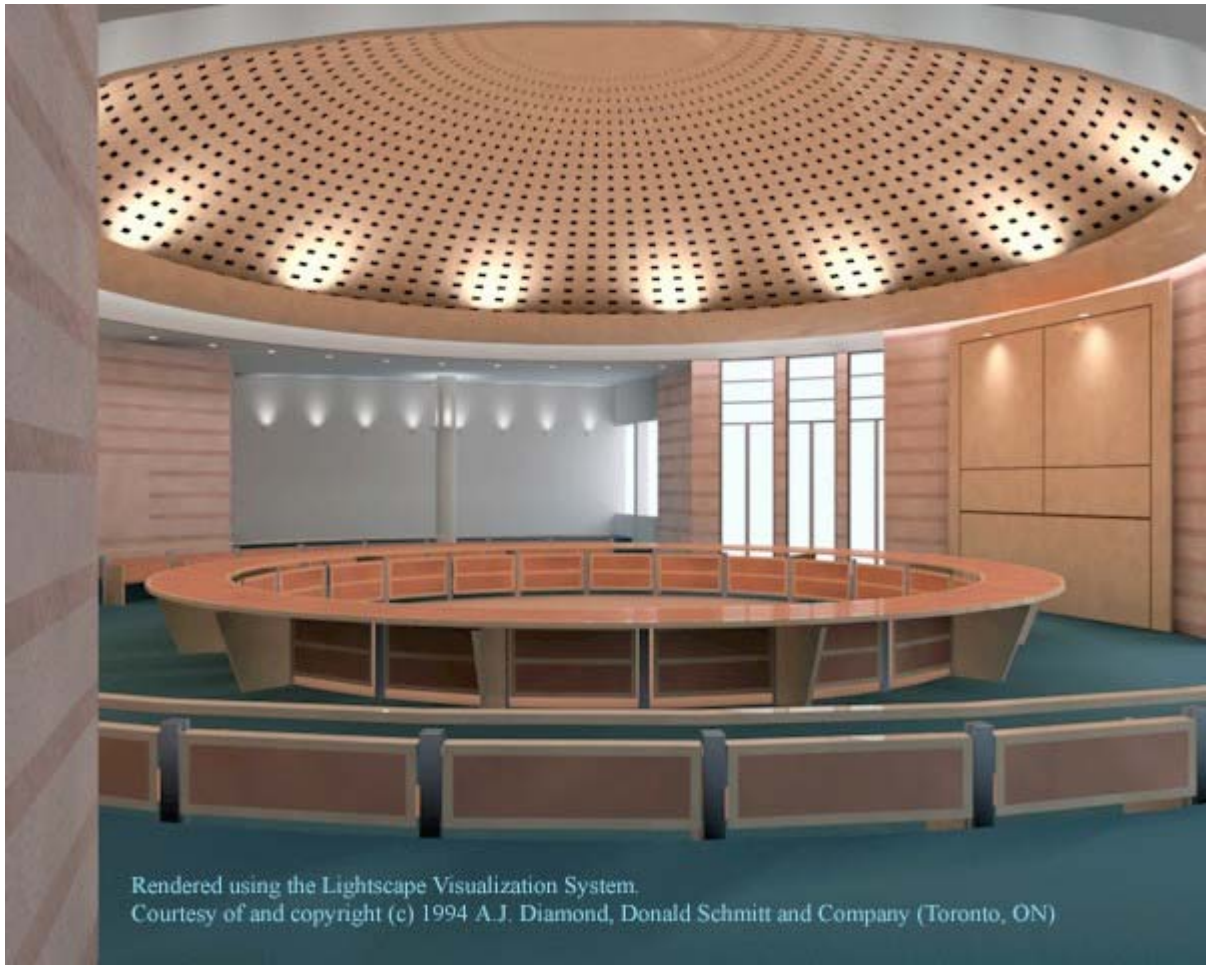


image produced using Lightscape

Nonphotorealistic rendering