ECS275A
Advanced Computer Graphics

Winter 2011

Kwan-Liu Ma

Objective

- Realistic Image Synthesis
- Rendering
- Global illumination
- Visualization

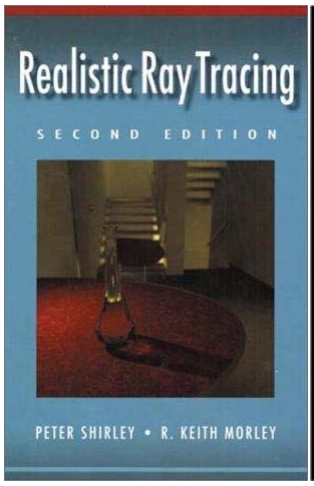
Logistics

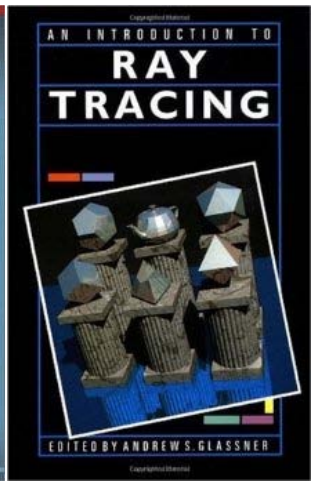
- No TA
- No Textbook but …
- No office hours but …
- 4 programming projects, one project proposal, one final project report, one midterm exam, two oral presentations
- Details see http://www.cs.ucdavis.edu/~ma/ECS275

Readings

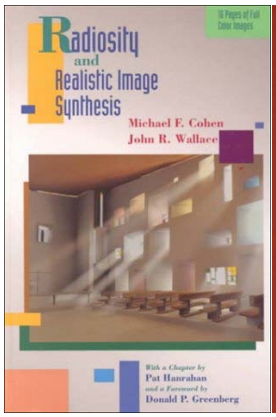
- Books
- Seminal papers
  - D. Greenberg's realistic image synthesis framework
  - Kajiyas rendering equation
  - T. Whitted's ray tracing
  - R. Cook et al.'s distributed ray tracing
  - M. Cohen et al.'s radiosity
  - H. Jensen's photon mapping
- Advanced topics

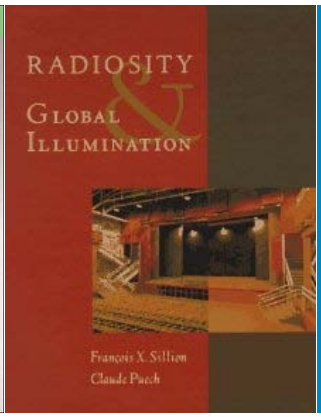
Books

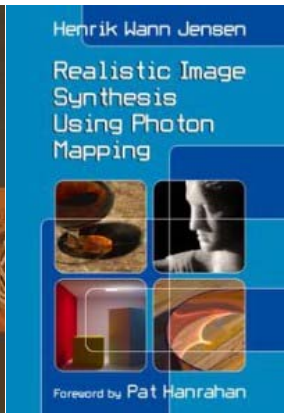

Realistic Ray Tracing
SECOND EDITION
PETER SHIRLEY • R. KEITH MORLEY


AN INTRODUCTION TO
RAY TRACING
EDITED BY ANDREW S. GLASSNER

Books


Radiosity and Realistic Image Synthesis
Michael F. Cohen
John R. Wallace
With a Chapter by
Pat Hanrahan
and a Foreword by
Donald P. Greenberg


RADIOSITY
&
GLOBAL
ILLUMINATION
François X. Sillion
Claude Puech


Henrik Wann Jensen
Realistic Image Synthesis Using Photon Mapping
Foreword by Pat Hanrahan

Books

Projects and Other Work

- Project 1: A simple raytracer 10%
- Project 2: An enhanced raytracer 20%
- Project 3: Radiosity 15%
- Final project 25%
  - Proposal (500+ words) 8%
  - Presentation 5%
  - Demonstration and final report (2,000+ words) 12%
- Paper presentation 10%
- Midterm exam 20%

Special Projects

- Must be related to illumination and (non-photo) realistic rendering
- Project Proposal 15%
- Project presentation 10%
- Interim demonstration and report 15%
- Final demonstration and report (5,000+ words) 30%
- Paper presentation 10%
- Midterm exam 20%

Schedule

- January 4 – February 15 (13) Lectures
- February 17 – 24 (3) Paper presentations
- March 1 Midterm Exam (80 minutes)
- March 3 Guest lecture
- March 8 and 10 ➔ March 11 (Friday)

  5-7:40pm Project presentations
- March 17 Final project demo and report due

Communication

- ma@cs.ucdavis.edu
- Office: 2121 Kemper Hall
- Phone: 530 752-6958
- URL: http://www.cs.ucdavis.edu/~ma
- Class Home Page:
  http://www.cs.ucdavis.edu/~ma/ECS275
- Blogs?

Realistic Image Synthesis & Global Illumination

An Introduction

Global Illumination

- Indirect illumination

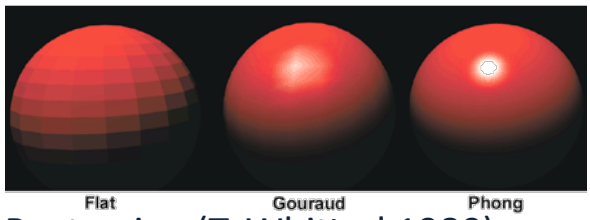
Global Illumination

- Indirect illumination
- A physically based simulation
- Input includes a description of the geometry and the materials as well as the light sources
- Interaction of light and surfaces
- Physical nature of light
- Reflectance properties of a surface (BRDF)
- The rendering equation [Kajiya 1986]

Methods

- Primitive shading algorithms

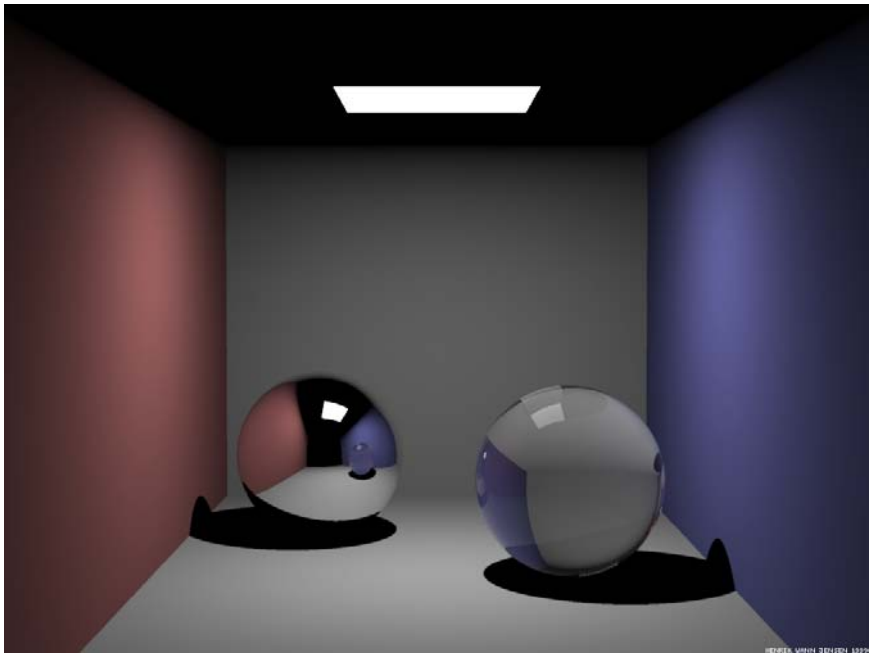
  Flat shading, Gouraud shading [1971], Phong shading [1975]



- Raytracing (T. Whitted 1980)
- Radiosity (Goral et al. 1984)
- Hybrid and multi-pass techniques
- Photon mapping (H. Jensen 1996)

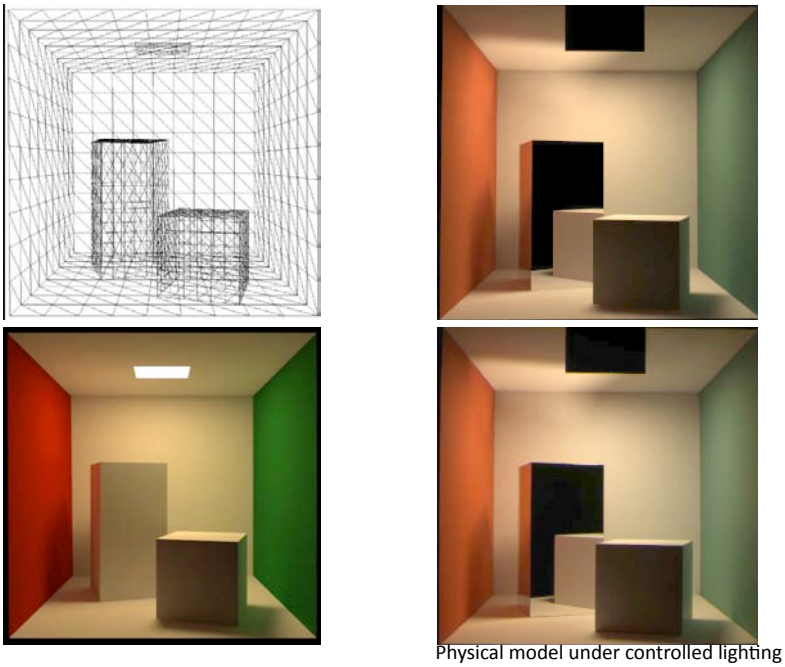
Ray Tracing

- Point sampling
- View dependent
- Mirror reflection/refraction, direct illumination, and shadow
- Monte Carlo methods can cover all types of light scattering and effects from depth of field, motion blur, caustics, glossy reflection, etc.
- Computationally expensive but independent of the complexity of the overall geometry



Radiosity

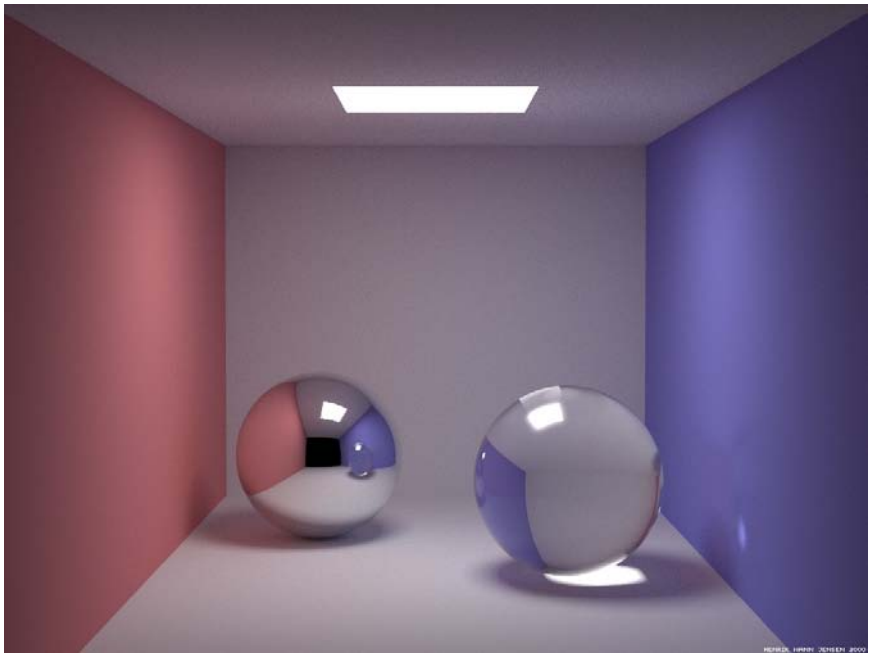
- Finite elements
- View independent
- Computing the equilibrium of the light exchange between “diffuse” surfaces in a model
- Subdividing the model into small patches and solving a linear equations for lighting distribution among the patches
- Very expensive for complex models



Physical model under controlled lighting using a Photometrics CCD camera

Hybrid and Multi-Pass Techniques

- Raytracing to add specular reflections to radiosity
- Radiosity to compute indirect illumination on diffuse surfaces
- Monte Carlos ray tracing to catch details while using simplified mesh for radiosity
- Photon mapping, a highly efficient two-pass algorithm like bi-directional path tracing



Readings

- Class home page
- A Framework for Realistic Image Synthesis, D. Greenberg, Communication of ACM, 1998