

ECE 516 / CS 532 Computer Vision

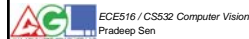
Class 2
January 28, 2008

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Advanced Graphics Lab



Announcements

- No office hours tomorrow (Tuesday Jan 29)
- Email me if you want to meet
- Also this is a good idea in the future (email me a heads up whenever you plan on dropping by)



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Last time

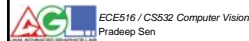
- Pinhole camera and basic lenses
- Forsyth Ch 1



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Today

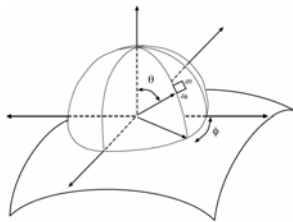
- Radiometry
- Local shading models
- Ch. 4 & and start of ch. 5



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Angle notation

- Planar angles (radians)
- Solid angles (steradians)



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Radiometry

- The science of measuring light



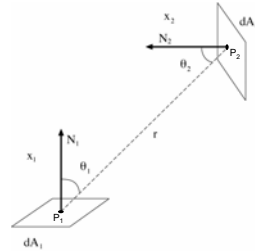
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Radiance

- The power traveling at some point in a specified direction, per unit area perpendicular to the direction of travel, per unit solid angle ($W/m^2 \text{ sr}$)
- Think of it as the power (energy per unit time) in a ray of light
- Constant along rays (in a vacuum)
- Useful property because it gives us an invariant when simulating light flow (used in both computer graphics and vision)

Radiance

- Radiance is constant along rays



- Power 1->2, leaving 1:

$$L(\underline{x}_1, \vartheta, \phi) dA_1 \cos \theta_1 \left(\frac{dA_2 \cos \theta_2}{r^2} \right)$$

- Power 1->2, arriving at 2:

$$L(\underline{x}_2, \vartheta, \phi) dA_2 \cos \theta_2 \left(\frac{dA_1 \cos \theta_1}{r^2} \right)$$

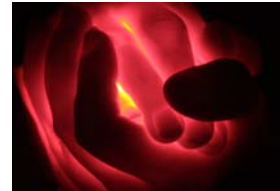
- But these must be the same, so that the two radiances are equal

Irradiance

- Incident power per unit area (W/m^2)

Local reflectance model

- The radiance leaving a point on a surface is due only to the radiance arriving at this point



Local reflectance model

- The radiance leaving a point on a surface is due only to the radiance arriving at this point
- All the light leaving a surface at a given wavelength is due to the light arriving at that wavelength
- Surfaces do not generate light

The BRDF

- Bidirectional Reflectance Distribution Function
- A ratio of the radiance in the outgoing direction to the incident radiance
- Units: $1/\text{sr}$

Radiance leaving a surface

- To compute the radiance leaving a surface point in a particular direction we multiply the irradiance from a direction by the BRDF
- If we want to determine the outgoing radiance from all the incident irradiance, we integrate over the hemisphere of incident directions

Important properties of the BRDF

- Helmholtz reciprocity: symmetric in the incoming and outgoing direction
- Cannot be arbitrary values: the total energy in cannot be less than total energy out (no energy created)
- This is a physical restriction

Reading

- Forsyth, Ch 5