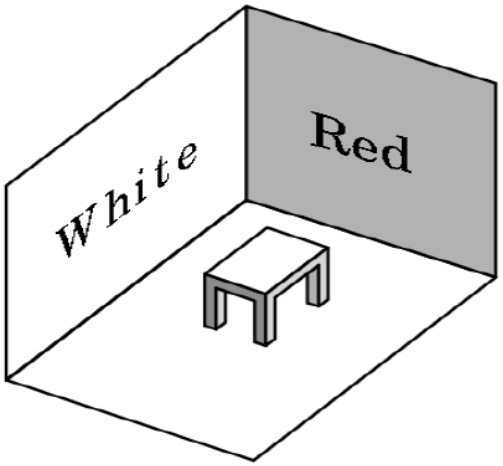
Radisoity

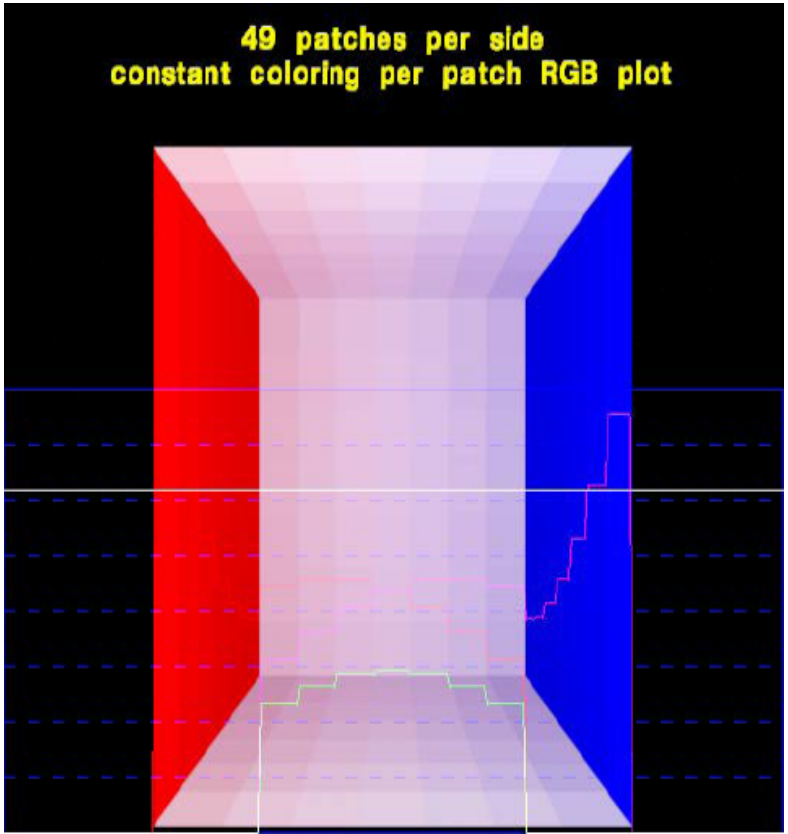
Introduction

- Ray tracing is best with many highly specular sufaces
  - Not characteristic of real scenes
- Rendering equation describes general shading problem
- Radiosity solves rendering equation for perfectly diffuse surfaces

Radiosity

- Ideal for scene consisting of only perfectly diffuse surfaces.
- Light interactions in a view-independent way
- paths which leave a light source and are reflected diffusely some number of times (possibly zero) before hitting the eye.
- An example
  - Some of the diffuse reflections from red wall would fall on white wall.
  - Diffuse light from white wall would have a similar effect on red wall.
  - Simple shading model does not consider these diffuse-diffuse interactions.





Radiosity

- Physical laws governing the radiant-energy transferred(1950)
- Radiant energy terms
  - Energy of each Photon
  - Total radiant energy sum over all photons and all frequency
  - Radiant power [flux] (Φ)
- Rate at which light energy is transmitted (in watts = joules/sec).

Radiosity

- Radiosity(B)
  - Existent flux density from a locally planar area (in watts/ m^2)

$$B = \frac{d\Phi}{dA}$$

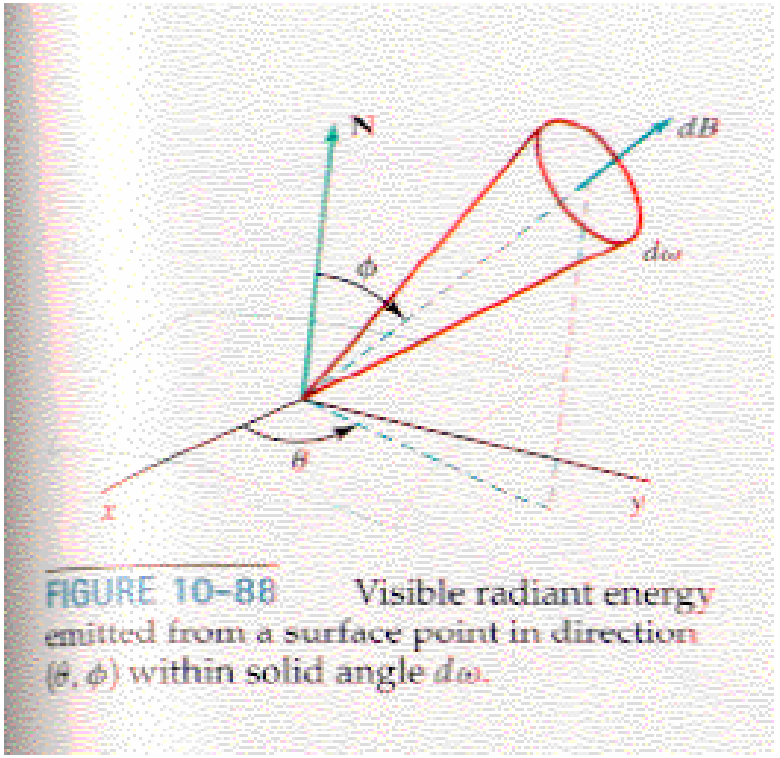
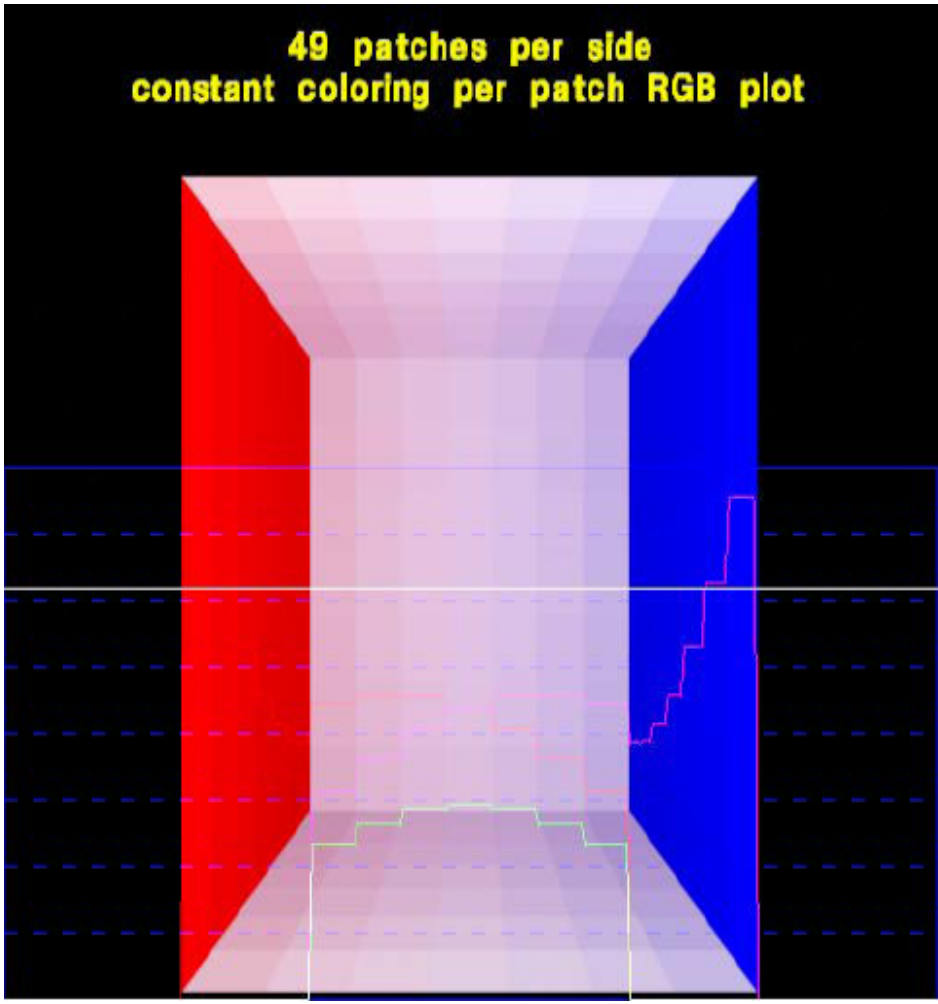


FIGURE 10-88 Visible radiant energy emitted from a surface point in direction (θ, ϕ) within solid angle $d\omega$.

Radiosity Equation

$$B_k = E_k + \rho_k H_k = E_k + \rho_k \sum_j B_j F_{jk}$$

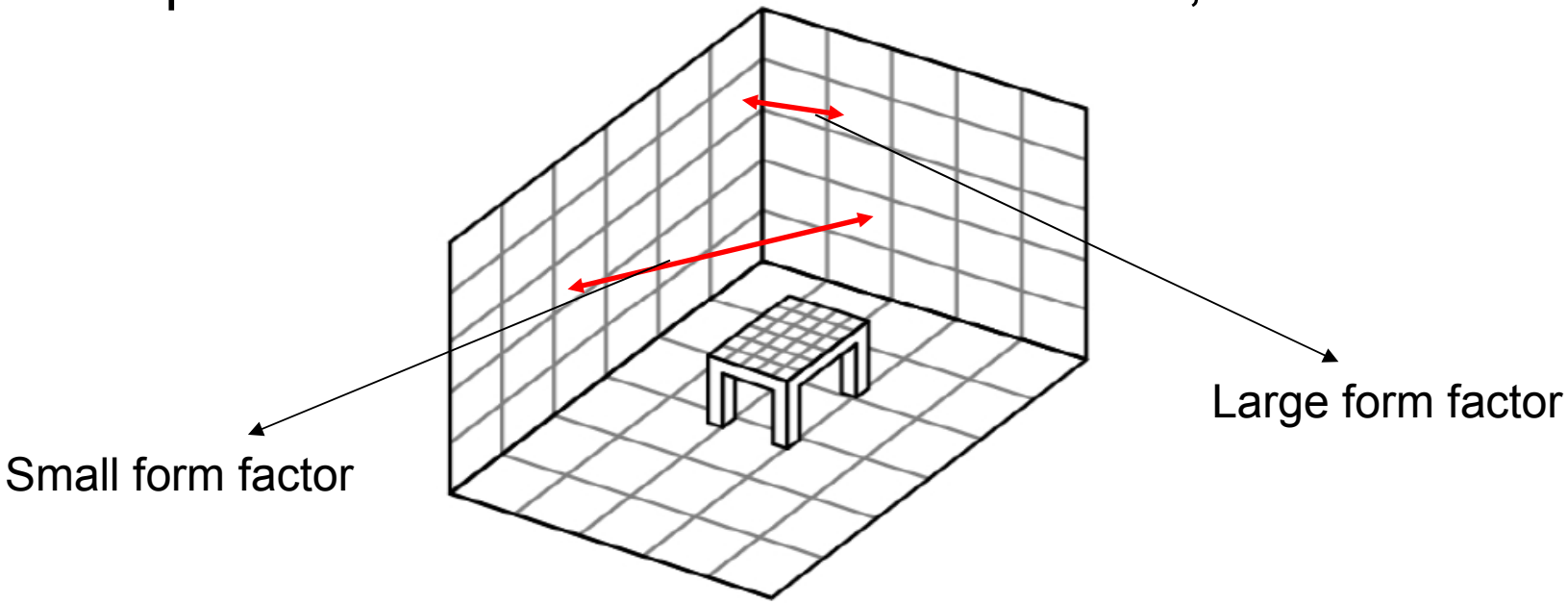
- B_k–Radiosity at surface k
- E_k-Energy emitted from surface k
- ρ_k-reflectivity factor for surface k
- H_k–sum of the radiant energy contributions from all surfaces in the rendered volume arriving at surface k per unit time per unit area
- F_{jk}-Form factor of surface j related to surface k



http://www.siggraph.org/education/materials/HyperGraph/radiosity/overview_1.htm

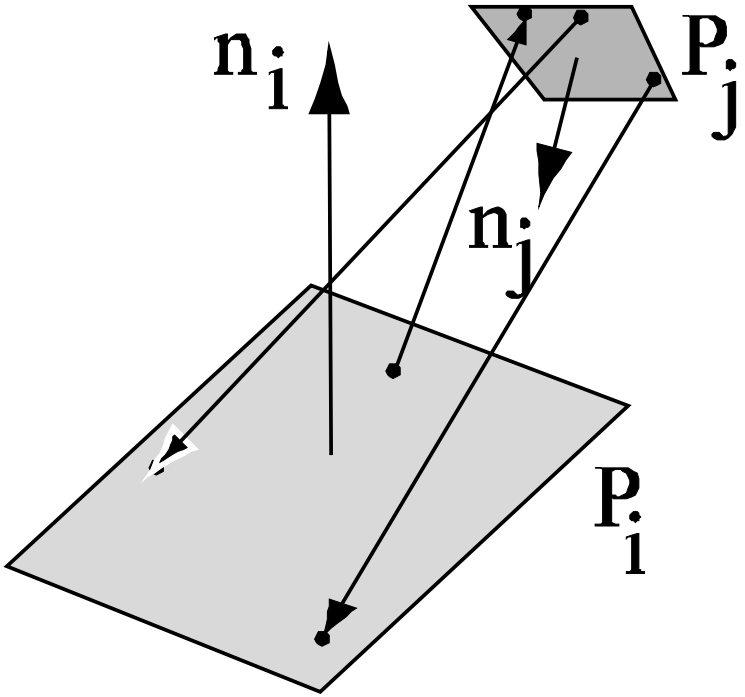
The Form Factors

- Breaks up the scene into small polygonal patches.
- Consider patches pair wise to determine form factors.
- The factors determine how the light energy leaving one patch affects the other.
- Depends on distance. shape. orientation, occlusion

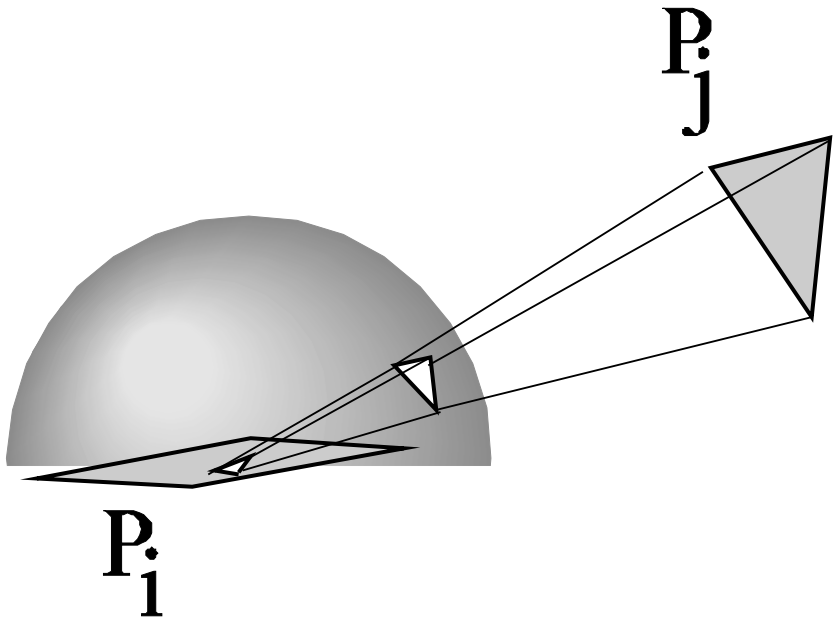


Computing Form Factors

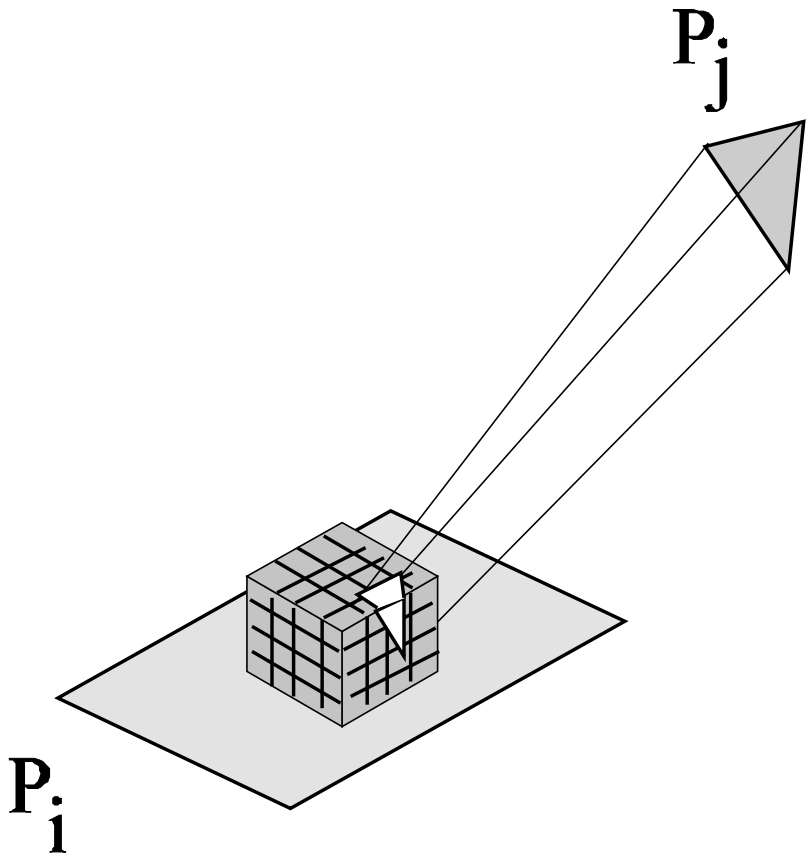
- Consider two flat patches



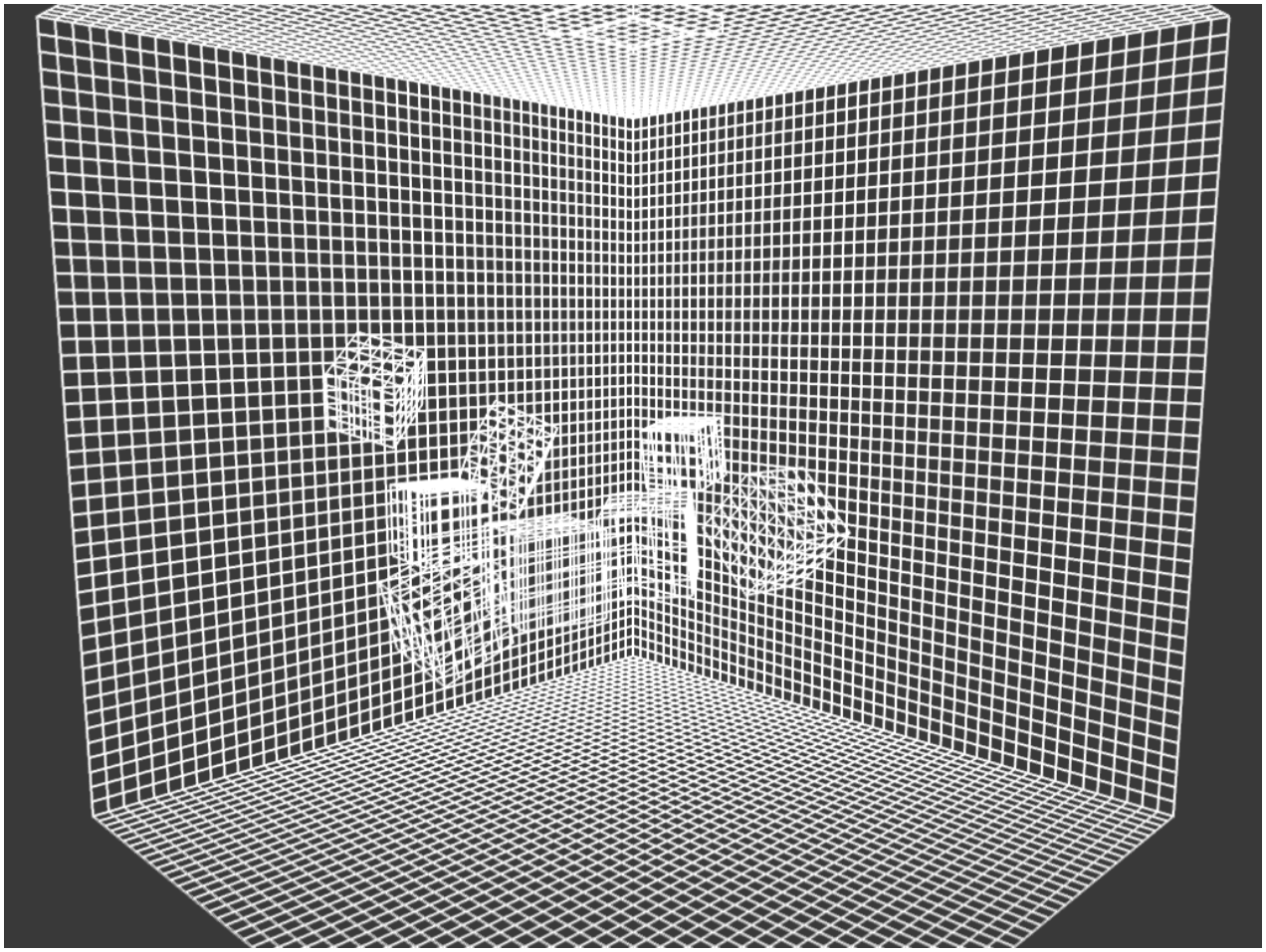
Hemisphere



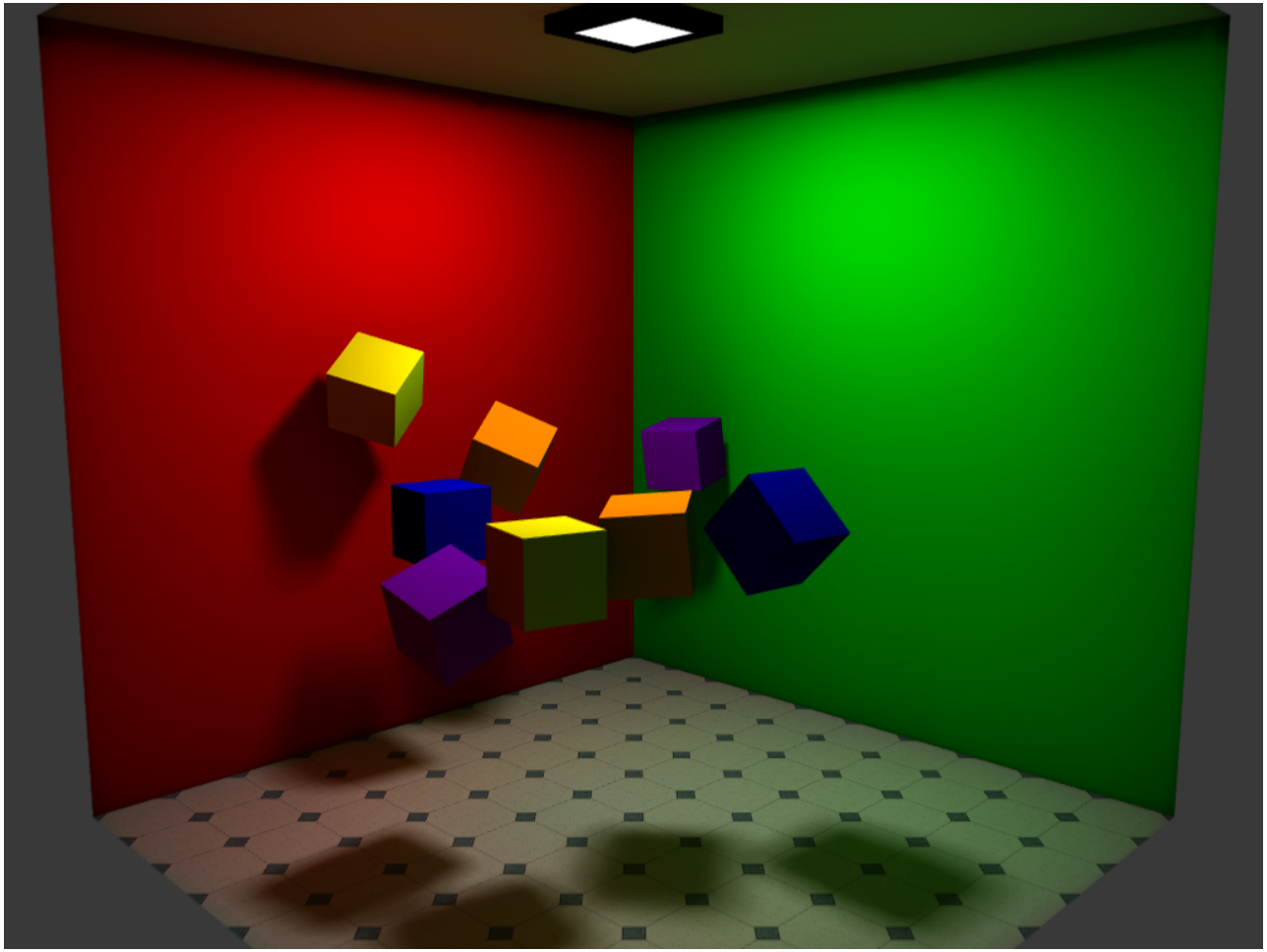
Hemicube



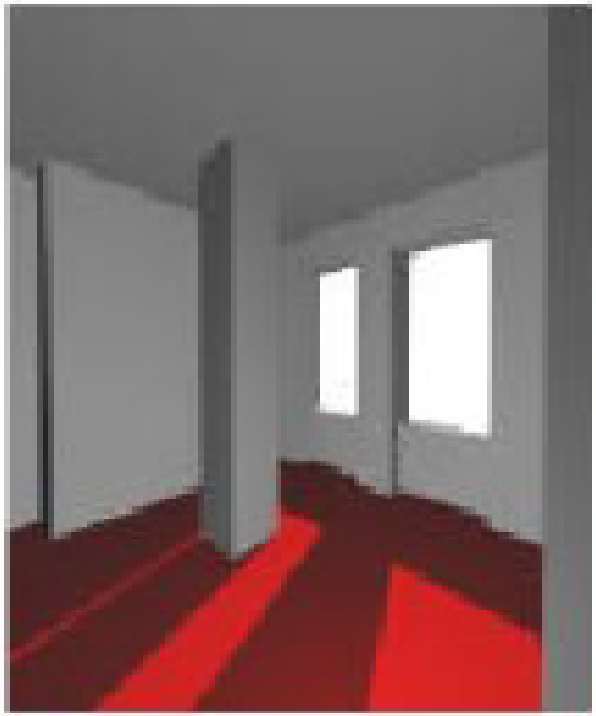
Patches



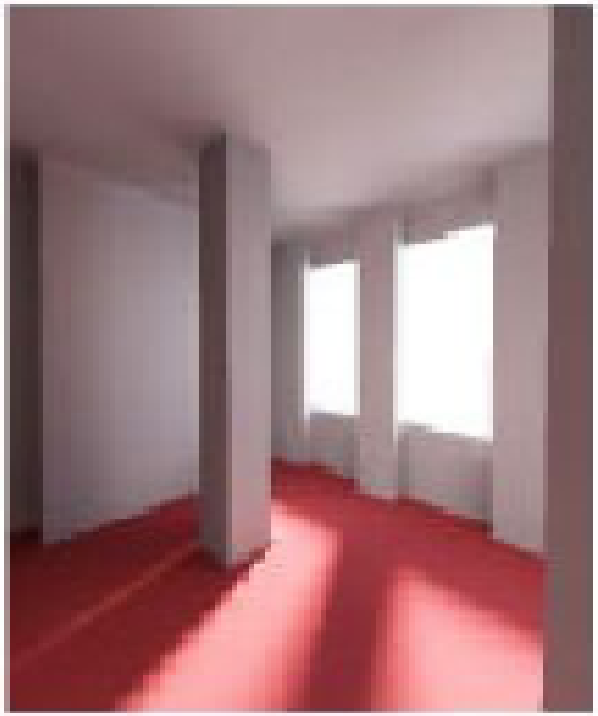
Rendered Image



Radiosity : *Another Example*



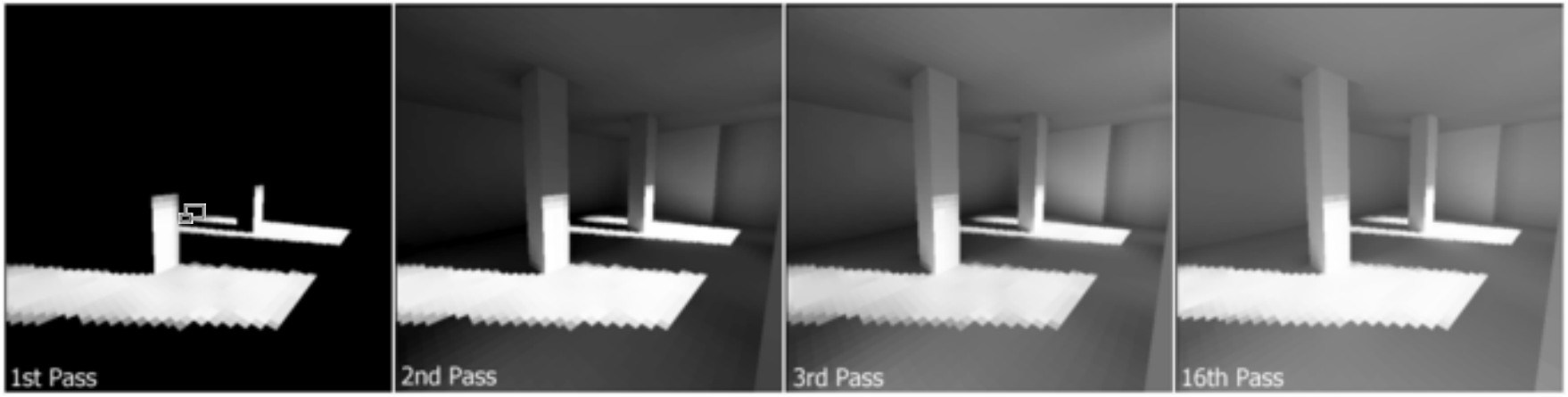
Ray-Traced Room



Radiosity Room

Progressive radiosity

- have intermediate radiosity values for the patch correspond to bounce levels



As the algorithm iterates, light can be seen to flow into the scene, as multiple bounces are computed. Individual patches are visible as squares on the walls and floor.

Overall comments on Global Illumination

- Ray-tracing models specular reflection well, but diffuse reflection is approximated
- Radiosity models diffuse reflection accurately, but specular reflection is ignored
- Advanced algorithms combine the two –Get your PhD by improving it