CSE 528: Computer Graphics

Global Illumination Supplement

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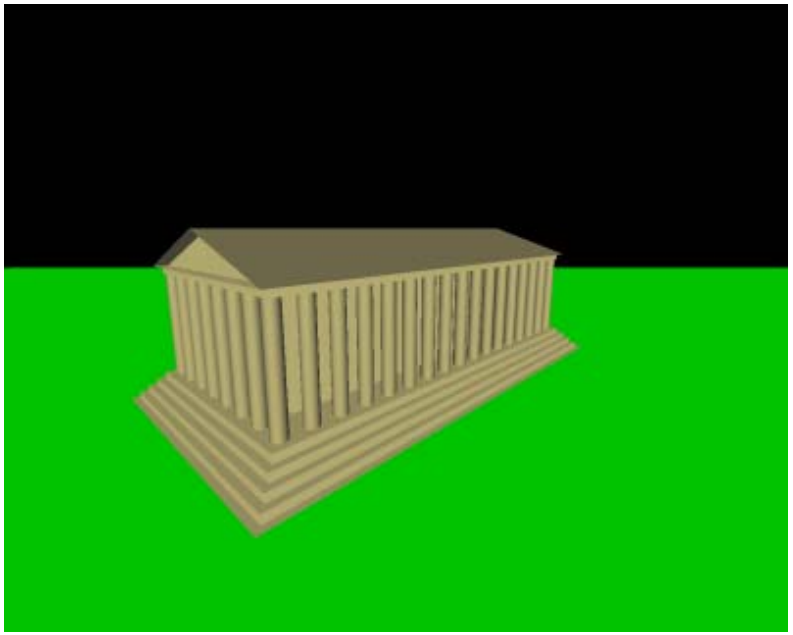
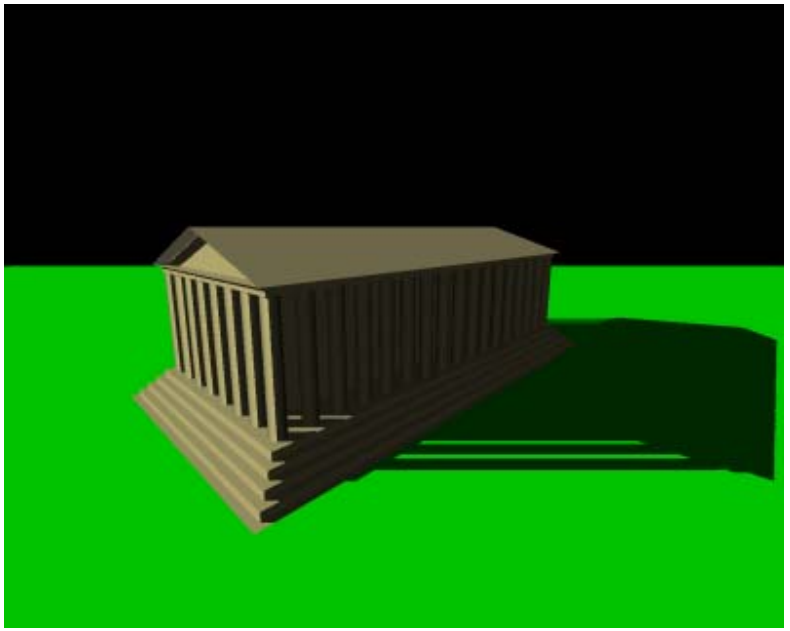
Shadow Buffer

Effective way to generate shadows for a rendered scene

- can use graphics hardware (z-buffer, matrix) for acceleration
- originally described for hard shadows
- extension to soft shadows have been proposed
- devised by L. Williams, 1978



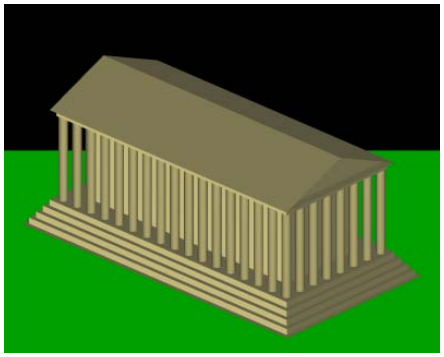
no shadow



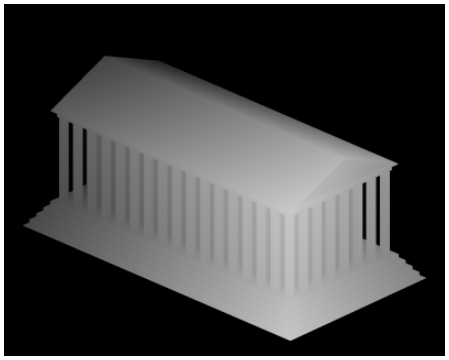
scene with shadow map

Shadow Buffer: Algorithm

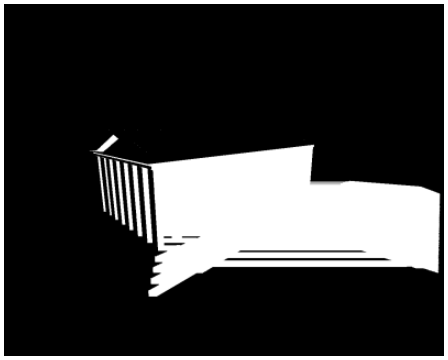
1. Set view to light source and render scene into depth buffer
2. Render scene from the eye point
   - transform each intersection point into the light source view → z_{int}
   - if $z_{lightsource} < z_{int}$ then point is in shadow → depth test failure



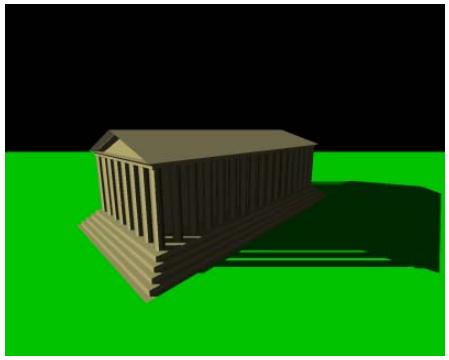
scene rendered from the light source's view



corresponding z-buffer



depth test failures



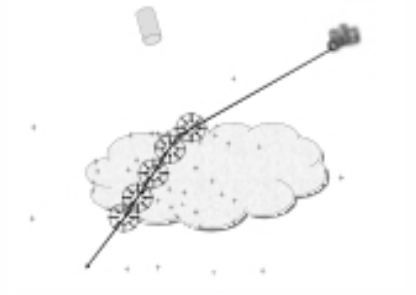
rendered scene

Photon Mapping

Overall idea:

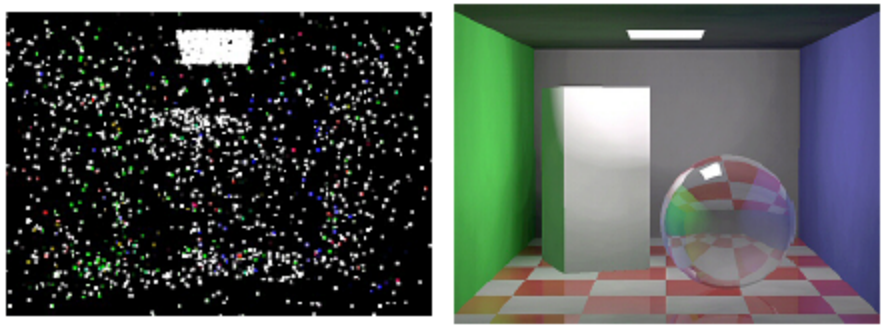
- spread photons (light particles into the scene)

- store them

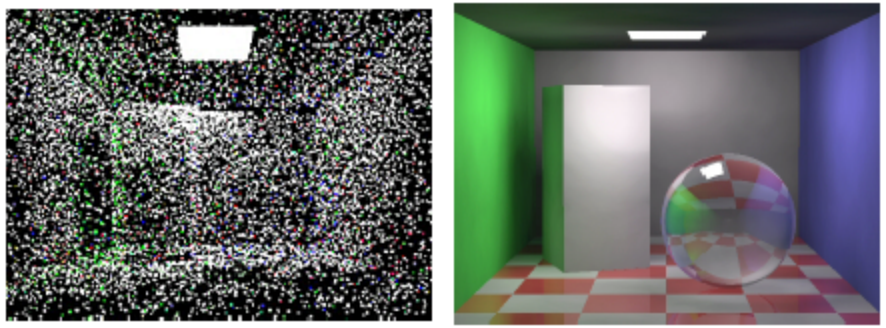


- gather them up with raycasting
- devised by H. Wann Jensen, Rendering Techniques 1996

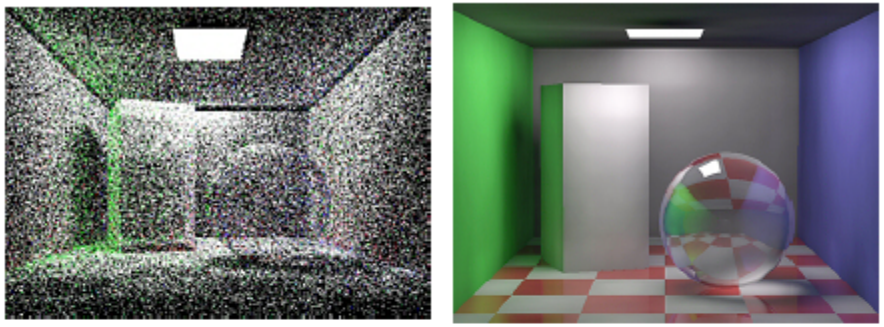
Photon Mapping: Details



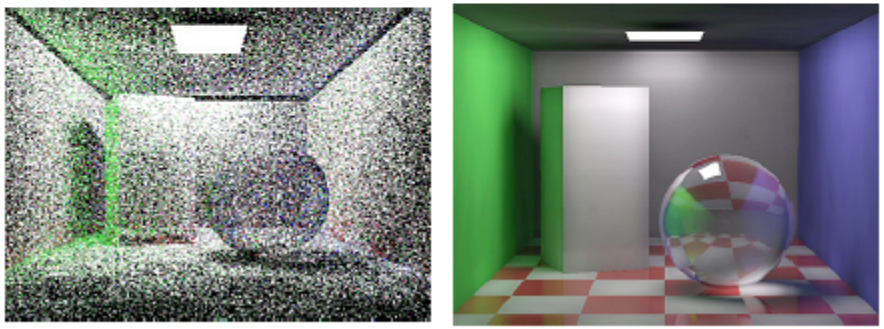
(a) 1,000 photons $r = 4.0$



(b) 10,000 photons $r = 2.0$



(c) 100,000 photons $r = 1.0$



(d) 200,000 photons $r = 0.4$

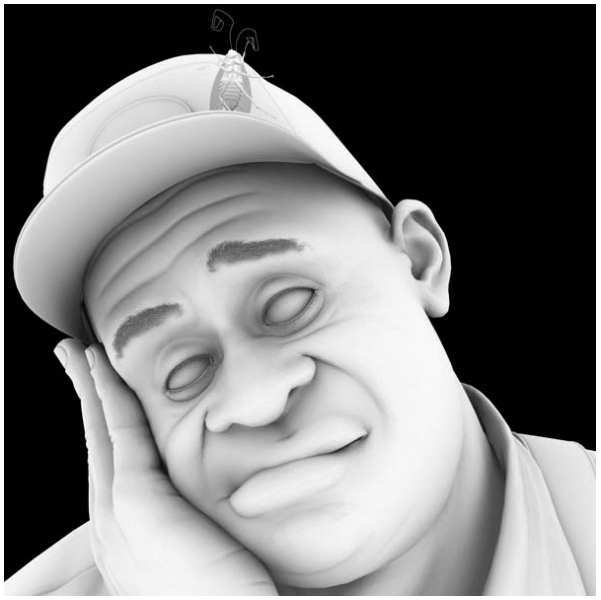
Challenge:

- storage is irregular
- typically use KD-tree

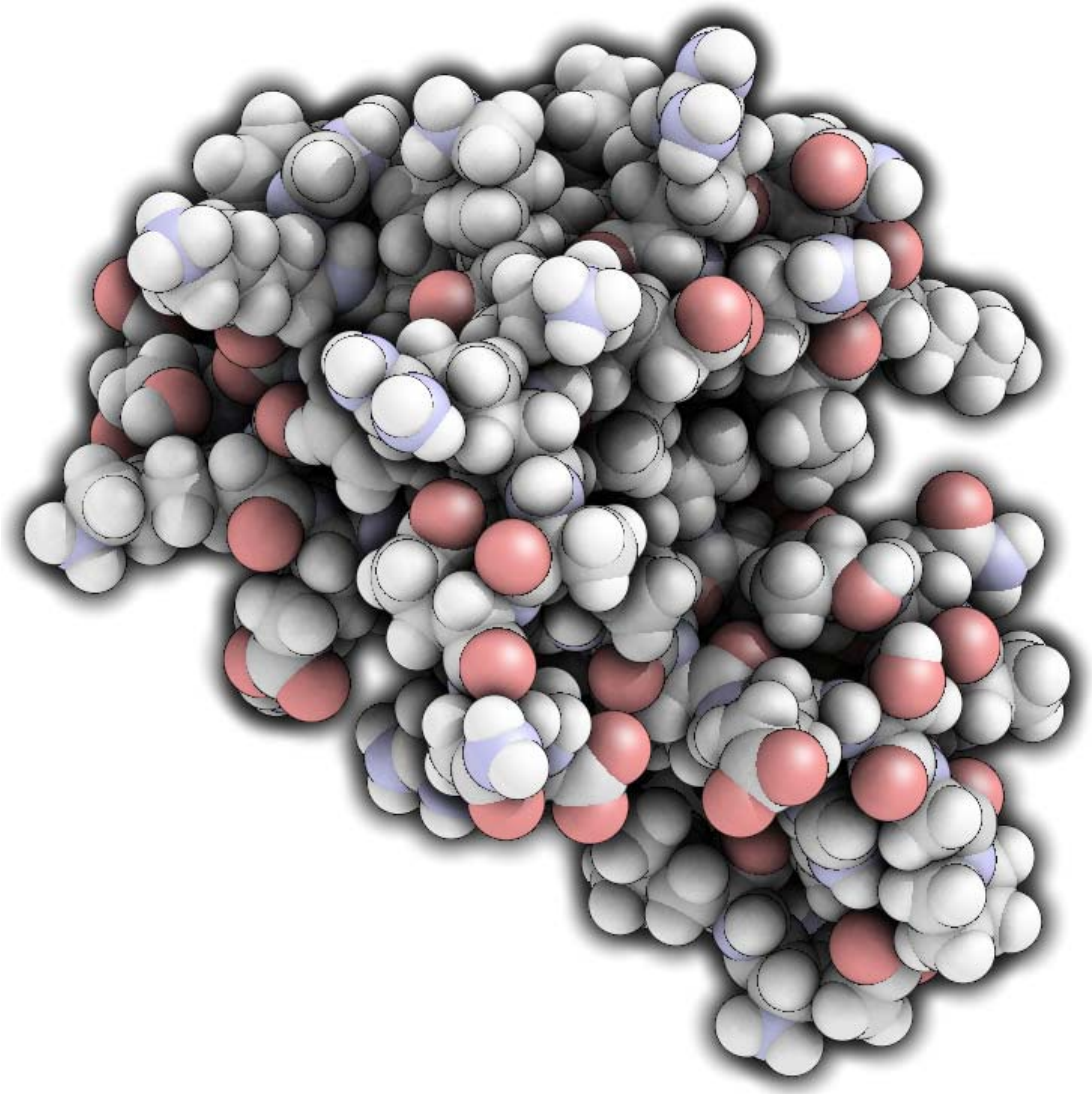
Ambient Occlusion

Efficient way to approximate global illumination

- instead of bouncing light around check for percentage of local occlusion / visibility
- does not require computation of normal vectors
- related to accessibility shading



Ambient Occlusion



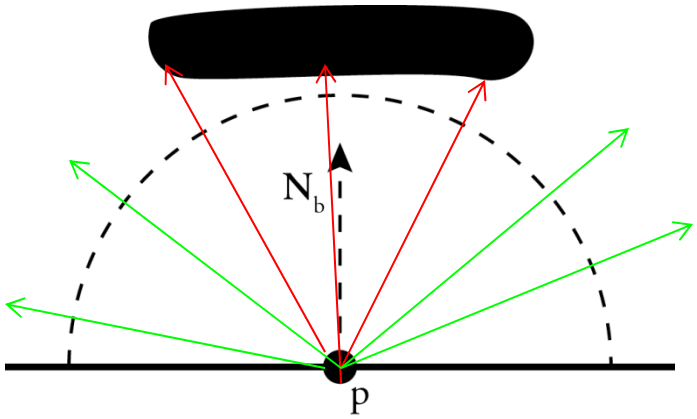
Ambient Occlusion: Algorithm

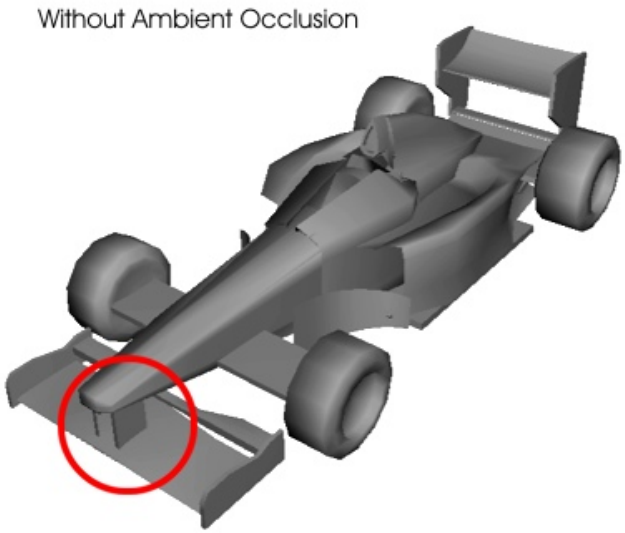
Cast rays in every direction of a hemisphere

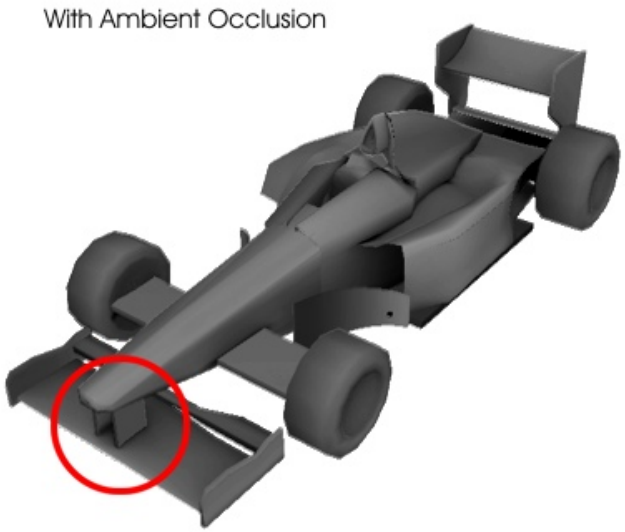
- intersect with (nearby) geometry

Formally, integrate visibility over Ω

$$A_{\bar{p}} = \frac{1}{\pi} \int_{\Omega} V_{\bar{p},\hat{\omega}} (\hat{n} \cdot \hat{\omega}) \, \mathrm{d}\, \omega$$





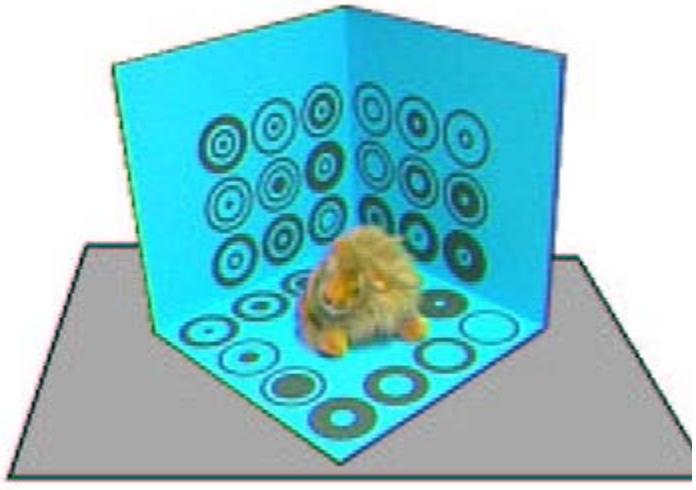


Light Field – The Lumigraph

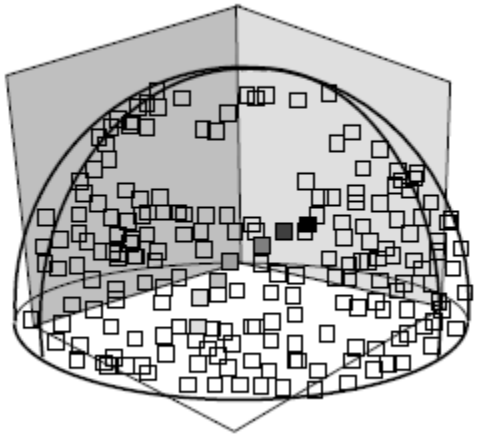
Groundbreaking work for image-based rendering

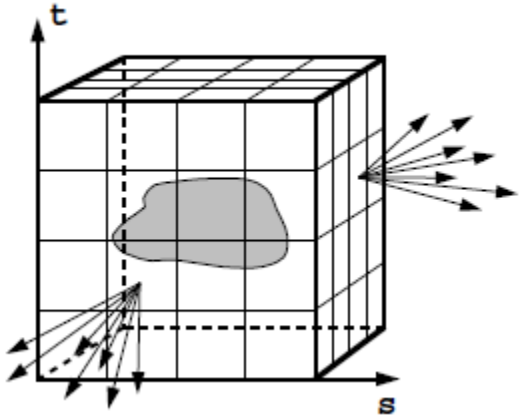
- Lumigraph: 1996 SIGGRAPH paper by Gortler et al.
- Lightfield rendering: 1996 SIGGRAPH paper by Levoy and Hanrahan

Captures and renders any object appearance



light stage



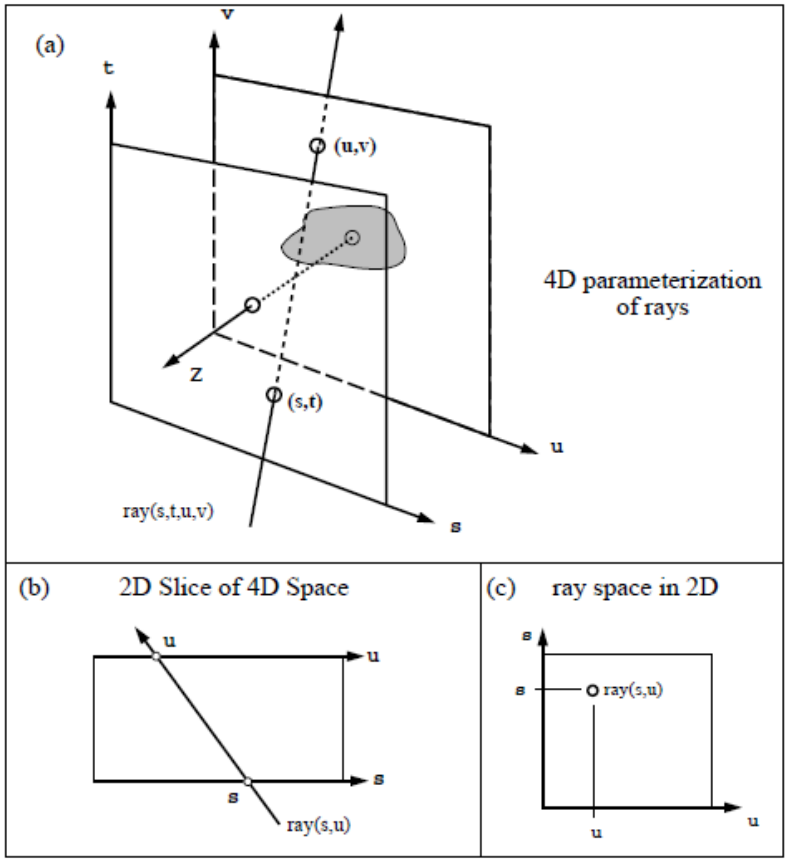


radiance information

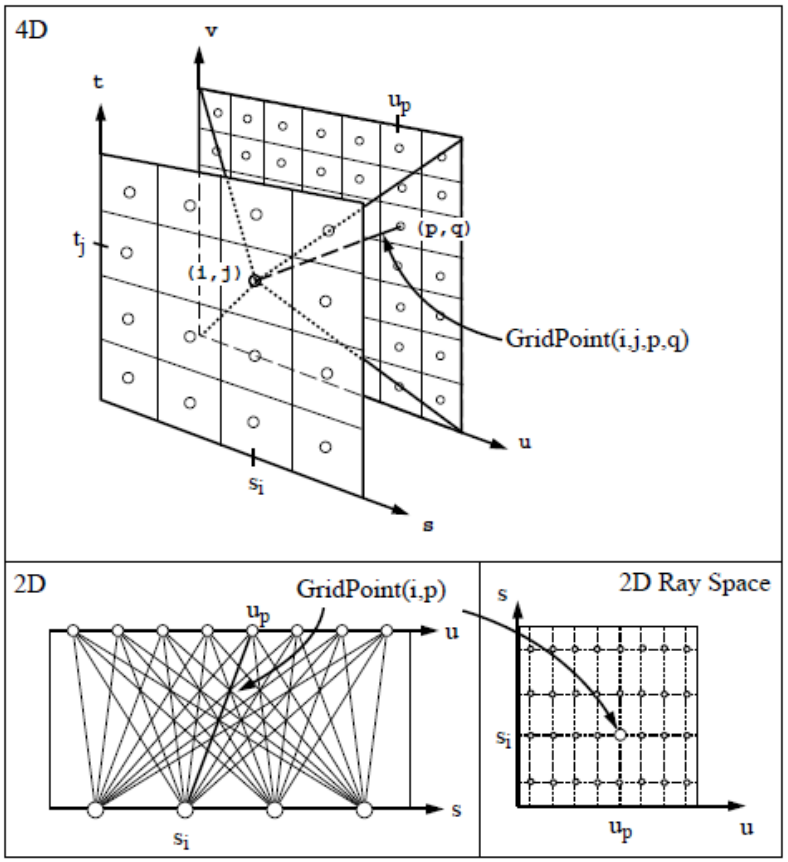
rendered object

The Lumigraph: Representation

Acquires the 4-D plenoptic function



Parameterization of the Lumigraph



Discretization of the Lumigraph

The Lumigraph: Rendering