Lighting and Shading wrapup

Texture Mapping

Textbook Appendix A4, Chapter 15

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Today

- Lighting and Shading, odds and ends
  - Phong shading vs. Gouraud shading
  - Phong reflection/illumination vs. Phong shading
  - Global illumination and ambient
  - Blinn-Phong reflection and the halfway vector
  - Color in OpenGL
  - Toon shading
- Texture mapping introduction

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Lighting and Shading odds and ends

- Phong shading vs. Gouraud shading
  - Gouraud == per-vertex normals and illumination. Interpolate vertex colors to fragments
  - Phong == Interpolate vertex normals, per-fragment illumination
- Phong reflection vs. Phong shading
  - P. reflection == an approximation of BRDF, into specular + diffuse + …
- Global illumination and ambient
  - Ambient term is a crude approximation of global illumination

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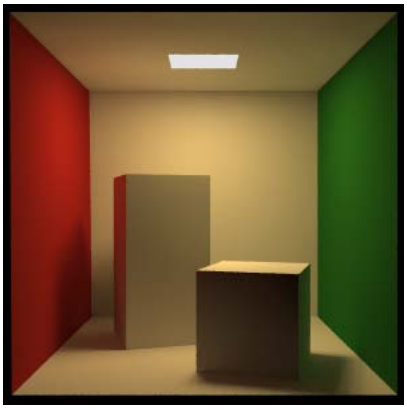
Global Illumination Cornell box



http://en.wikipedia.org/wiki/Cornell_box

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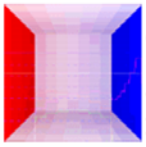
www.graphics.cornell.edu/online/box/history.html

History of the Cornell Box

Cornell University Program of Computer Graphics



The Original Cornell Box

This is the original Cornell box, as simulated by Cindy M. Goral, Kenneth E. Torrance, and Donald P. Greenberg for the 1984 paper *Modeling the interaction of Light Between Diffuse Surfaces*, Computer Graphics (SIGGRAPH '84 Proceedings), Vol. 18, No. 3, July 1984, pp. 213-222. Because form factors were computed analytically, no occluding objects were included inside the box.

Hemicube Form Factors

This simulation of the Cornell box was done by Michael F. Cohen and Donald P. Greenberg for the 1985 paper *The Hemi-Cube, A Radiosity Solution for Complex Environments*, Vol. 19, No. 3, July 1985, pp. 31-40. The hemi-cube allowed form factors to be calculated using scan

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C³ Review: Normal Transform

- When is the normal matrix the same as the model-view matrix?
  a) When the model-view matrix is a pure translation
  b) When the model-view matrix is a pure rotation
  c) When the model-view matrix is a scaling along only one axis
  d) (a) and (b)
  e) (a) and (c)

C³ Review: Normal Transform

- To transform the normal, we need to pass a normal mapping matrix `normalMatrix` to the vertex shader. Which of the following creates the correct `normalMatrix`?

```
mv = V * M
mvp = P * V * M
```

a)
```
normalMatrix = transpose(mv)
```

b)
```
normalMatrix =
transpose(inverse(mv))
```

c)
```
normalMatrix =
transpose(inverse(mvp))
```

d)
```
normalMatrix = transpose(mvp)
```

Lighting and Shading odds and ends

- Switch to pen for
  - Blinn-Phong reflection and the halfway vector
  - Color in OpenGL
  - Toon shading

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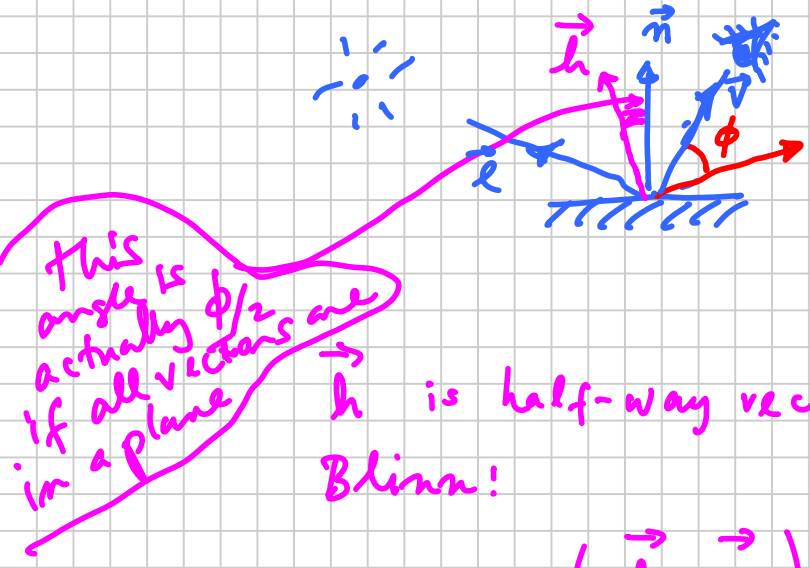
Note Title 2014-03-03

- Half-way vector (Blinn-Phong Reflaction)



Phong: $(\vec{R} \cdot \vec{v})^{\omega}$

$\vec{h}$ is half-way vector (between $\vec{l}$ and $\vec{v}$)

Blinn!

$$(\vec{h} \cdot \vec{n})^{\omega}$$

$\vec{h}$ is computed easily: $\text{normalize}(\vec{l} + \vec{v})$

(if $\vec{l}$ & $\vec{v}$ are unit vectors)

This produces a similar effect, but need a larger ω (shininess) exponent.

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§ Color in OpenGL

Red

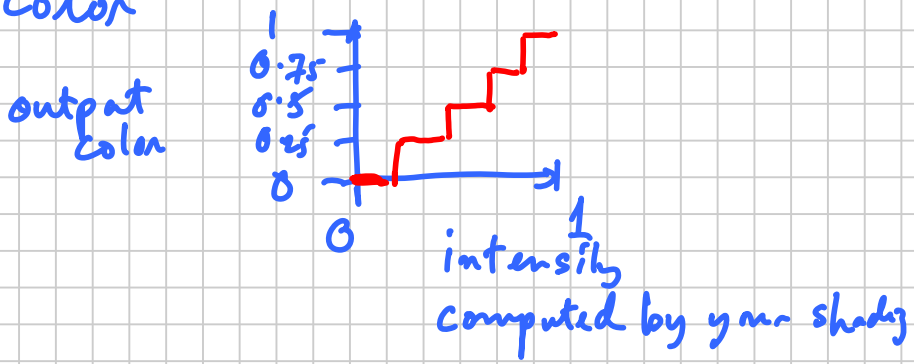
Green

Blue

Alpha - used to represent transparency, compositin

§ Toon Shading (assignment 3)

Similar to computing the diffuse (+ ambient) color



Texture Mapping

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An example scene from Pixar's Bolt

Figure 12: *A final production still from "Bolt" using Ptex for all models. (© Walt Disney Animation Studios)*

http://ptex.us/ptexpaper.html

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Texture Mapping in Doom ca. 1993!

http://en.wikipedia.org/wiki/Doom_%28video_game%29

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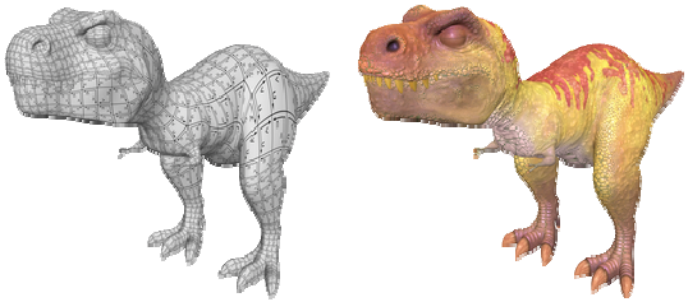
Example: Pixar's ptex



Source: http://ptex.us/ptexpaper.html

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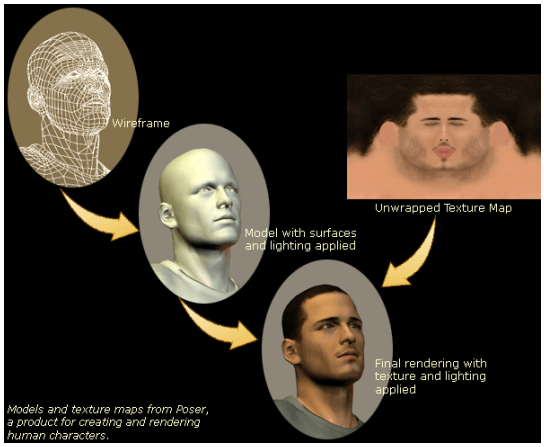
Another Example



Source: (result of random web search)
http://blog.gamerdna.com/2007/03/27/anatomy-of-an-mmorpg/

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First example
How to model the earth?

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