Global Illumination Methods

• Ray Tracing
• Radiosity
• Path Tracing
Ray Tracing

- Specular Reflection
- Diffuse Reflections
- Incident Light Beam
- Reflected Scatter Distribution BRDF
End of Review
Radiosity
Radiosity

... or how to render diffuse interreflections!!!
Radiosity Algorithms

- Polygons only
- Diffuse BRDFs only
- Diffuse light sources only
- Static scenes only
Museum Simulation

(Chen et al. 1988)
Radiosity Advantages

• Physically based approach for diffuse environments
• Can model diffuse interactions, color bleeding, indirect lighting and penumbra (area light sources)
• Accounts for very high percentage of total energy transfer
RADIOSITY = 

EMITTED + REFLECTED LIGHT
\[ \sum B_j F_{ij} \]

\[ \rho_i \sum B_j F_{ij} \{B_i \} \]

surface \[ i \]
The Radiosity Method

\[ B_i = E_i + \rho_i \sum_{j=1}^{n} B_j F_{ij} \]

- \( B_i \) = radiosity of patch i
- \( E_i \) = emission of patch i
- \( \rho_i \) = reflectivity of patch i
- \( F_{ij} \) = form-factor from i to j

* assuming diffuse environments
Form Factor

- $F_{i \leftarrow j} = \text{the fraction of power emitted by } j, \text{ which is received by } i$
Form Factor

- **Area**
  - if i is smaller, it receives less power

- **Orientation**
  - if i faces j, it receives more power

- **Distance**
  - if i is further away, it receives less power
The Radiosity Method

\[ B_i = E_i + \rho_i \sum_{j=1}^{n} B_j F_{ij} \]

- \( B_i \) = radiosity of patch \( i \)
- \( E_i \) = emission of patch \( i \)
- \( \rho_i \) = reflectivity of patch \( i \)
- \( F_{ij} \) = form-factor from \( i \) to \( j \)

* assuming diffuse environments
Simultaneous Radiosity Equations
49 patches per side
linear interpolation RGB plot
John Ferren - Daylight Experiment (Facade), 1968 Diagram
Hirshhorn Museum
CPU time
VAX 11/780

202 Min.

19 Min.

22 Min.

Total:
243 Min.

1985
MODEL ENVIRONMENT
BREAKUP INTO PATCHES

FORM-FACTORS

CHANGE
COLORS

SOLUTION

CHANGE
VIEW

RENDER IMAGE

DISPLAY

CPU time
VAX 11/780

0 Min.

19 Min.

22 Min.

Total:
41 Min.
CPU time
VAX 11/780
0 Min.
0 Min.
22 Min.
Total: 22 Min.

1985
Radiosity (gathering)
Radiosity (shooting)
Ambient Only
Progressive Refinement Radiosity
The new epidemic of sexually transmitted diseases.
The quest for the origin of life.
Chaos in the brain may shape perception.

Vivid computer graphics replace architects' pencil sketches and handcrafted models with realistic moving images.
Discontinuity Meshing
Discontinuity Meshing
Discontinuity Meshing
Discontinuity Meshing
End...