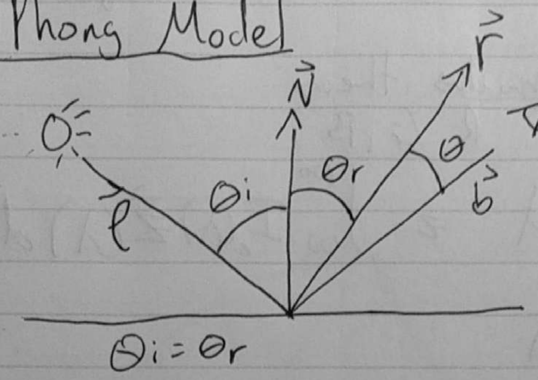
Light + Intensity

Phong Model



$\cos\theta$

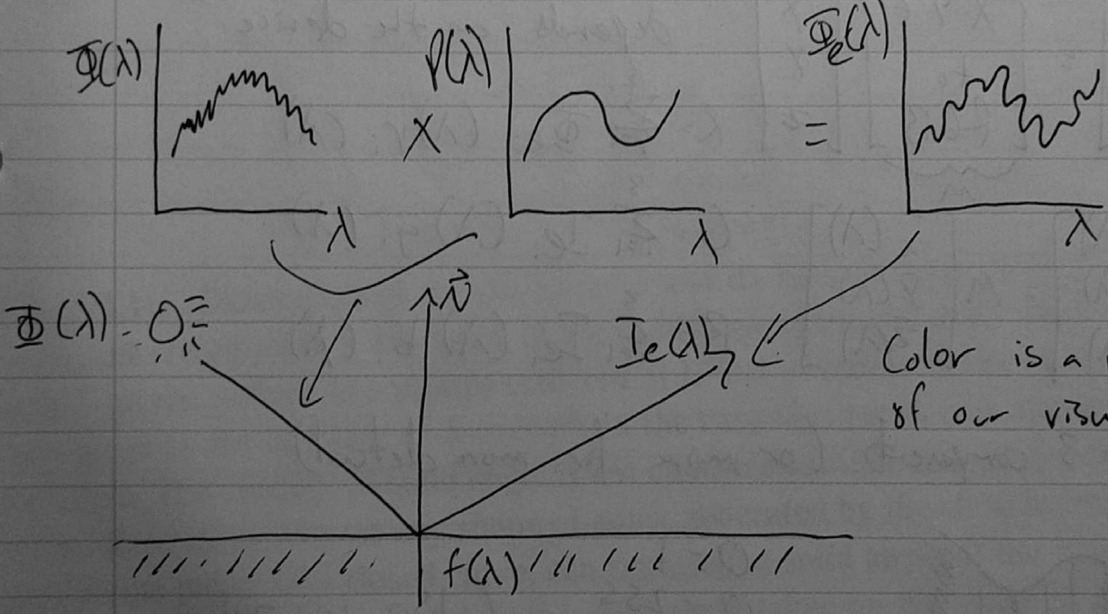
$\vec{r} \cdot \vec{b} \rightarrow (\cos\theta)^p$

→ small p, very diffuse

→ large p, very reflective (mirror)

More modern than on slides:

$k_d \to \rho_d$, $k_s \to \rho_s$



Color is a representation of our visual system

CIE Commission Internationale de l'Eclairage

Trichromatic or Tri-stimulus theory:

- 3 types of photo receptors: R, G, B

$$X = \int_{400}^{700} \Phi_e(\lambda)\,\bar{x}(\lambda)\,d\lambda \qquad Z = \int_{400}^{700} I_e(\lambda)\,\bar{z}(\lambda)\,d\lambda$$

$$Y = \int_{400}^{700} \Phi_e(\lambda)\,\bar{y}(\lambda)\,d\lambda$$

- color matching functions
  ⇒ these functions are expensive, used in theory, not always in practice
- In practice:

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \underbrace{\begin{bmatrix} XYZ \\ \text{to} \\ RGB \end{bmatrix}}_{M} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}$$

→ this matrix is hard to define & depends on the device

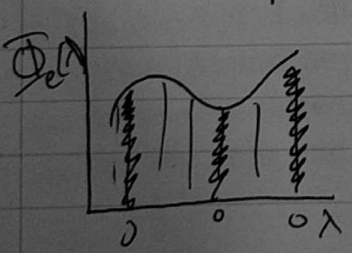
$$R = \sum_{i=1}^{3} \Phi_{e_i}(\lambda)\,r_i(\lambda)$$

$$\begin{bmatrix} r(\lambda) \\ g(\lambda) \\ b(\lambda) \end{bmatrix} = M \begin{bmatrix} \bar{x}(\lambda) \\ \bar{y}(\lambda) \\ \bar{z}(\lambda) \end{bmatrix}$$

$$G = \sum_{i=1}^{3} I_{e_i}(\lambda)\,g_i(\lambda)$$

$$B = \sum_{i=1}^{3} I_{e_i}(\lambda)\,b_i(\lambda)$$

- Pick 3 components (or more for more detail)



0 - 1
0 - 255

(150, 100, 70)
R G B

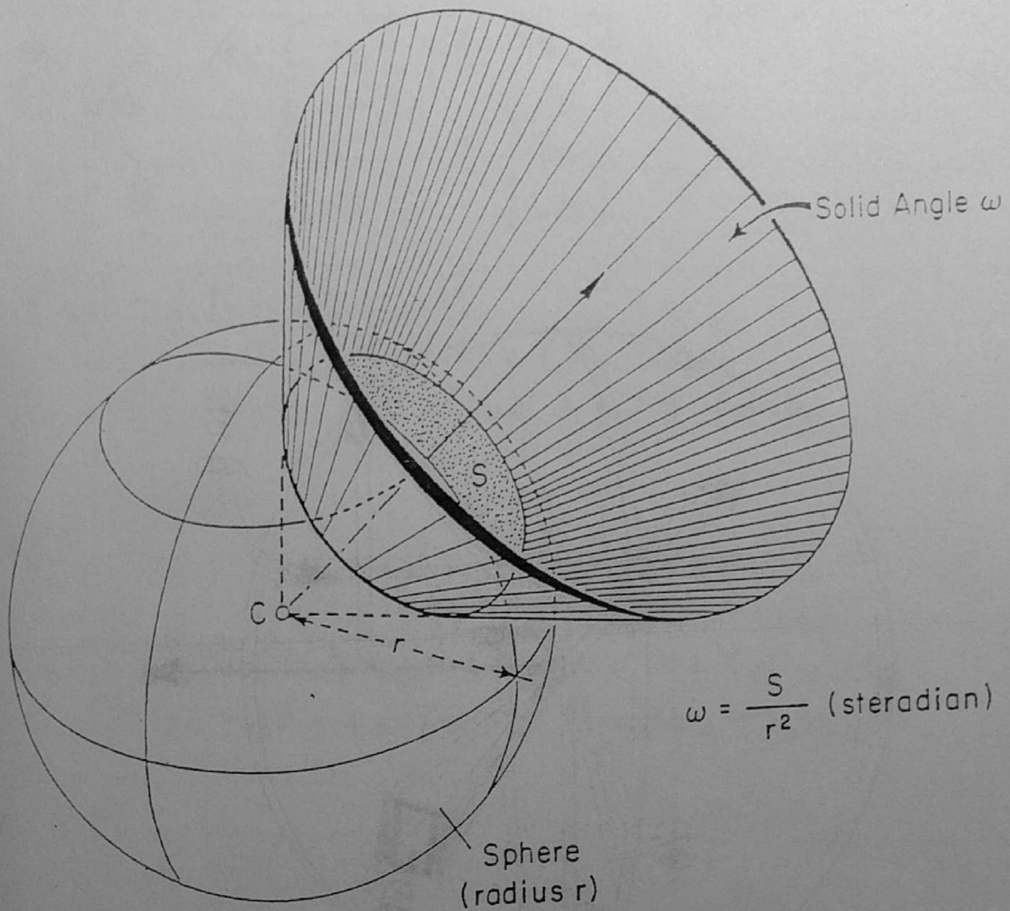
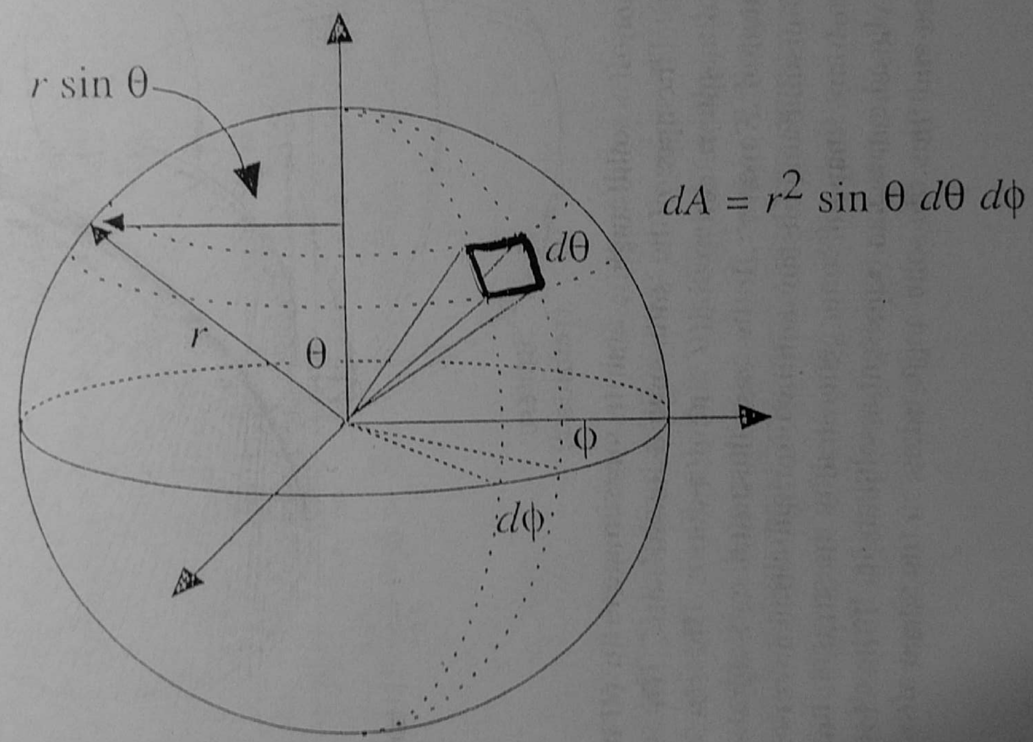


Fig. 2(1.1). Illustration of a solid angle ω and its measurement in terms of the unit of solid angle, the steradian (sr). The apex of the solid angle is located at C. The solid angle cuts off an area S on the surface of a sphere centered at C and of radius r. The size of the solid angle ω is then given by the quotient of S over r^2. In the case illustrated, ω is approximately equal to one steradian. The concept of solid angle is not confined to right-circular cones of the kind depicted in the illustration. Almost any shape of cone, generated by the straight lines emerging from the apex to the points of a closed curve, can represent a solid angle. If the closed curve is a polygon (e.g., a square), the cone and thus the solid angle takes on the shape of a pyramid.


r sin θ
r
θ
dθ
ϕ
dϕ
dA = r2 sin θ dθ dϕ

Opponent-Process Theory

- The photoreceptors are linked together to form three opposing color pairs. Blue/yellow, Red/green, black/white.

- Activation of one member inhibits activity in the other
- when one member is fatiqued by extended inspection, inhibition of the corresponding pair member is reduced

- This increases the relative activity level of the unfatiqued member and results in its color to be percieved.

Gamma Correction

- Human Eye is sensitive to ratios of intensity levels rather than to absolute values of intensity

Ex. Light bulbs 50w - 100w - 150w

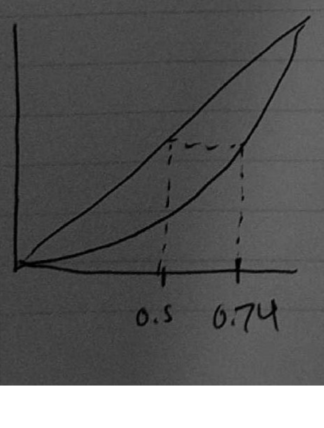
→ differen b/c it is 100% large

- Intensity levels should be specified logorithmically rather than linearly to achieve equal steps in brightness

$$I_g = I_{max}\left(\frac{V_g}{V_{max}}\right)^{\gamma}$$ v = voltage γ = gamma

Example: $I_g = 0.5$ $V_j = ?$ $\gamma = 2.3$

$I_{max} = 1.0$ $V_{max} = 1.0$



$V_j = 0.74$

if we map V_{max} to 255

V_j will map to 188

Dynamic Range

- the ratio between the maximum and min. intensities

Ex. CRT 40-200, Photographic prints: 1-100
Photographic slides: 1-1000
Eye: 1-4096, 1-10384   Digital camera: 1-256, 1-4046

Midterm:

Room 4021-MC - 45 minutes

Two types of Questions
- short answer - 5 question, 2 marks each
  ↳ might be true/false, it is very black/white

- lots of details if we have to derive something
- no coding
- everything covered in class/notes.
- parts of notes that we skipped → ignore them
  ↳ extra details are not counted.
- bring Calculator