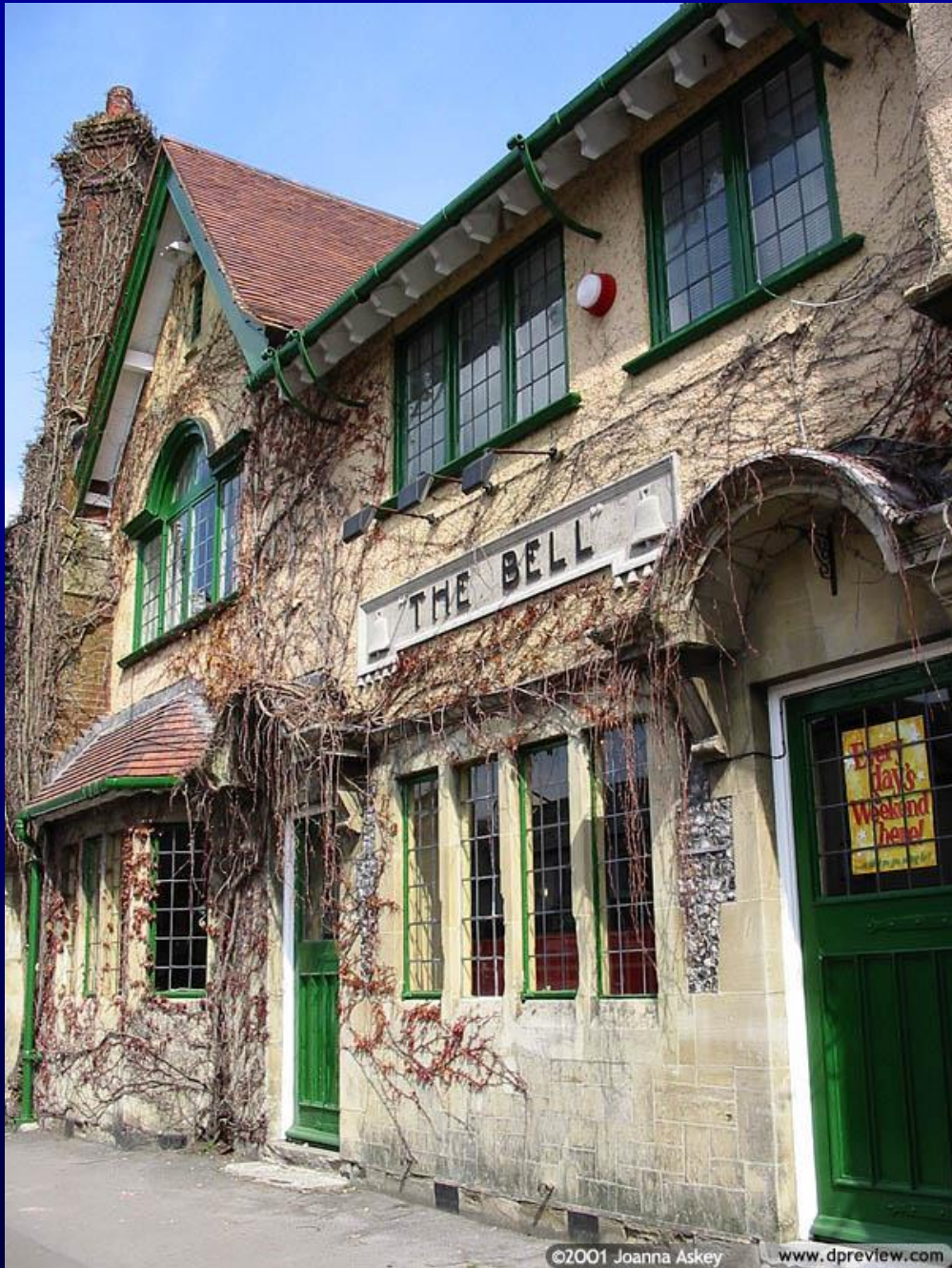


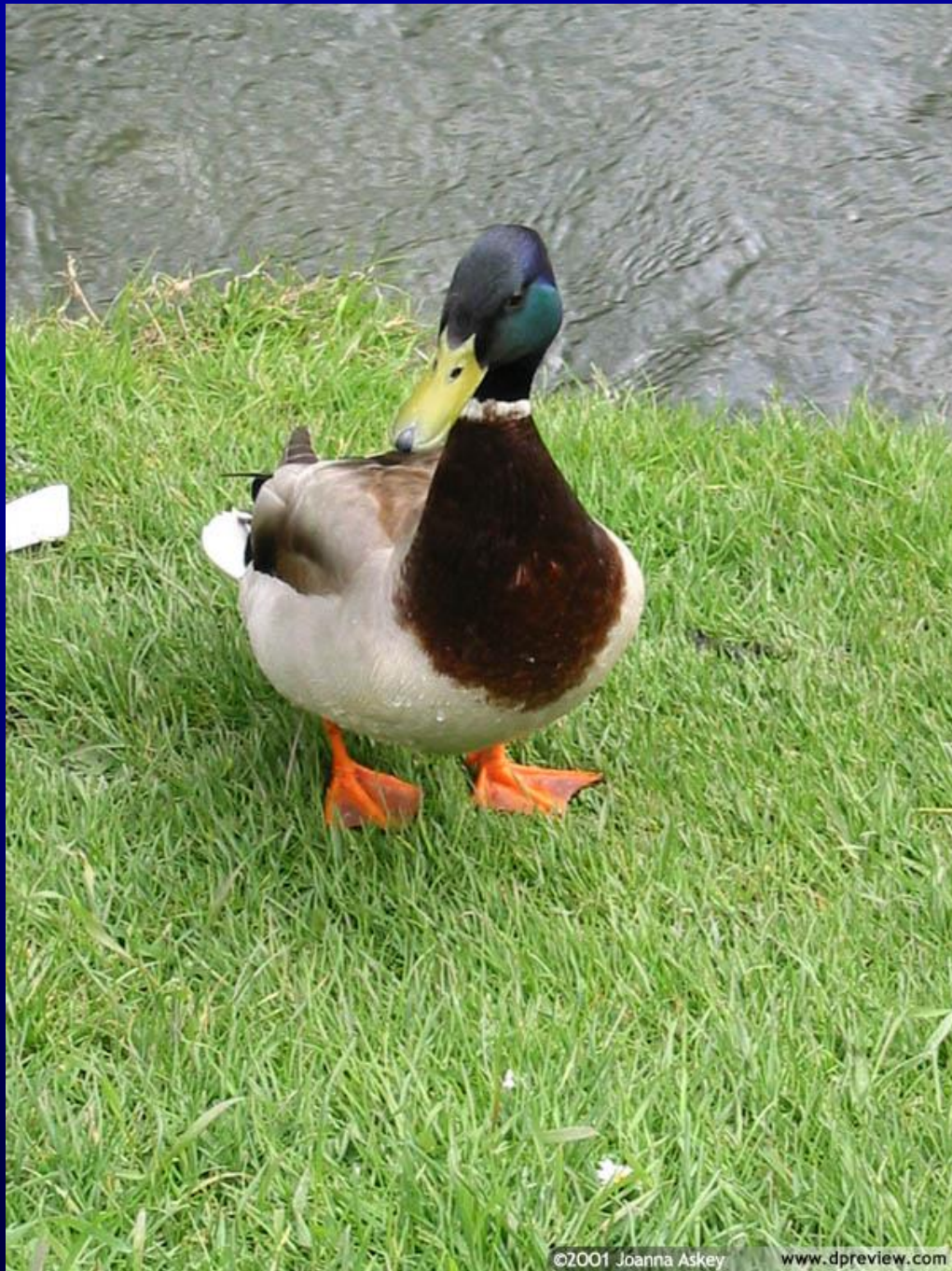
Lightfield / Lumigraph

Photographs

- We have tools that acquire and tools that display photographs at a convincing quality level







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www.dpreview.com







Photographs

- We have tools that acquire and tools that display photographs at a convincing quality level, **for almost 100 years now**



Sergei Mikhailovich Prokudin-Gorskii.

A Settler's Family, ca. 1907-1915.





Sergei Mikhailovich Prokudin-Gorskii.
Tea Factory in Chakva.
Chinese Foreman Lau-Dzhen-Dzhau.
ca. 1907-1915.



Sergei Mikhailovich Prokudin-Gorskii.

The Emir of Bukhara, 1911.

RGB in early 1900's



Lightfield – Lumigraph approach

[Levoy96, Gortler96]

- Take all photographs you will ever need to display
- Model becomes database of rays
- Rendering becomes database querying

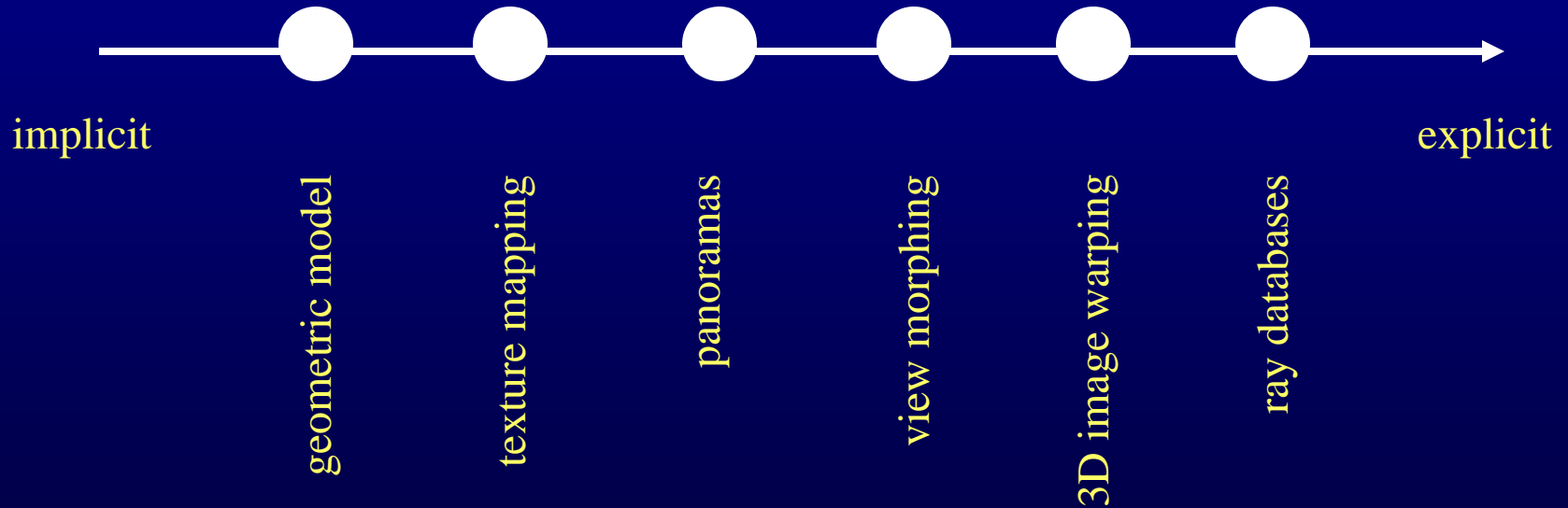
Plenoptic function

- Defines all the rays
 - through any point in space (x, y, z)
 - with any orientation (θ, φ)
 - over all wavelenghts (λ)
 - at any given moment in time (t)

$$\rho = P(x, y, z, \phi, \varphi, \lambda, t)$$

IBR summary

Representation of plenoptic function



Overview

- Introduction
- Lightfield – Lumigraph
 - definition
 - construction
 - compression

Overview

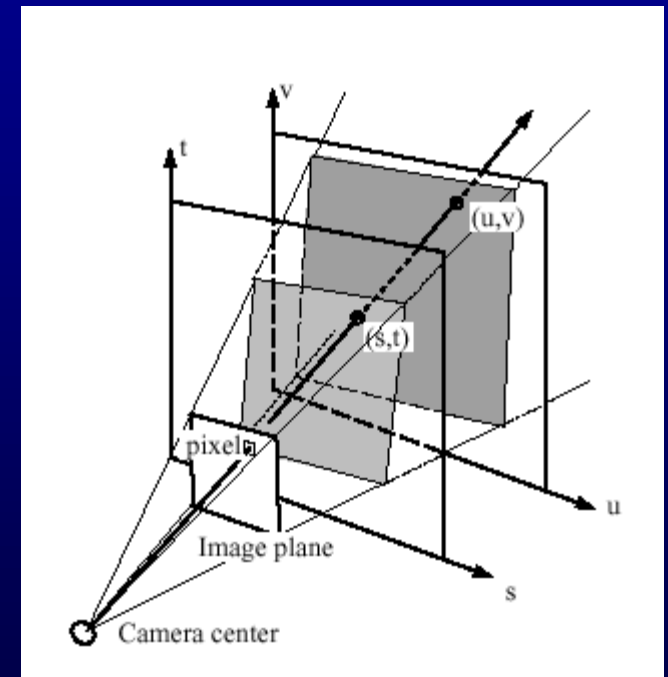
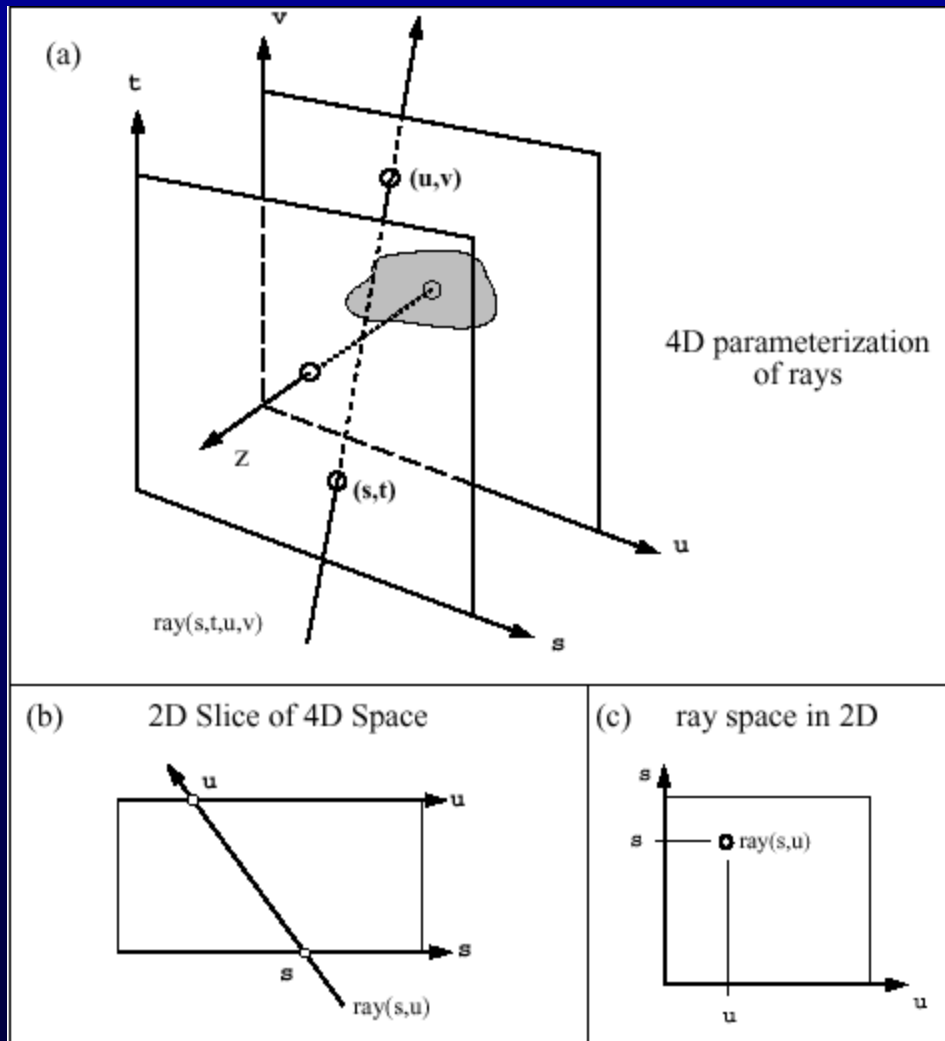
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From 7D to 4D

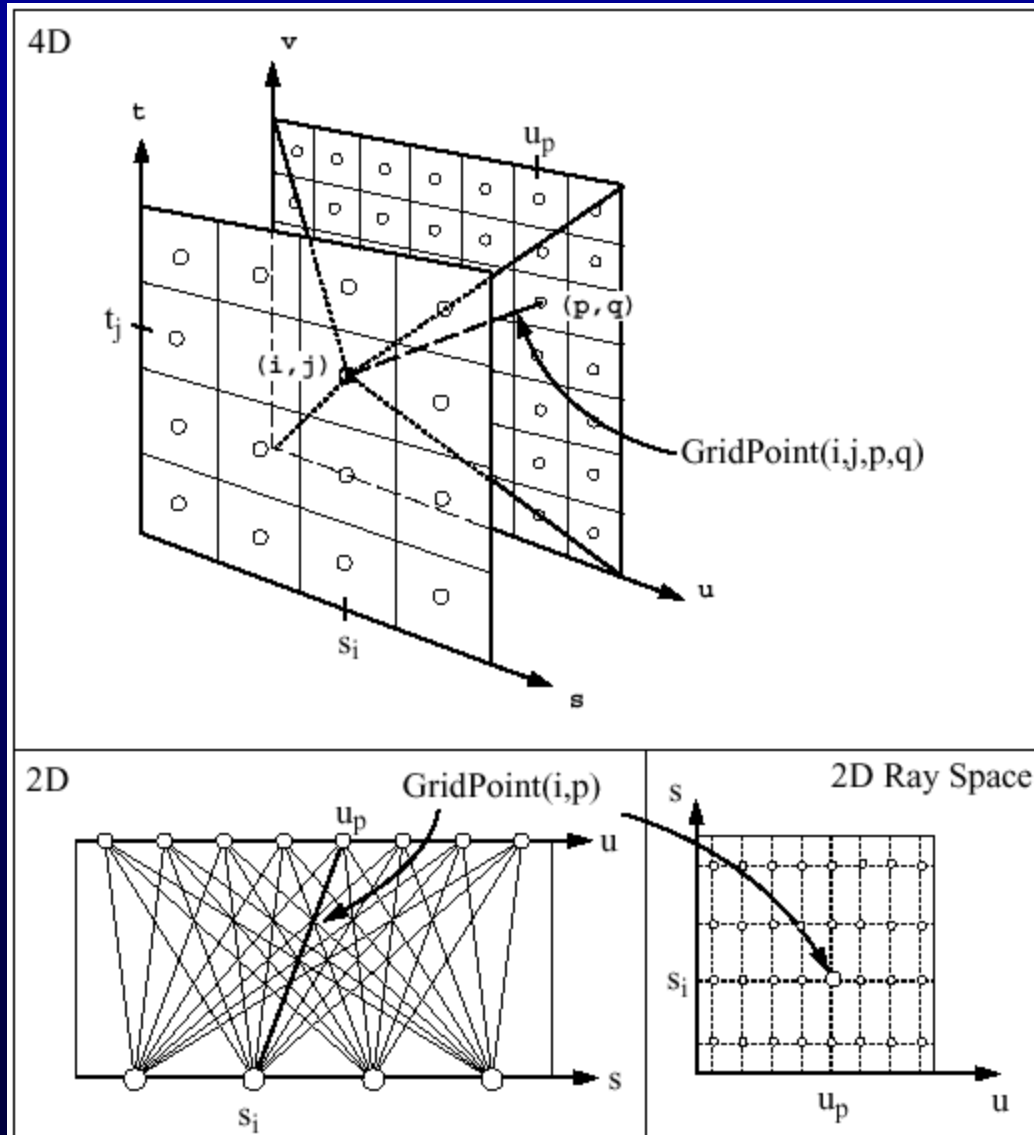
$$\rho = P(x, y, z, \phi, \varphi, \lambda, t)$$

- Static scene, t constant
- λ approximated with RGB
- consider only convex hull of objects, so the origin of the ray does not matter

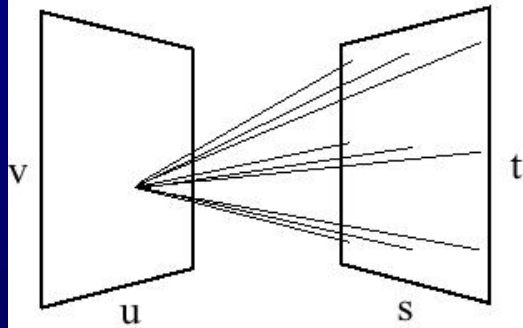
4D Lightfield / Lumigraph



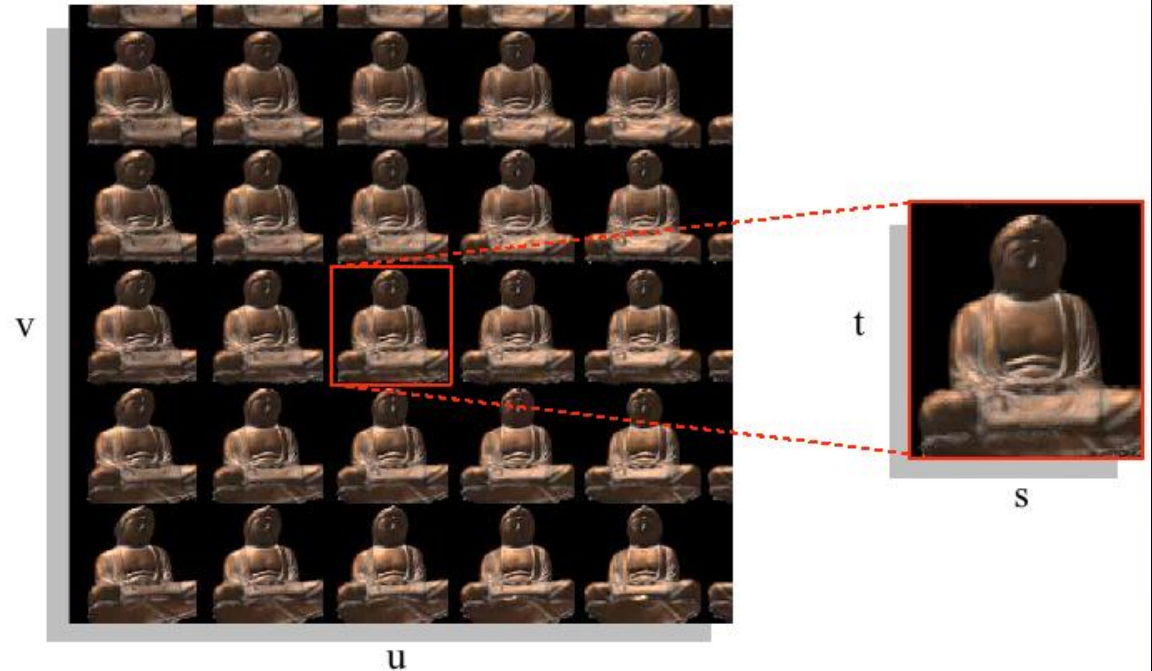
Discreet 4D Lightfield



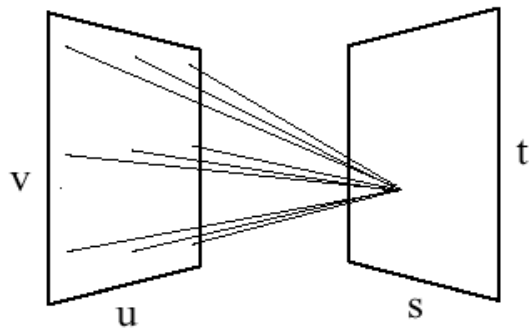
Lightfield: set of images with COPs on regular grid



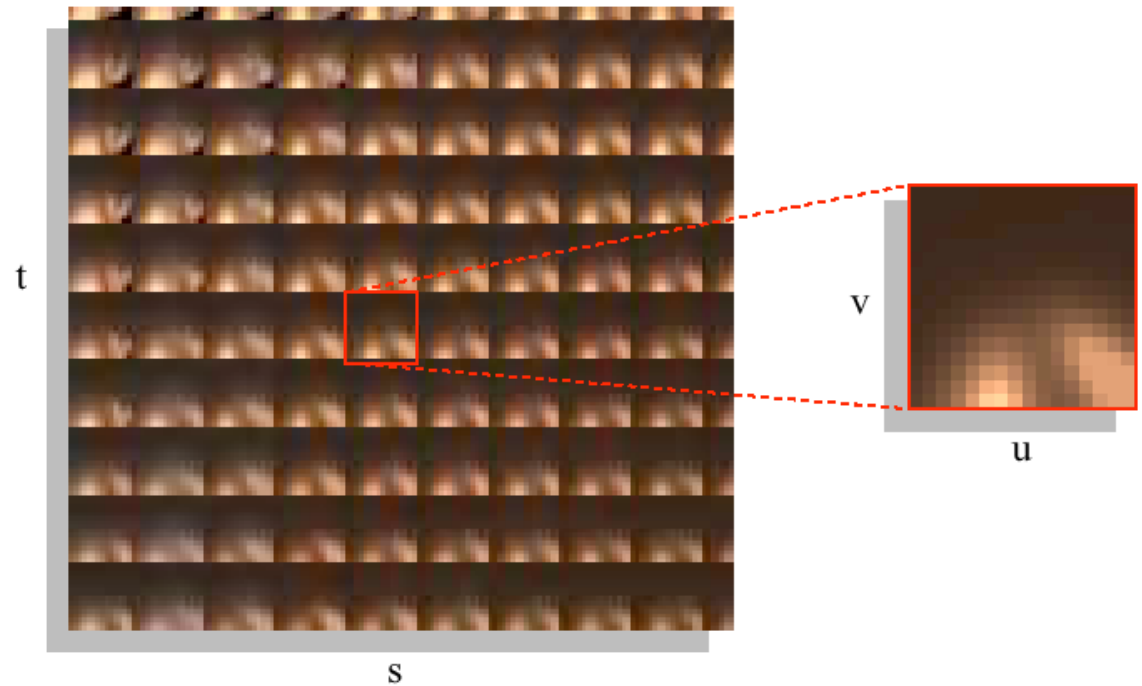
(a)



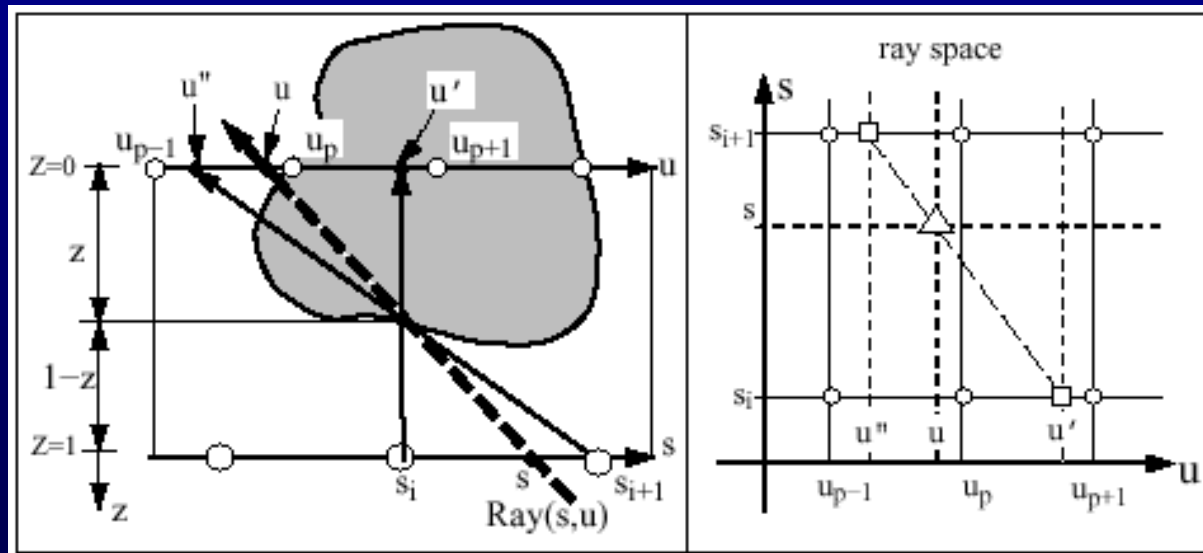
or Lightfield: set of images of a point seen at various angles



(b)



Depth correction of rays



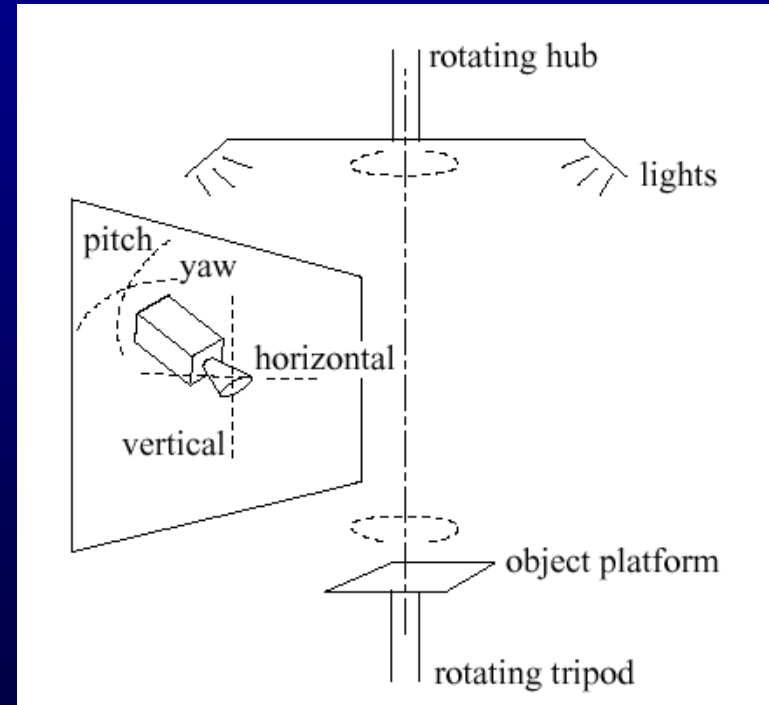
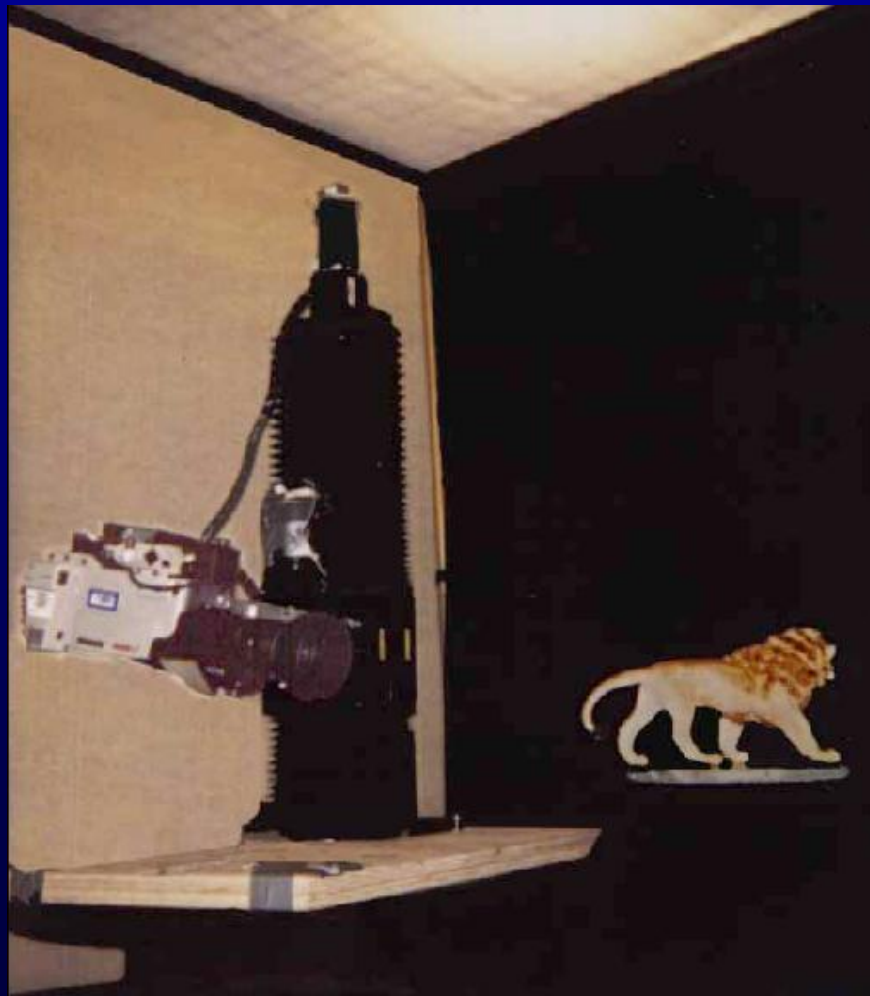
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- Lightfield – Lumigraph
 - definition
 - construction
 - compression

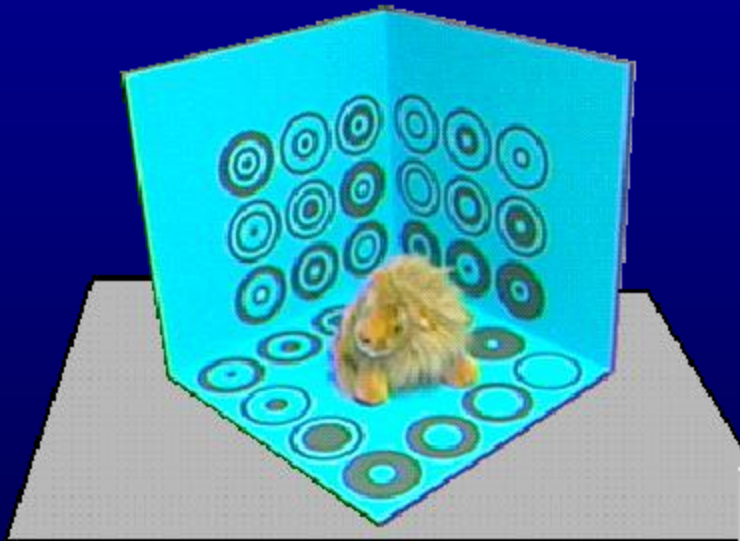
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- Lightfield – Lumigraph
 - definition
 - construction
 - compression

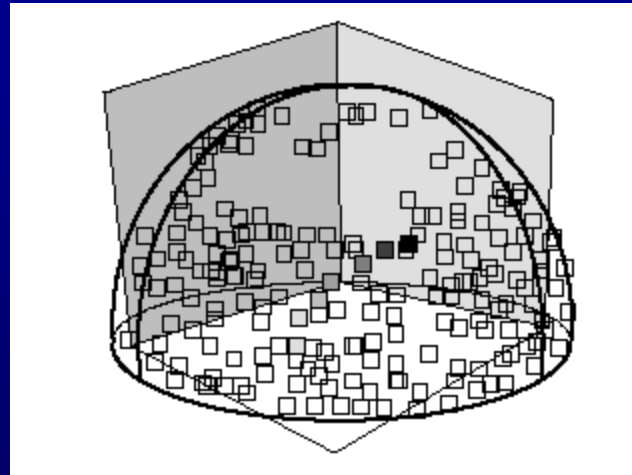
Construction from dense set of photographs



Construction from sparse set of photographs



acquisition stage



camera positions

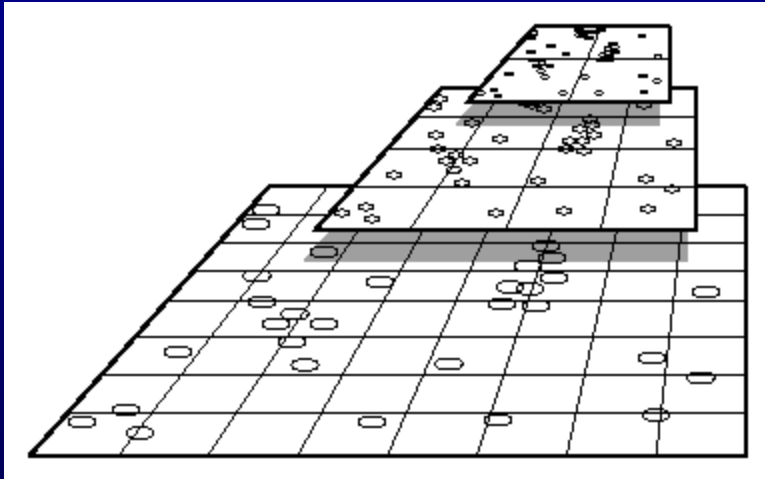


blue screening



space carving

Filling in gaps using pull-push algorithm



- Pull phase
 - low res levels are created
 - gaps are shrunk
- Push phase
 - gaps at high res levels are filled using low res levels

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Compression

- Large size uncompressed: 1.125GB
 - 32×32 (s, t) x 256×256 (u, v) x 6 faces x 3 B
- Compression
 - jpeg + mpeg (200:1 to 6MB)
 - or vector quantization + entropy encoding

Vector Quantization (VQ)

- Principle
 - codebook made of codewords
 - replace actual word with closest codeword
- Implementation
 - training on representative set of words to derive best codebook
 - compression: replacing word with index to closest codeword
 - decompression: retrieve indexed codeword from codebook



Lightfield compression using VQ

