

Lighting and Shading wrapup

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1

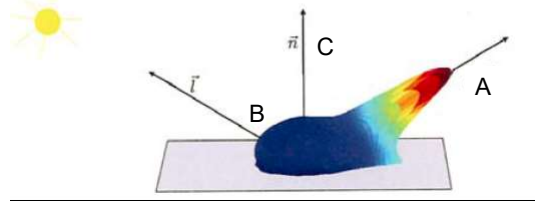
Today

- Lighting and Shading
 - Blinn-Phong reflection and the halfway vector
 - Toon shading
 - Global illumination and ambient
 - Transforming normals

2

Review: Phong Reflection

- Which feature is modelled by the specular component in the Phong reflection model?
- Which feature is modelled by the diffuse component?



- a) A b) B c) C d) All of the above e) None of the above

Lighting and Shading odds and ends

- Global illumination and ambient
- Blinn-Phong reflection and the halfway vector
- Toon shading
- Anisotropic reflection

Global Illumination Cornell box



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

5

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

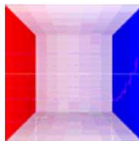
cornell cube



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

6

Phong Reflection

October 25, 2017

9:56 AM

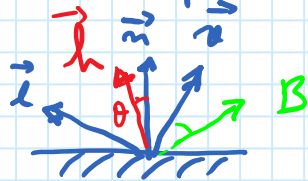
Typically also add an "Ambient" light
doesn't depend on \vec{l} or \vec{v} , approximates (crudely)
global illumination.

Phong \approx Diffuse + Specular + Ambient

— x —

Blinn-Phong (Blinn 77)
Reflection Model

Applies to Specular term only



\vec{h} = halfway vector
= normalize $(\vec{l} + \vec{v})$

When \vec{v} is aligned with \vec{B}
 \vec{h} " " " \vec{n}

Blinn takes specular to be

$$I_s = (\max(0, \vec{h} \cdot \vec{n}))^\alpha$$

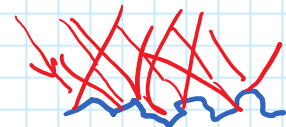
$(\cos \theta)^\alpha$ \swarrow shininess
(generates
larger
number
than
Phong)

Why?

— More consistent with the physics

\vec{h} is a better "extrinsic" description of illumination

— In practice: better results when $\vec{l}, \vec{n}, \vec{v}$ are
not co-planar. If they are coplanar, same as Phong



Toon Shading

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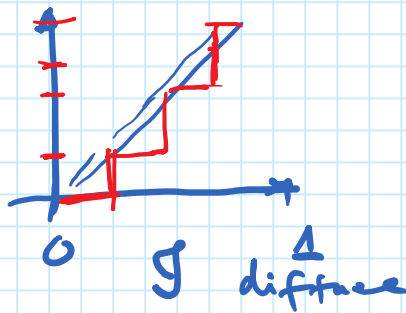
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Capture two qualitative features of cartoon

[Whole subfield called NPR
Non-photorealistic Rendering

(1) Small palette of colors

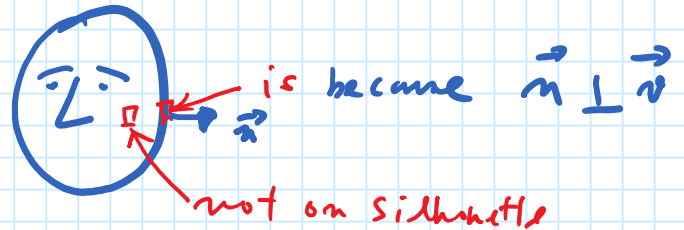
Simple algorithm: quantize diffuse component



Can also set
Cartoon like
"highlights"



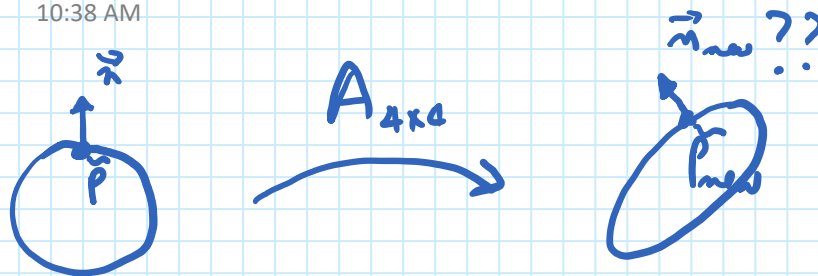
(2) Silhouette edges



Normals are not normal!!

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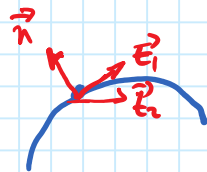


$$p_{\text{new}} = A p$$

$$n_{\text{new}} = A n ? \quad \text{WRONG!}$$

What is a normal?

A vector that is perpendicular to all tangent vectors



tangent vector is easier to define from A



$$\vec{t} = \lim_{h \rightarrow 0} \frac{\vec{p}_h - \vec{p}}{h}$$

So normal vector defined as

$$\vec{n} \cdot \vec{t} = 0$$

$$\vec{n}_{\text{new}} \cdot \vec{t}_{\text{new}} = 0$$

$$\boxed{t_{\text{new}} = A t}$$

In coordinates

$$n^T t = n_{\text{new}}^T t_{\text{new}} = n_{\text{new}}^T A t$$

Holds for all tangent vectors t

$$\text{So } n^T = n_{\text{new}}^T A$$

$$\boxed{n_{\text{new}} = (A^{-1})^T n}$$