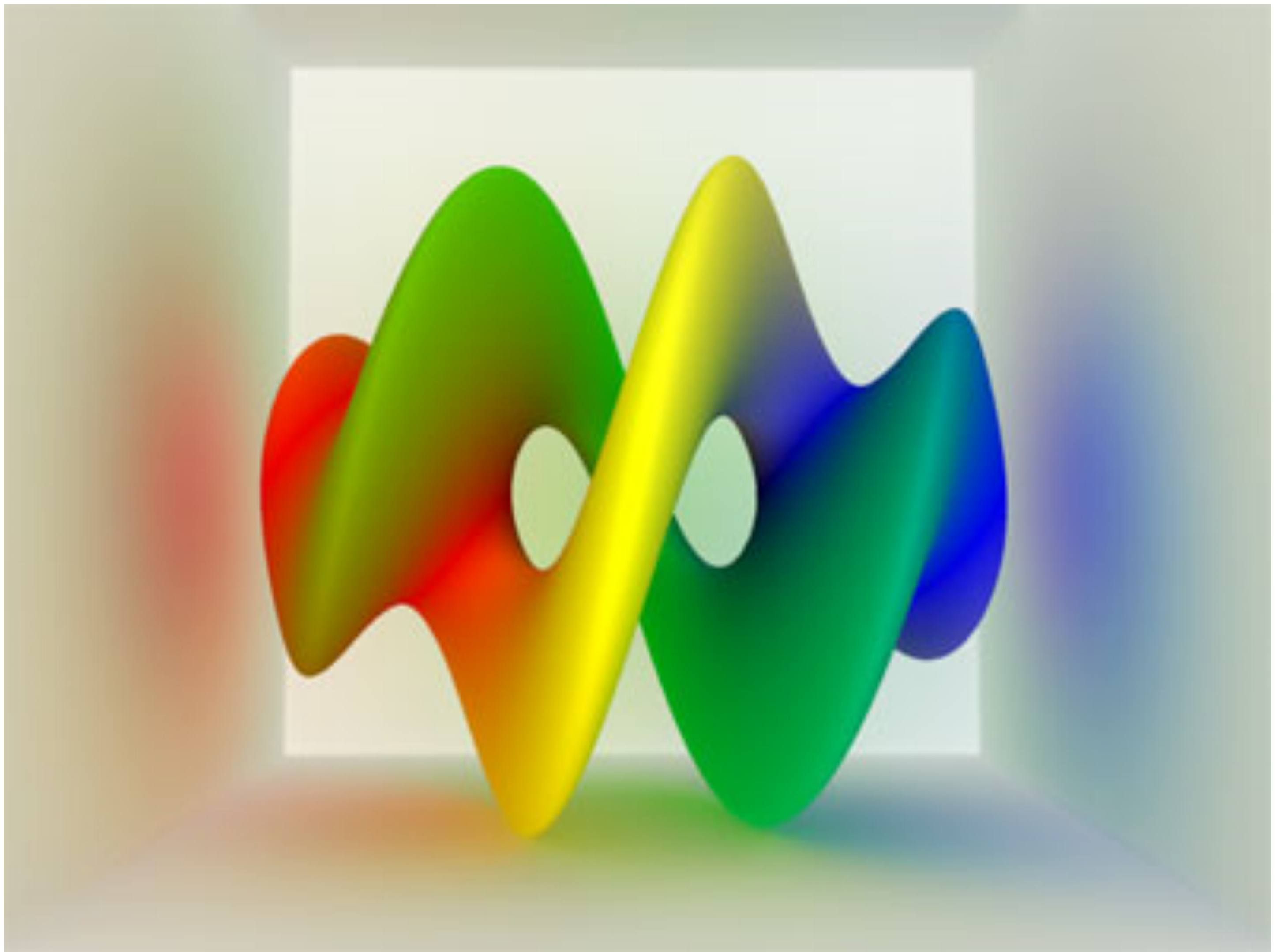
IL·LUMINACIÓ GLOBAL

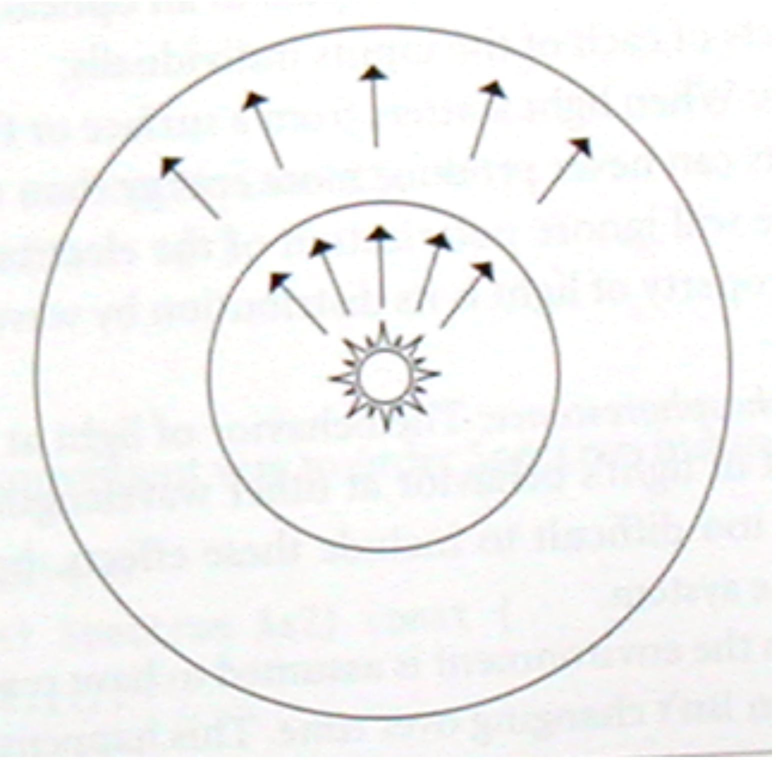
amb materials de Carlos Andújar i Mario Costa Sousa

Color bleeding

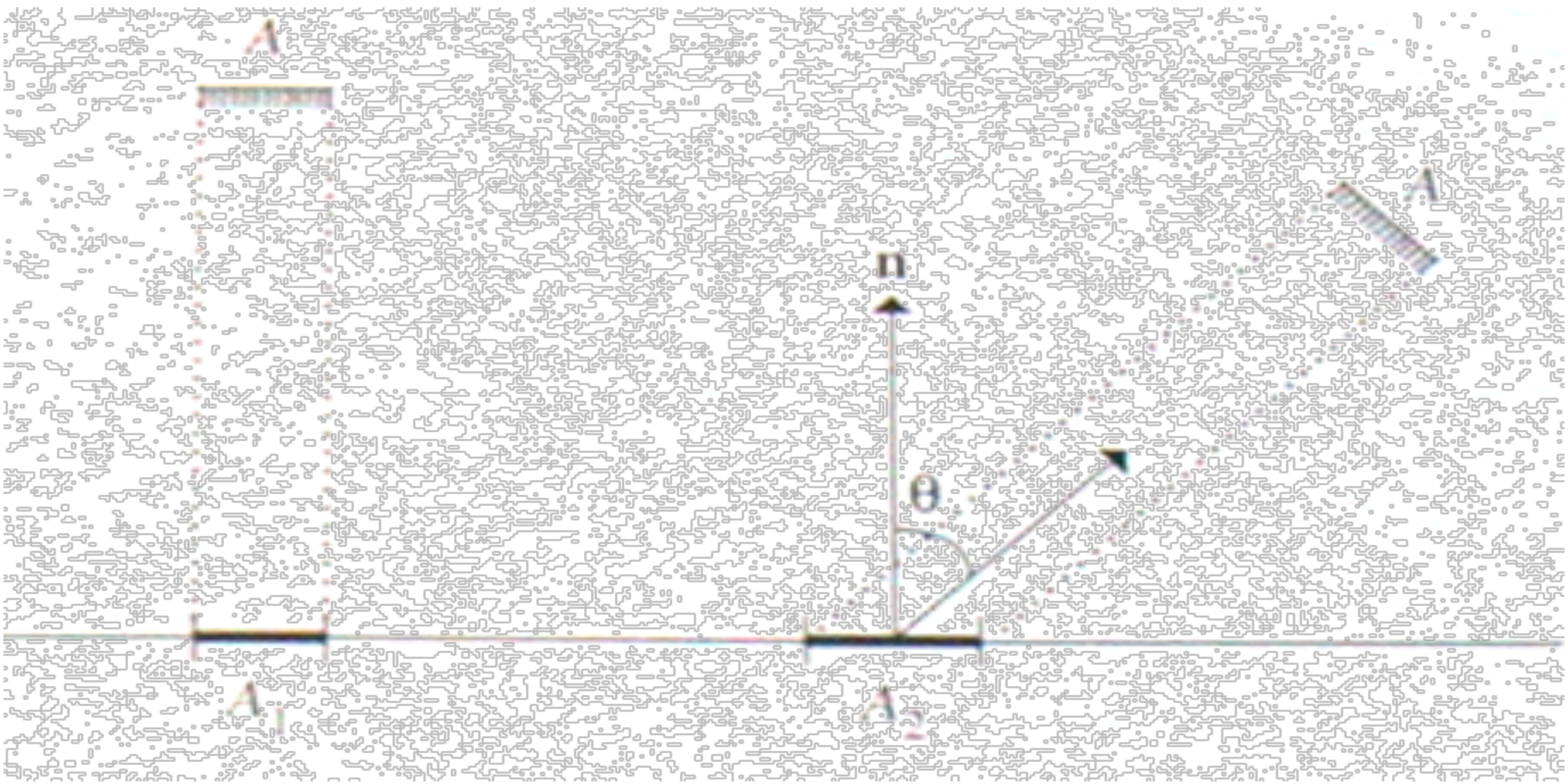


UNITATS RADIOMETRIA

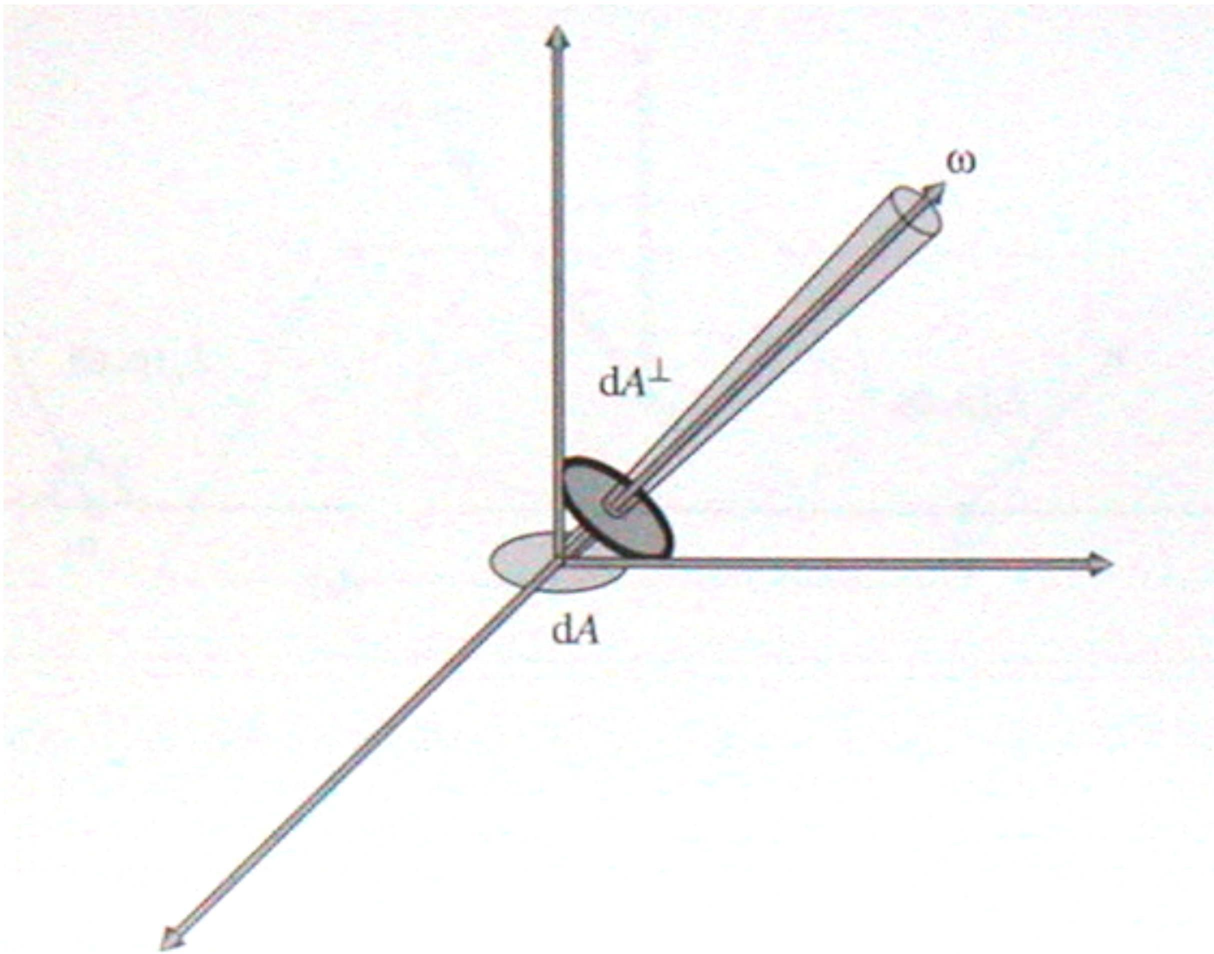
Flux radiant Φ



Irradiància E i Llei de Lambert



Radiància L(p,ω)

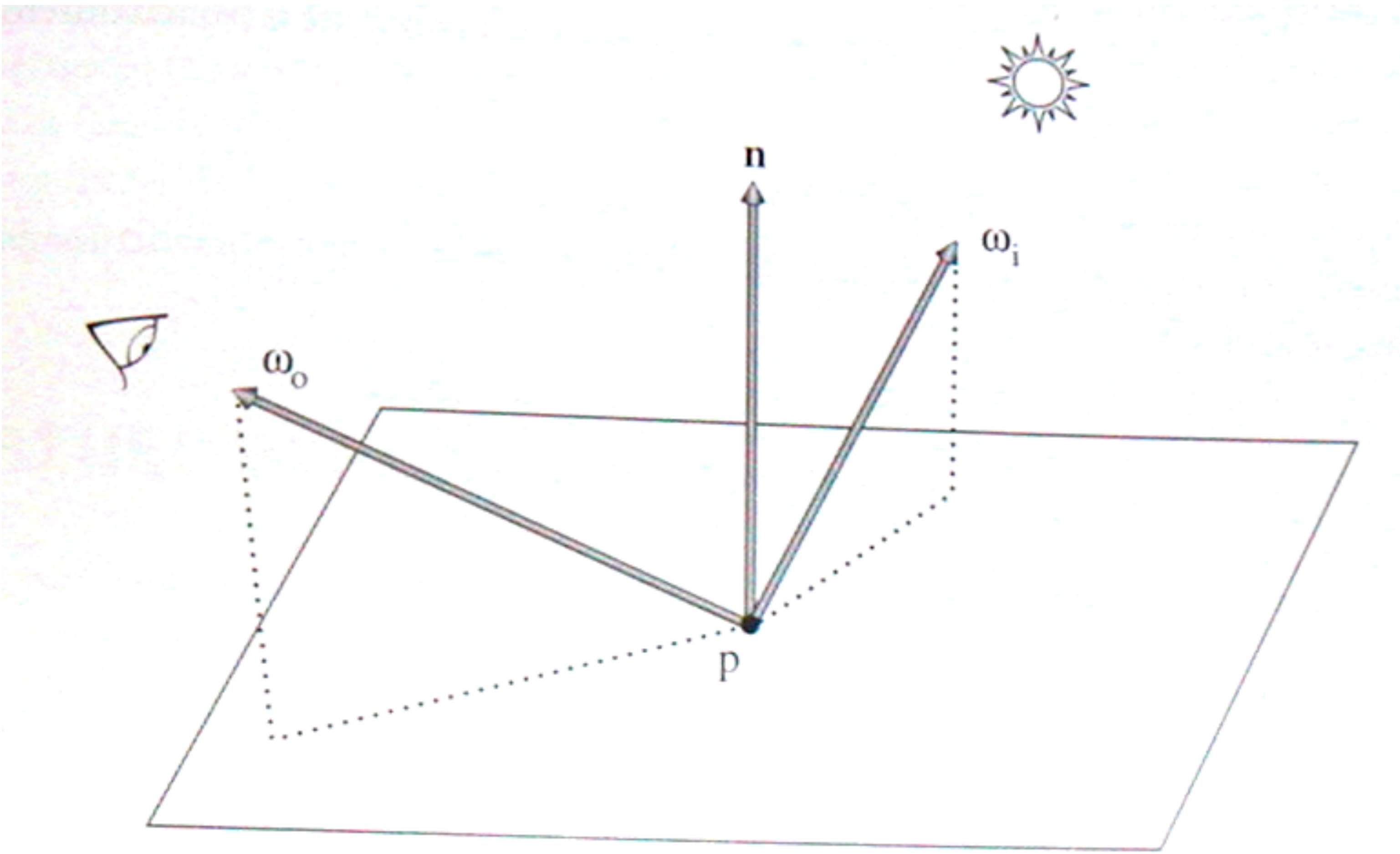


Resum fotometria

Sím.	**Radiomet.**	**Fotometria**	**Definició**	**Ús**
Φ	Fluxe (W)	Fluxe (lm)	Energia que travessa una superficie per unitat de temps	Energia total que emet una font de llum
E	Irradiancia (W/m^2)	Iluminància ($lux=lm/m^2$)	Fluxe per unitat **d'àrea**	Llum que incideix en un punt, des de qualsevol direcció
I	Intensitat (W/sr)	Intensitat (cd=lm/sr)	Fluxe per unitat **d'angle sòlid**	Distribució direccional d'una llum puntual
L	Radiància $W/(sr\cdot m^2)$	Luminància (cd/m^2)	Fluxe per unitat **d'àrea** i unitat **d'angle sòlid**	Energia que travessa un punt en una determinada direcció

BRDF

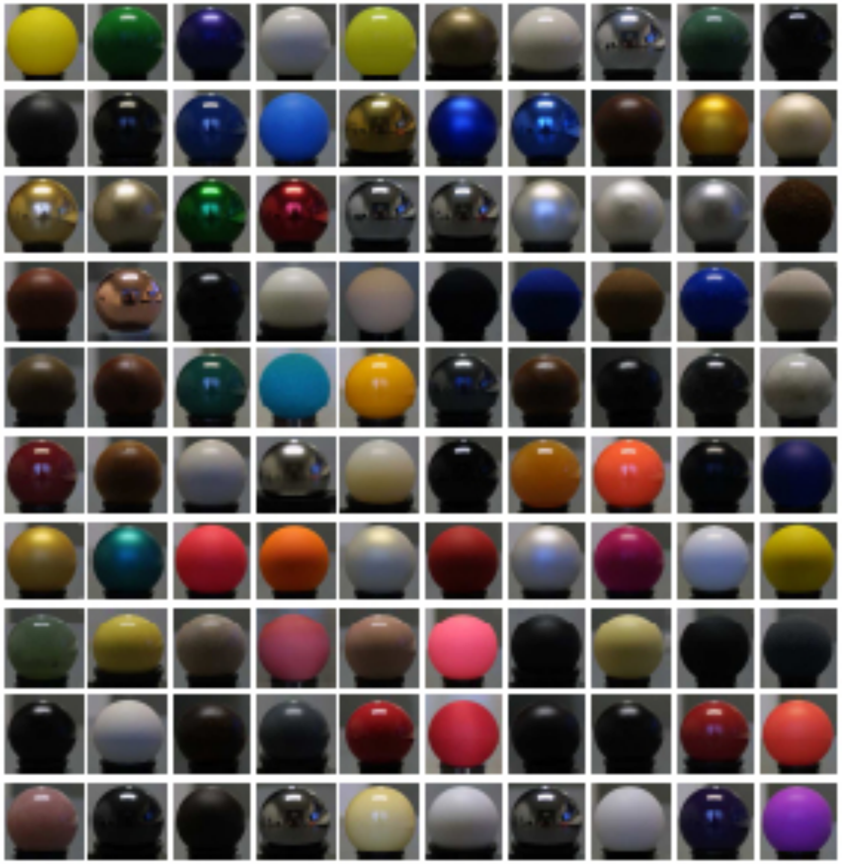
BRDF $f(p,\omega_o,\omega_i)$



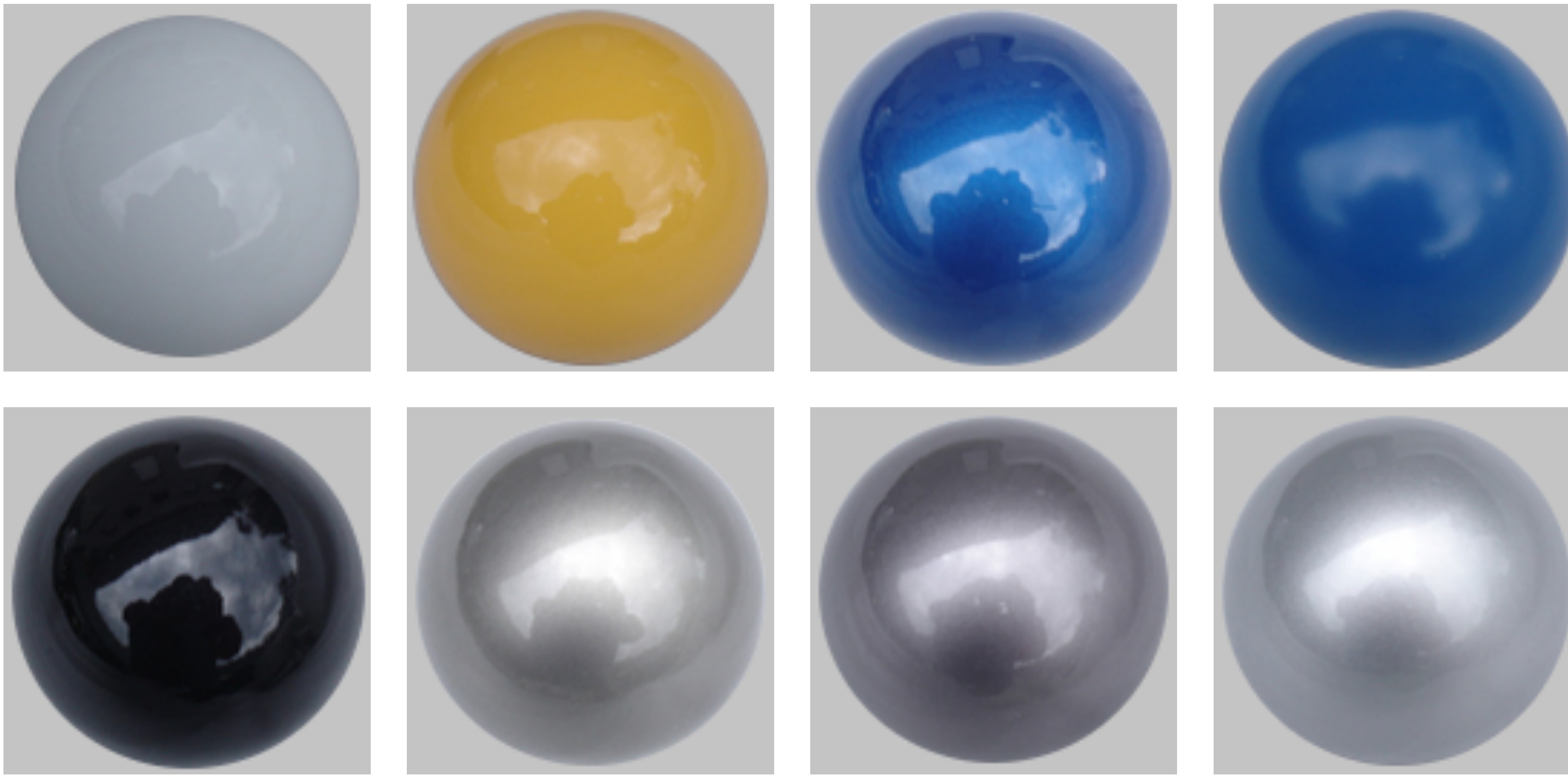
BRDF

MERL BRDF database

- www.merl.com/brdf/



BRDF de pinturas



Phong vs BRDF mesurat

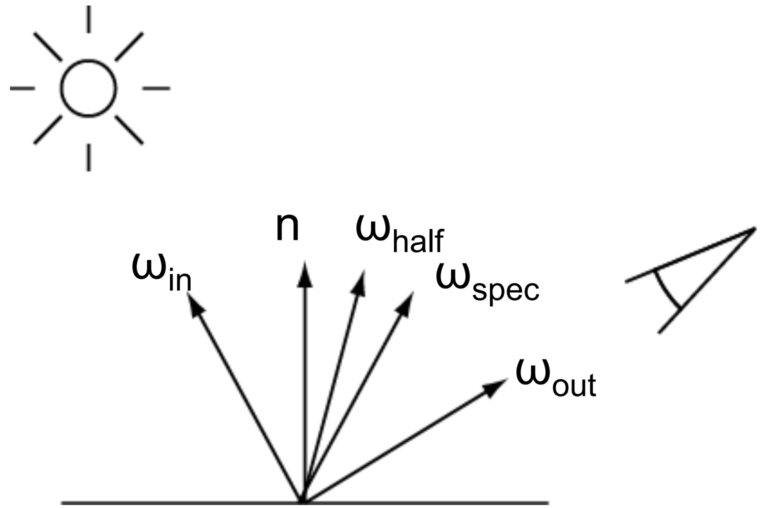
$$L_{out}(x, \omega_{out}) = L_{in}(x, \omega_{in}) * f(\omega_{in}, \omega_{out}) * (\omega_{in}.n)$$

$$L(x \rightarrow \Theta) = L_e(x \rightarrow \Theta) + \int_{\Omega_x} L(x \leftarrow \Psi) f_r(x, \Psi \leftrightarrow \Theta) \cos(n_x, \Psi) d\omega\Psi$$

- Reciprocitat
  - $f(x, \omega_{in}, \omega_{out}) = f(x, \omega_{out}, \omega_{in})$

- Conservació de l'energia
  - $\int f(\omega_{in}, \omega_{out}) * (\omega_{in}.n)\, d\omega_{in} \leq 1$

BRDFs Analítiques



Lambert: $f(\omega_{out}, \omega_{in}) = k_d$

Blinn: $f(\omega_{out}, \omega_{in}) = k_d + k_s (n. \omega_{half})^n$

Phong $f(\omega_{out}, \omega_{in}) = k_d + k_s (\omega_{out} . \omega_{spec})^n$

Hi ha moltes altres BRDFs analítiques que hom ha proposat, com Cook Torance-BRDF, Ward-BRDF,…

Radiosity

$$L(x \rightarrow \Theta) = L_e(x \rightarrow \Theta) + \int_{\Omega_x} L(x \leftarrow \Psi) f_r(x, \Psi \leftrightarrow \Theta) \cos(n_x, \Psi) d\omega\Psi$$

Suposem que totes les superfícies i fonts de llum són difuses, i tenen
Un comportament uniforme sobre tota la superfície.

Subdividim en pedaços per a mantenir l'uniformitat

Obtenim una versió disretitzada de l'equació de rendering

$$B_i = E_i + \rho_i \sum B_j F_{ij}$$

The Radiosity Equation

$$B_i = E_i + \rho_i \sum B_j F_{ij}$$

Radiosity of surface i

Emissivity of surface i

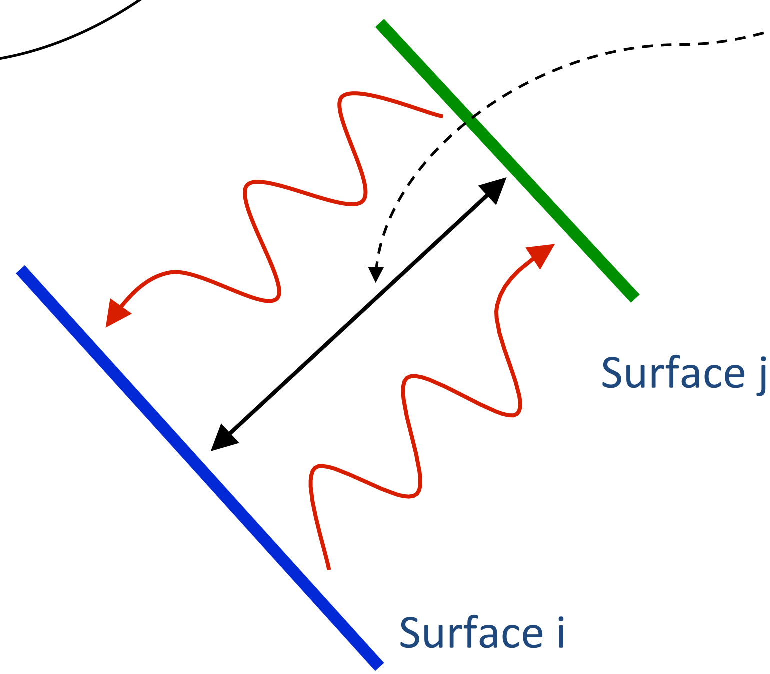
Reflectivity of surface i

will <u>absorb</u> a certain percentage of light energy which strikes the surface

Radiosity of surface j

Form Factor of surface j relative to surface i

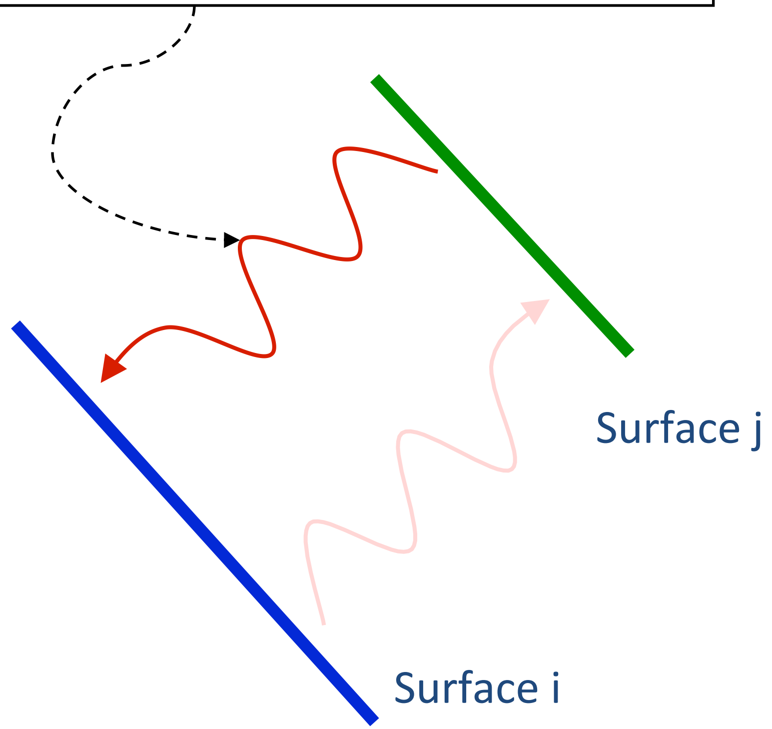
accounts for the <u>physical relationship</u> between the two surfaces



The Radiosity Equation

$$B_i = E_i + \rho_i \sum B_j F_{ij}$$

Energy reaching surface i from other surfaces



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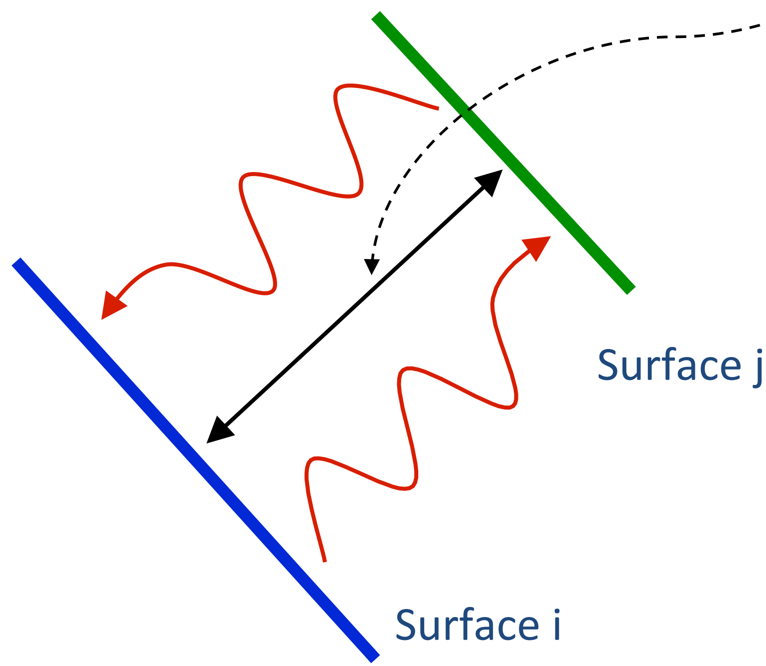
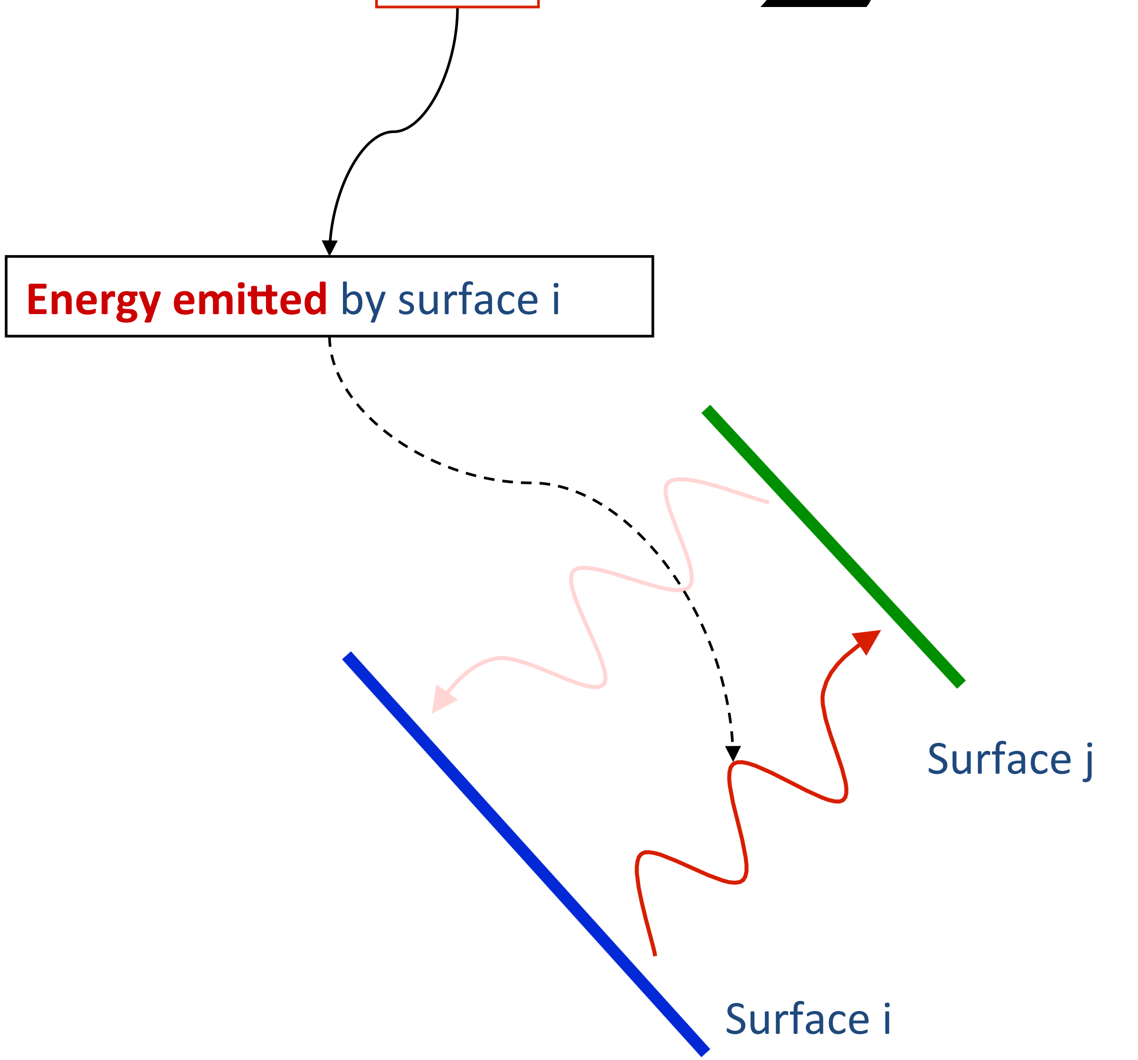


The Radiosity Equation

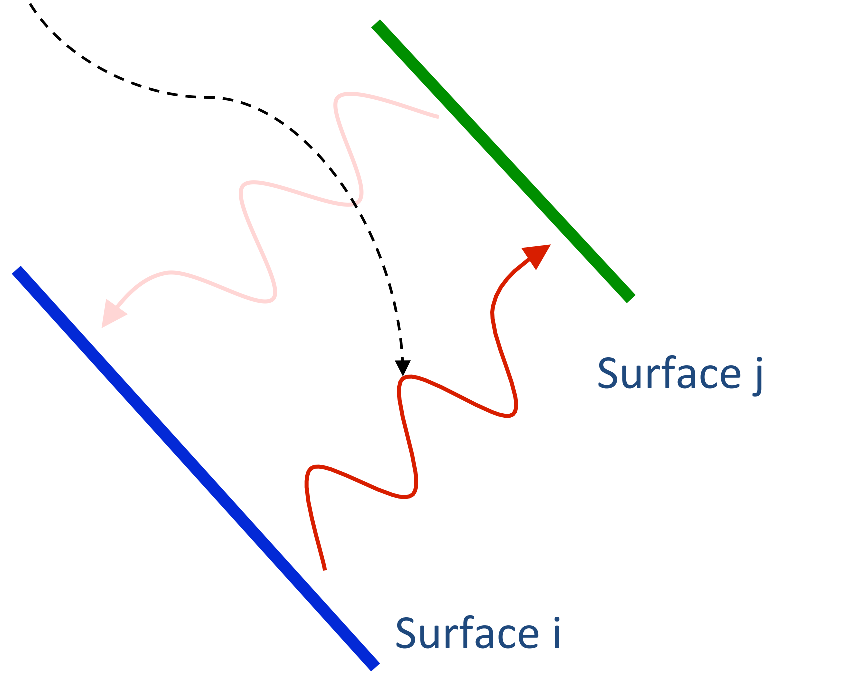
$$B_i = \boxed{E_i} + \rho_i \sum B_j F_{ij}$$



The Radiosity Equation

$$B_i = E_i + \boxed{\rho_i \sum B_j F_{ij}}$$

Energy reflected by surface i



The Radiosity Equation

Energy reflected by surface i

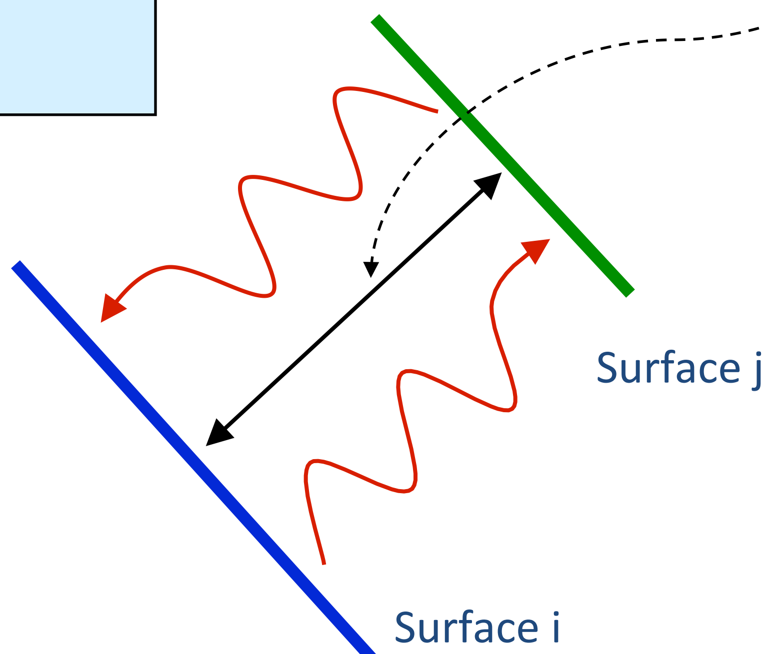
$$B_i = E_i + \rho_i \sum B_j F_{ij}$$

Reflectivity of surface i

Radiosity of surface j

Form Factor of surface j relative to surface i

Energy reflected by surface i =
Reflectivity of surface i *
Energy reaching surface i
from other surfaces



Reflectivity
will <u>absorb</u> a certain percentage of light energy which strikes the surface

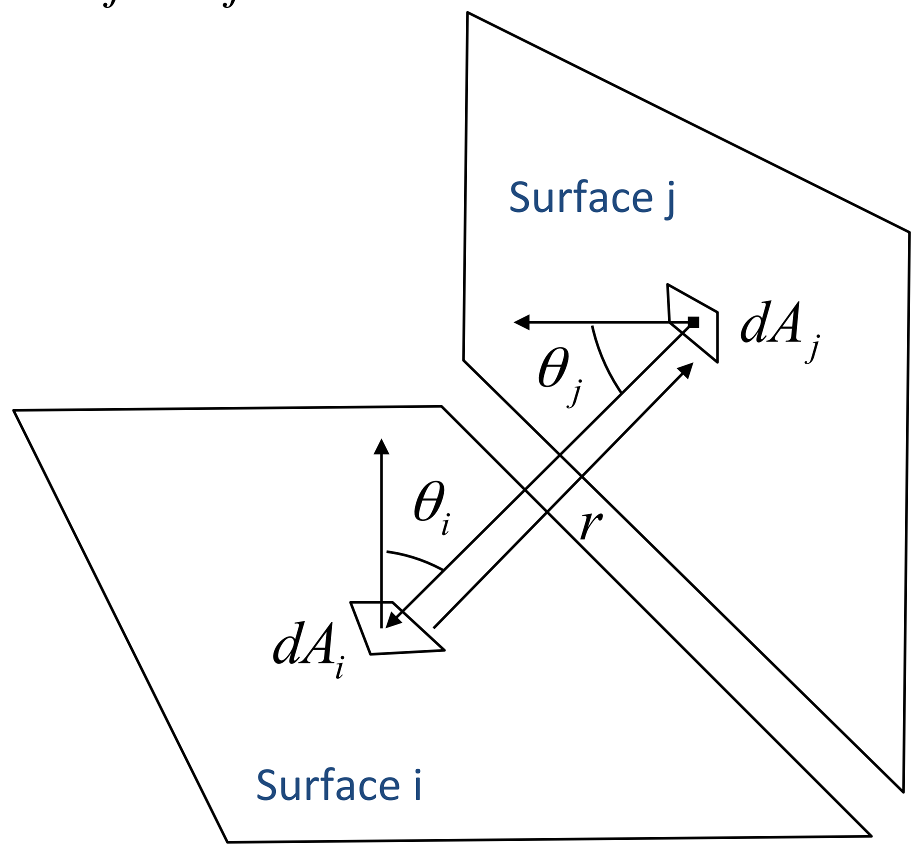
Form Factor
accounts for the <u>physical relationship</u> between the two surfaces

Càlcul dels factors de forma

$$F_{ij} = \frac{1}{A_i}\int_{A_i}\int_{A_j} \frac{\cos\theta_i \cos\theta_j}{\pi r^2} V_{ij}\, dA_j\, dA_i$$

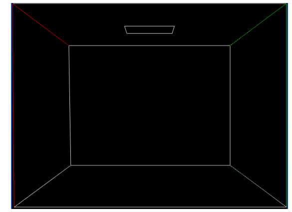
Area integral over surface *i*

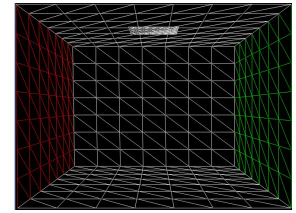
Area integral over surface *j*



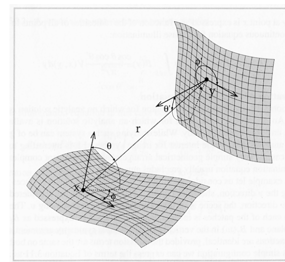
Classic Radiosity Algorithm

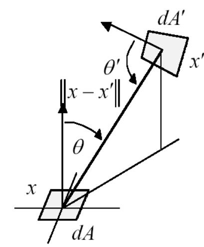
Mesh Surfaces into Elements



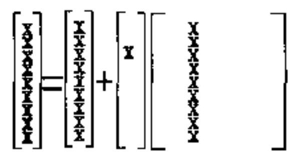


Compute Form Factors Between Elements





Solve Linear System for Radiosities



Reconstruct and Display Solution

Radiosity com a sistema d’equacions

$$\begin{bmatrix} 1-\rho_1 F_{11} & -\rho_1 F_{12} & \cdots & -\rho_1 F_{1n} \\ -\rho_2 F_{21} & 1-\rho_2 F_{22} & \cdots & -\rho_2 F_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ -\rho_n F_{n1} & -\rho_n F_{n2} & \cdots & 1-\rho_n F_{nn} \end{bmatrix} \begin{bmatrix} B_1 \\ B_2 \\ \vdots \\ B_n \end{bmatrix} = \begin{bmatrix} E_1 \\ E_2 \\ \vdots \\ E_n \end{bmatrix}$$

Resultats