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Radiosity

CPSC 314

Radiosity

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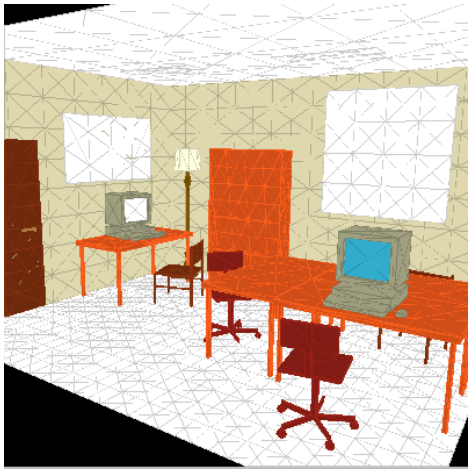

[IBM]

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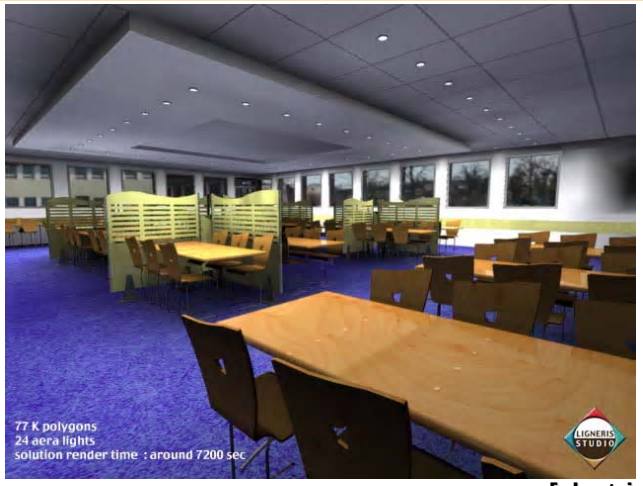

[electricimage.com]

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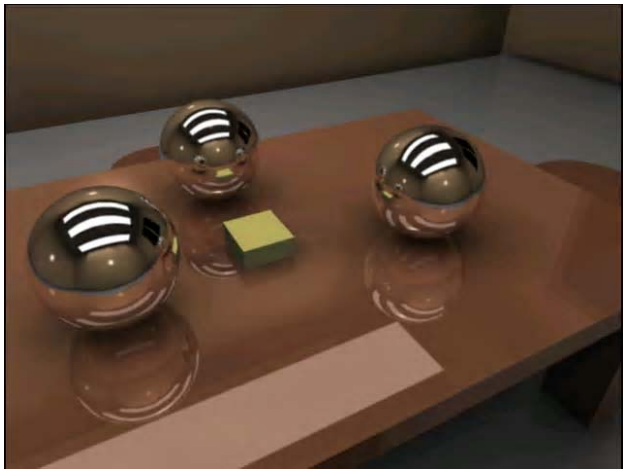

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Radiosity Example

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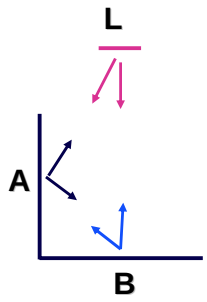

reflectivity

A	0.8
B	0.8
L	0.85

emission

A	0 W
B	0 W
L	100 W

form factors

from \ to	A	B	L
A	0	0.35	0.05
B	0.3	0	0.06
L	0.25	0.45	0

Computing an Energy Balance

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light leaving = light emitted + light reflected

$$I_L = 100 + 0.85 * (0.05 I_A + 0.06 I_B)$$
$$I_A = 0 + 0.8 * (0.3 I_B + 0.25 I_L)$$
$$I_B = 0 + 0.8 * (0.35 I_A + 0.45 I_L)$$

More formally...

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- ***flux***, **I**: energy per unit time (W)
- **radiosity**, B: exiting flux density (W/m^2)

flux = radiosity * area

I=B*A

- E: exiting flux density for light sources (W/m^2)
- **reflectivity**, R: fraction of incoming light reflected

More formally...

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light leaving surface = emitted light + reflected light

$$B_i A_i = E_i A_i + R_i \sum_j B_j F_{ji} A_j$$

$$B_i = E_i + R_i \sum_j B_j F_{ji} \frac{A_j}{A_i}$$

form-factor reciprocity:

$$F_{ji} A_j = F_{ij} A_i$$

$$B_i = E_i + R_i \sum_j B_j F_{ij}$$

More formally (cont.)

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$$\begin{bmatrix} E_1 \\ E_2 \\ \cdots \\ E_n \end{bmatrix} = \begin{bmatrix} 1-R_1F_{11} & \cdots & -R_1F_{1n} \\ -R_2F_{21} & & -R_2F_{2n} \\ \cdots & & \cdots \\ -R_nF_{n1} & \cdots & -R_nF_{nn} \end{bmatrix} \begin{bmatrix} B_1 \\ B_2 \\ \cdots \\ B_n \end{bmatrix}$$

emitted flux density

exiting flux density

Issues

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- need to solve N simultaneous equations
  What to do when N = 50,000 ?
  - *use iterative, hierarchical methods*
- form factor computation is costly due to visibility
- need to reconstruct a continuous image from patches
  - *interpolation schemes, non-constant basis*
- curved surfaces?
- sharp shadows?
- specular reflection, translucency, refraction?
  - *hybrid radiosity / ray-tracing techniques*