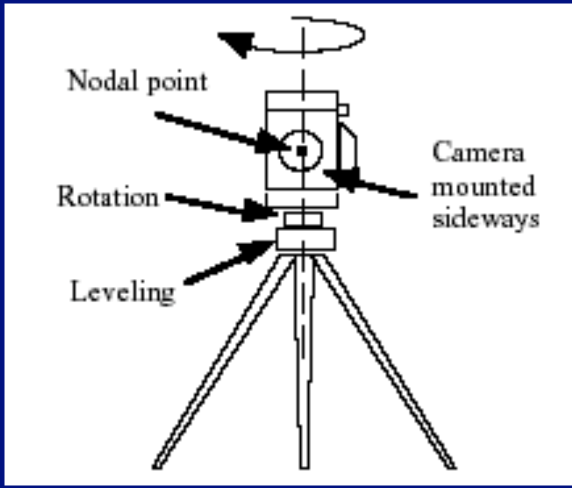
Multiple Views

CS 543 D.A. Forsyth

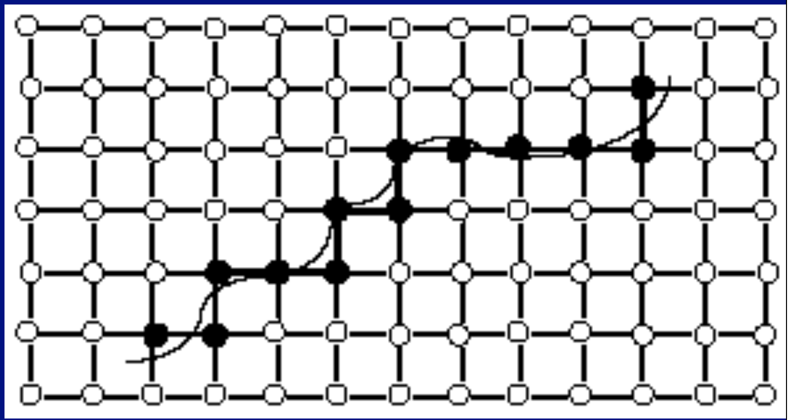
Topics

- Mosaics
  - translating cameras reveal extra information, break occlusion
- Explicit image based rendering
  - multiple calibrated cameras yield a system of rays that models objects
- Stereopsis
  - two cameras reveal a lot of geometry
- Structure from motion
  - more cameras yield even more geometry

Implicit example: Quicktime VR

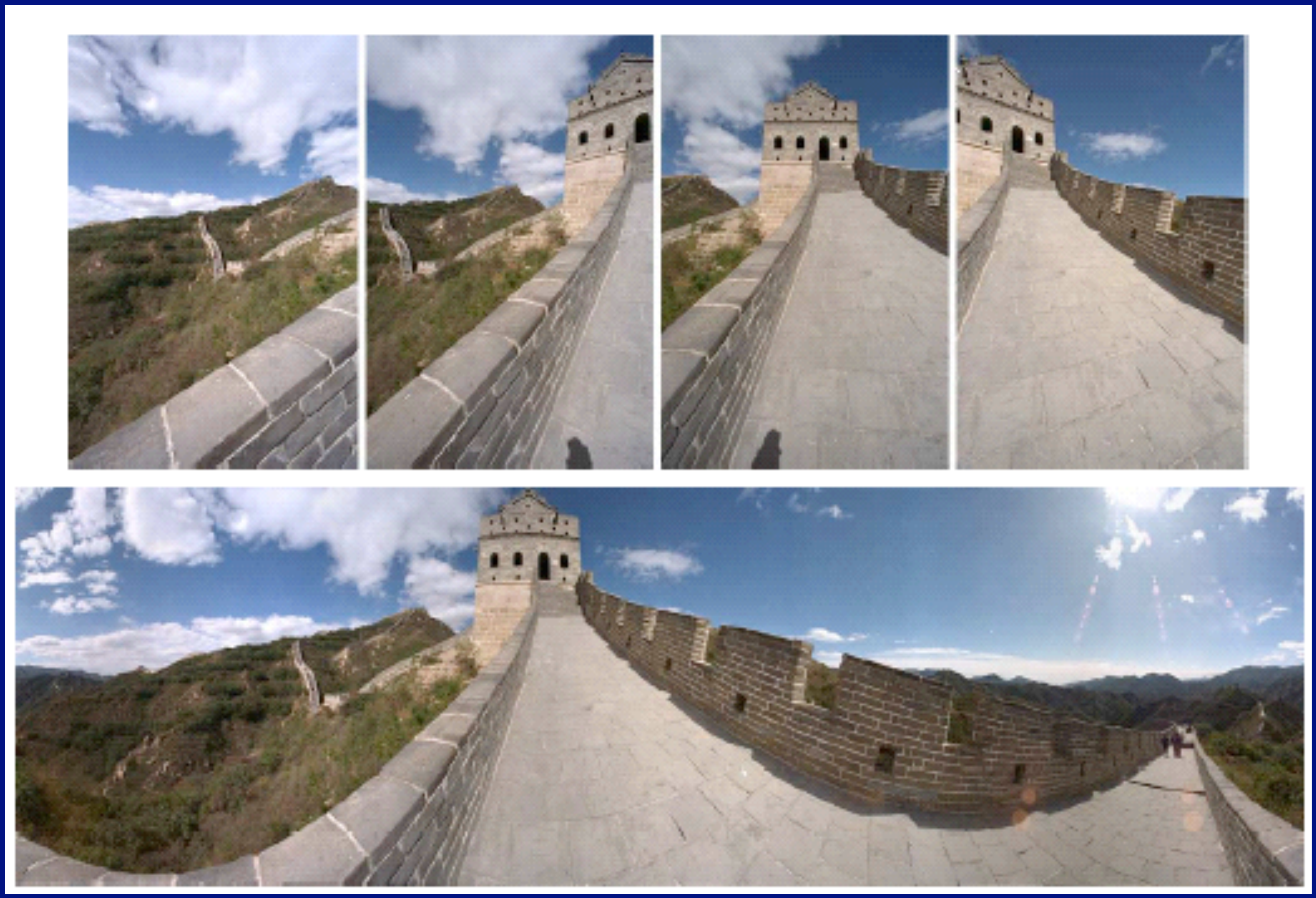


- Construct a mosaic that can provide various camera views at various points
- Issues:
  - recovering the mosaics
    - specialised hardware
    - correlation based mosaicing
  - structuring the representation for fast rendering



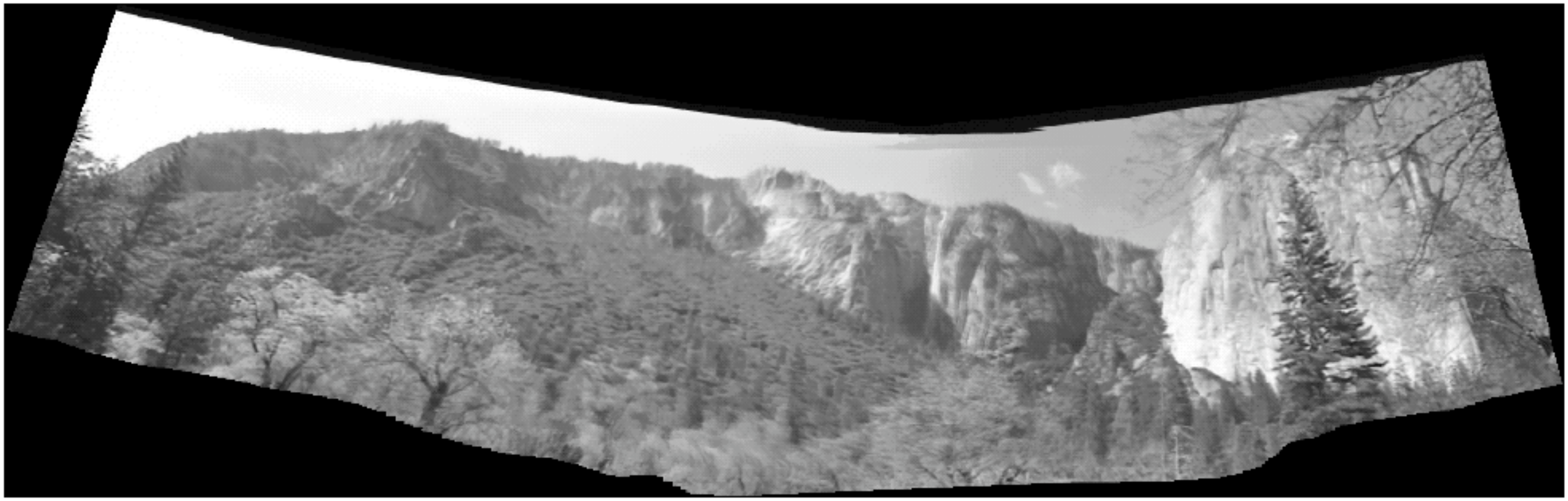
Figures from “QuickTime VR – An Image-Based Approach to Virtual Environment Navigation”, Shenchang Eric Chen, SIGGRAPH 95

Figures from “QuickTime VR – An Image-Based Approach to
Virtual Environment Navigation”, Shenchang Eric Chen, SIGGRAPH 95

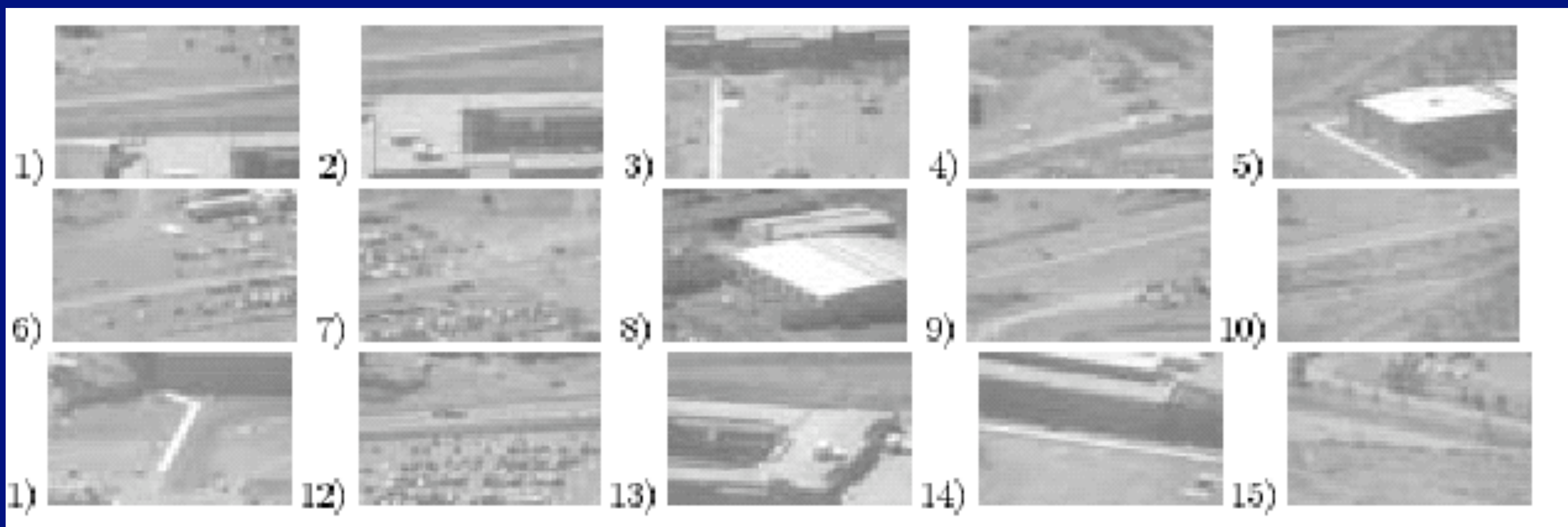


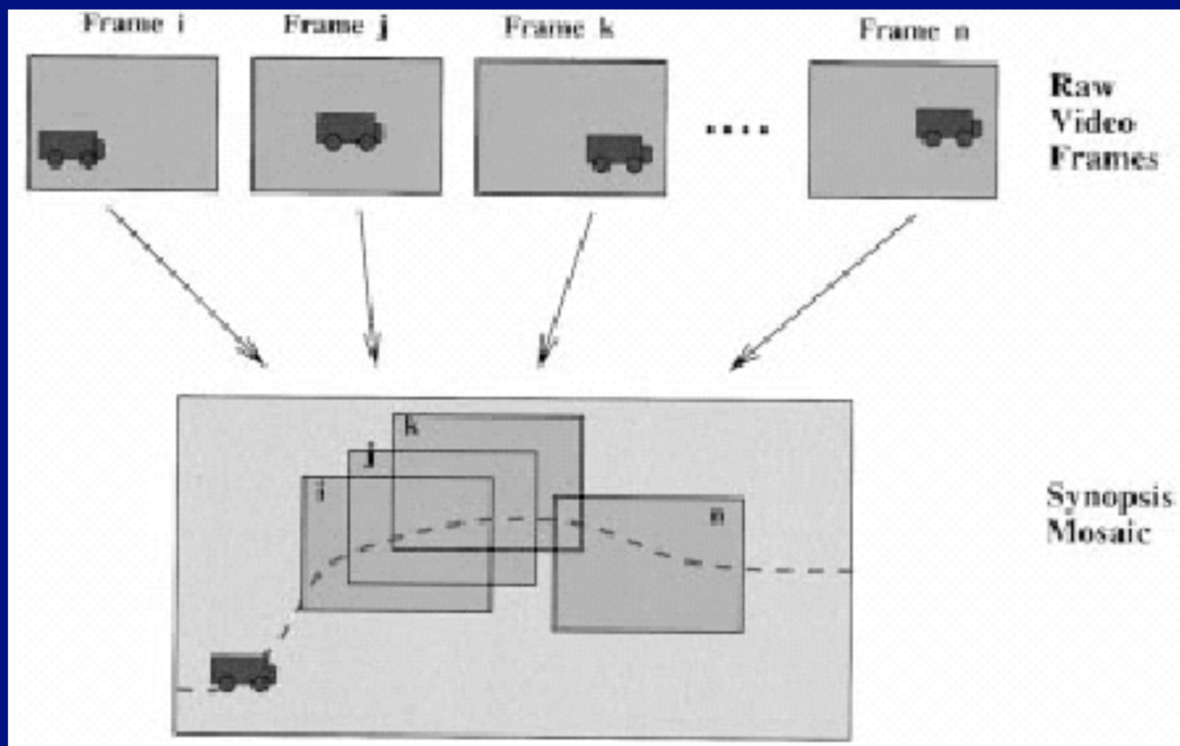
Figures from “QuickTime VR – An Image-Based Approach to
Virtual Environment Navigation”, Shenchang Eric Chen, SIGGRAPH 95


MAY 19 1995




Sequence
Find Place
Label Place
Clear Labels

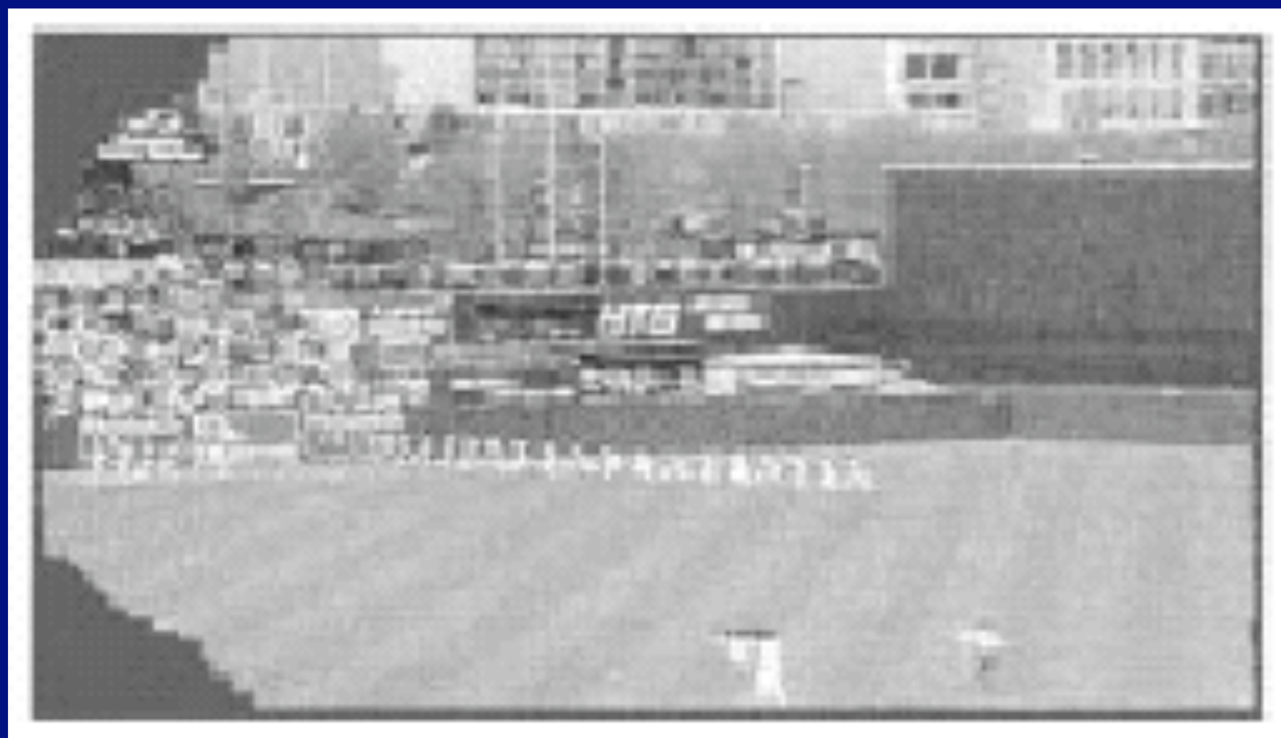

1)
2)
3)
4)
5)
6)
7)
8)
9)
10)
1)
12)
13)
14)
15)


Frame i
Frame j
Frame k
Frame n
Raw Video Frames
....
k
j
i
n
Synopsis Mosaic


HTS
FUJI FILM
WIZ

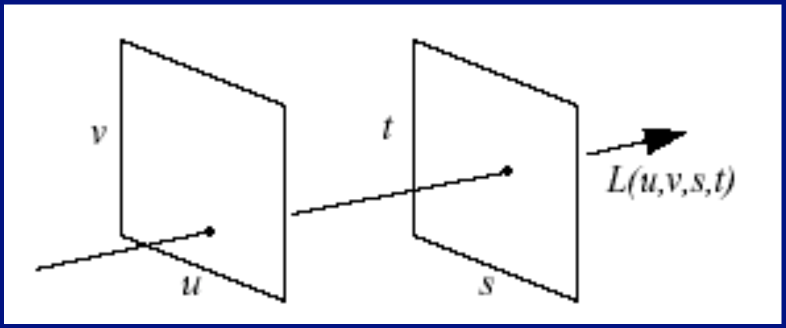

HTS


HTS
WIZ
FUJI FILM

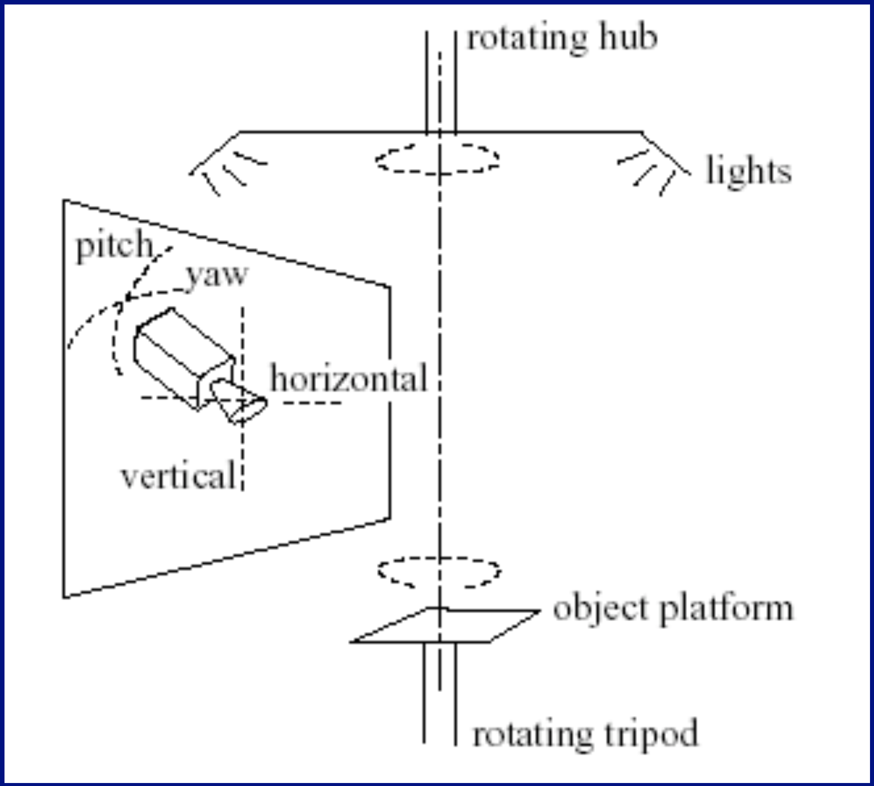

HTS

Implicit Example: Light Field rendering

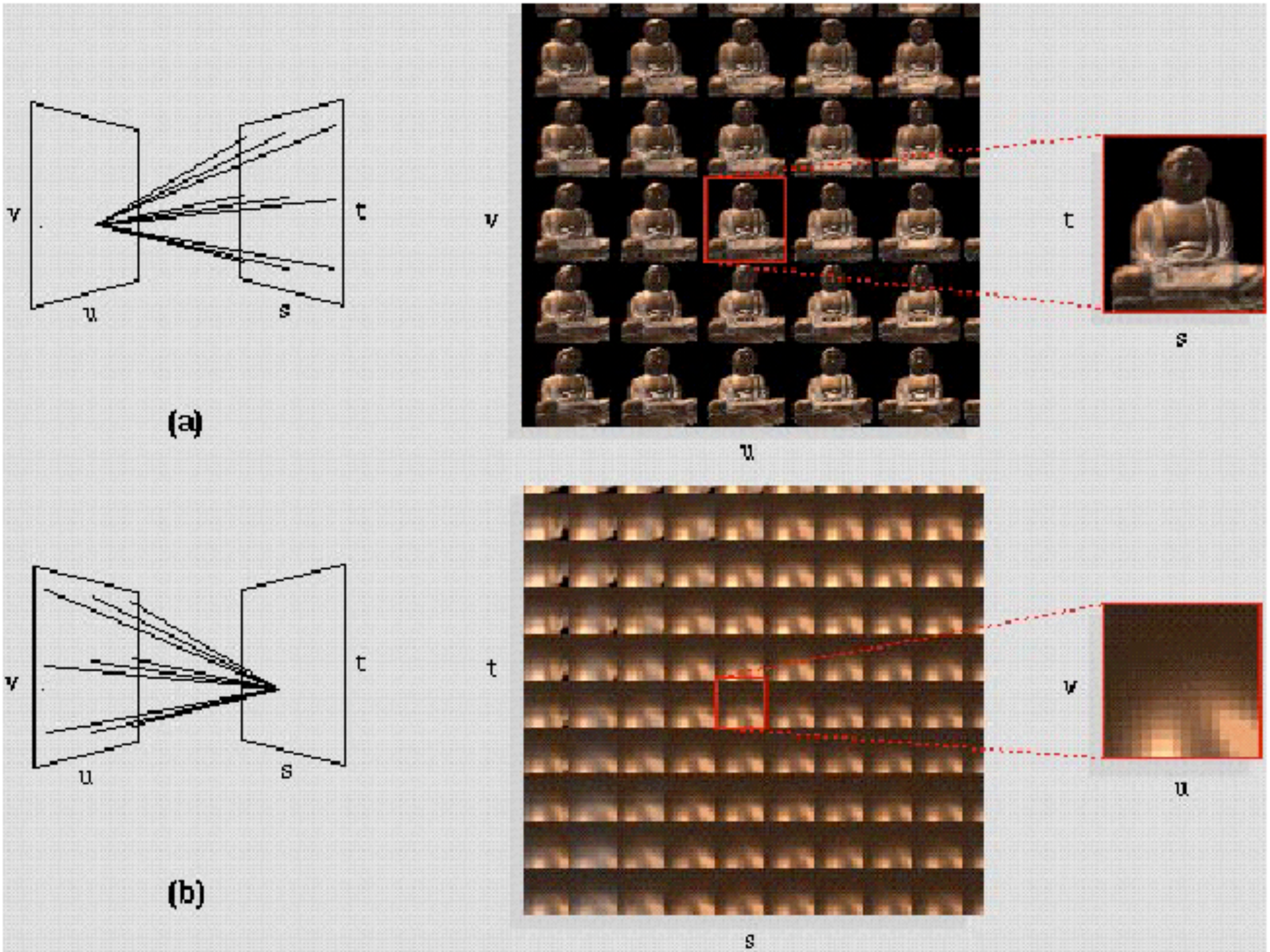
- Sample the set of rays passing through an object
  - rays represented by intersection with some polygons
  - render by smoothing families of rays
- Issues
  - behaviour of families of rays
  - Sampling
  - Size!



Figures from "Light Field Rendering"
Marc Levoy and Pat Hanrahan, SIGGRAPH 96



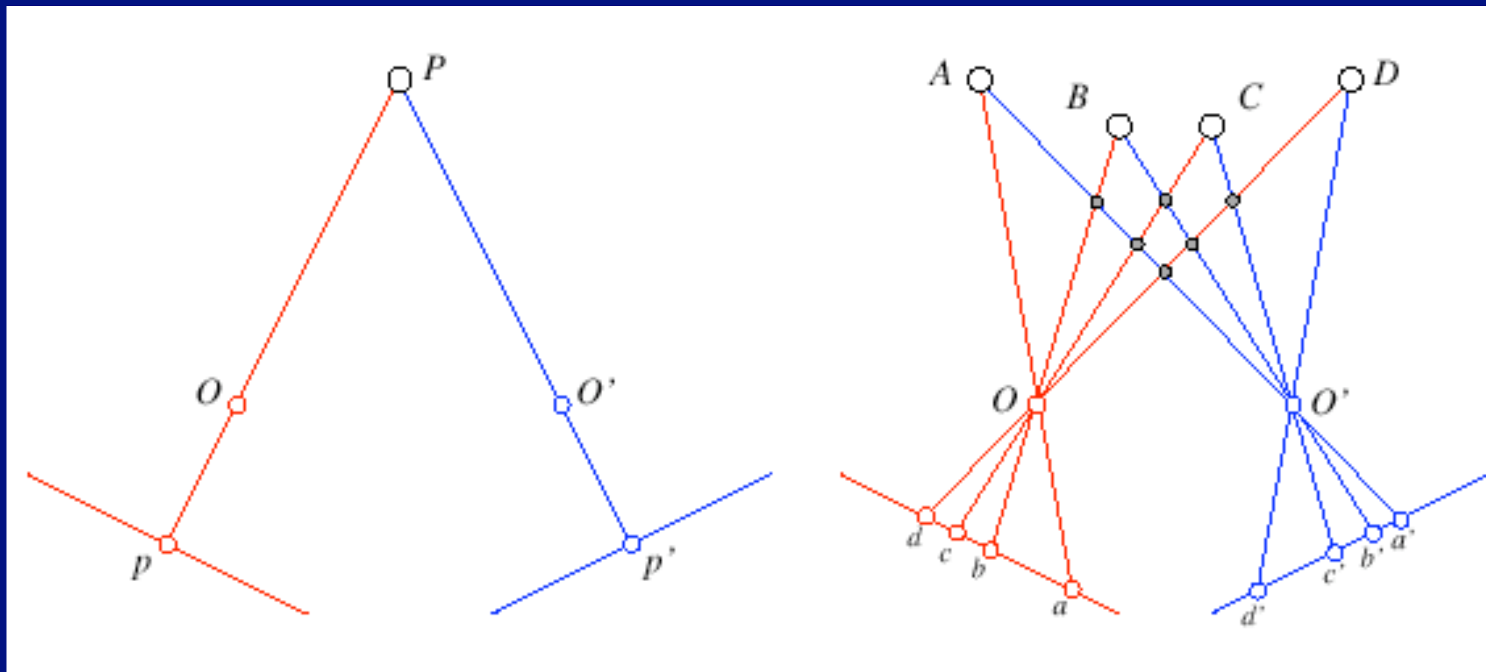
Figures from “Light Field Rendering”
Marc Levoy and Pat Hanrahan, SIGGRAPH 96



Figures from “Light Field Rendering”
Marc Levoy and Pat Hanrahan, SIGGRAPH 96

Two views

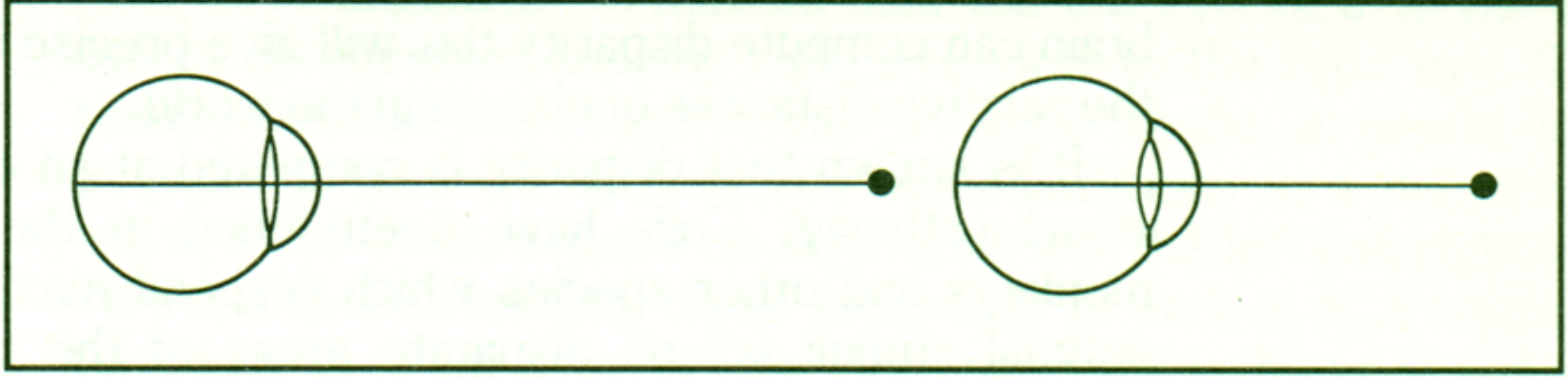
- Depth cues include
  - vergence
  - accomodation
  - stereopsis
  - motion
- Issues
  - what geometric information is available?
  - what matches are available? are correct?



Correspondence errors = depth errors

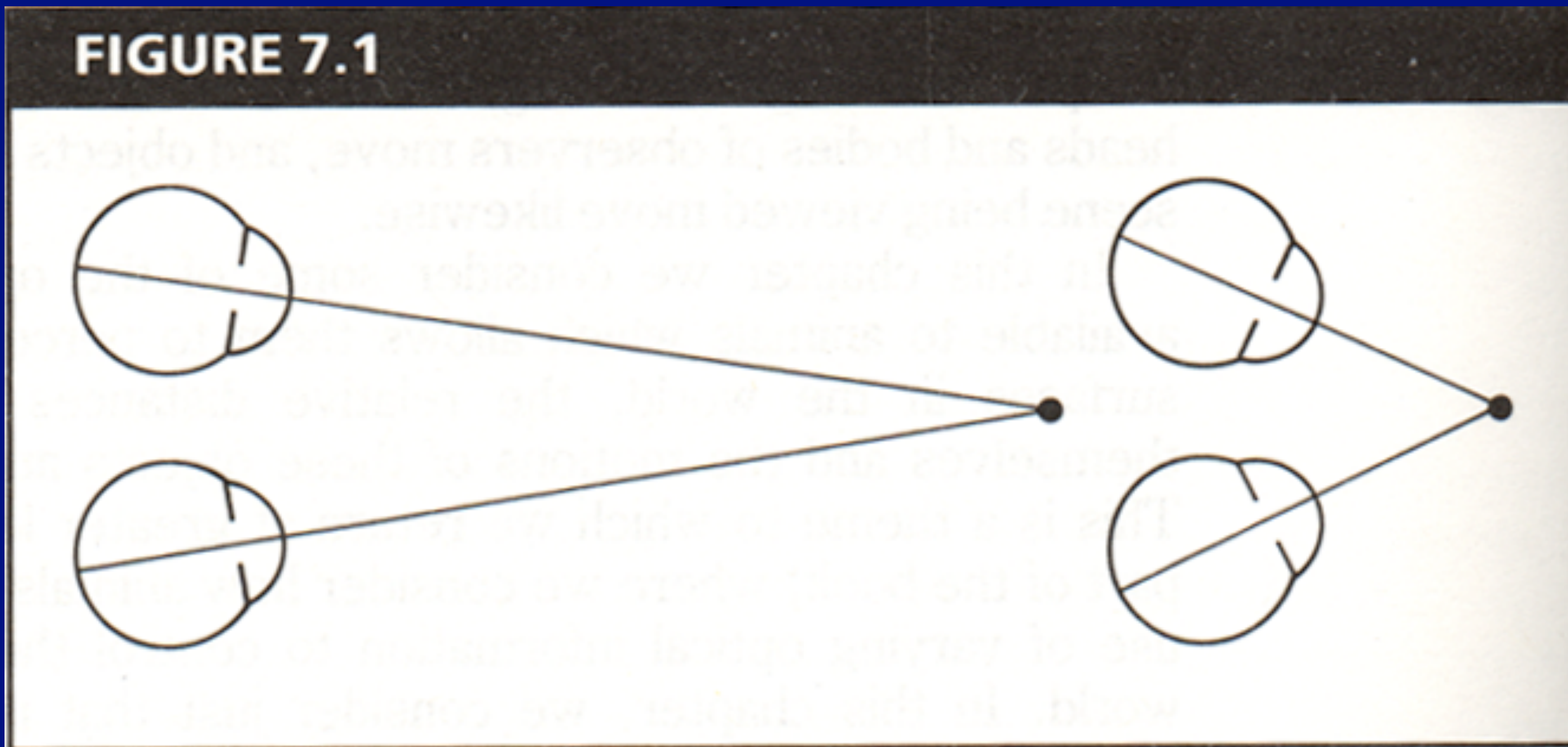
Accomodation and focus

FIGURE 7.2



From Bruce and Green, Visual Perception,
Physiology, Psychology and Ecology

Convergence



From Bruce and Green, Visual Perception, Physiology, Psychology and Ecology

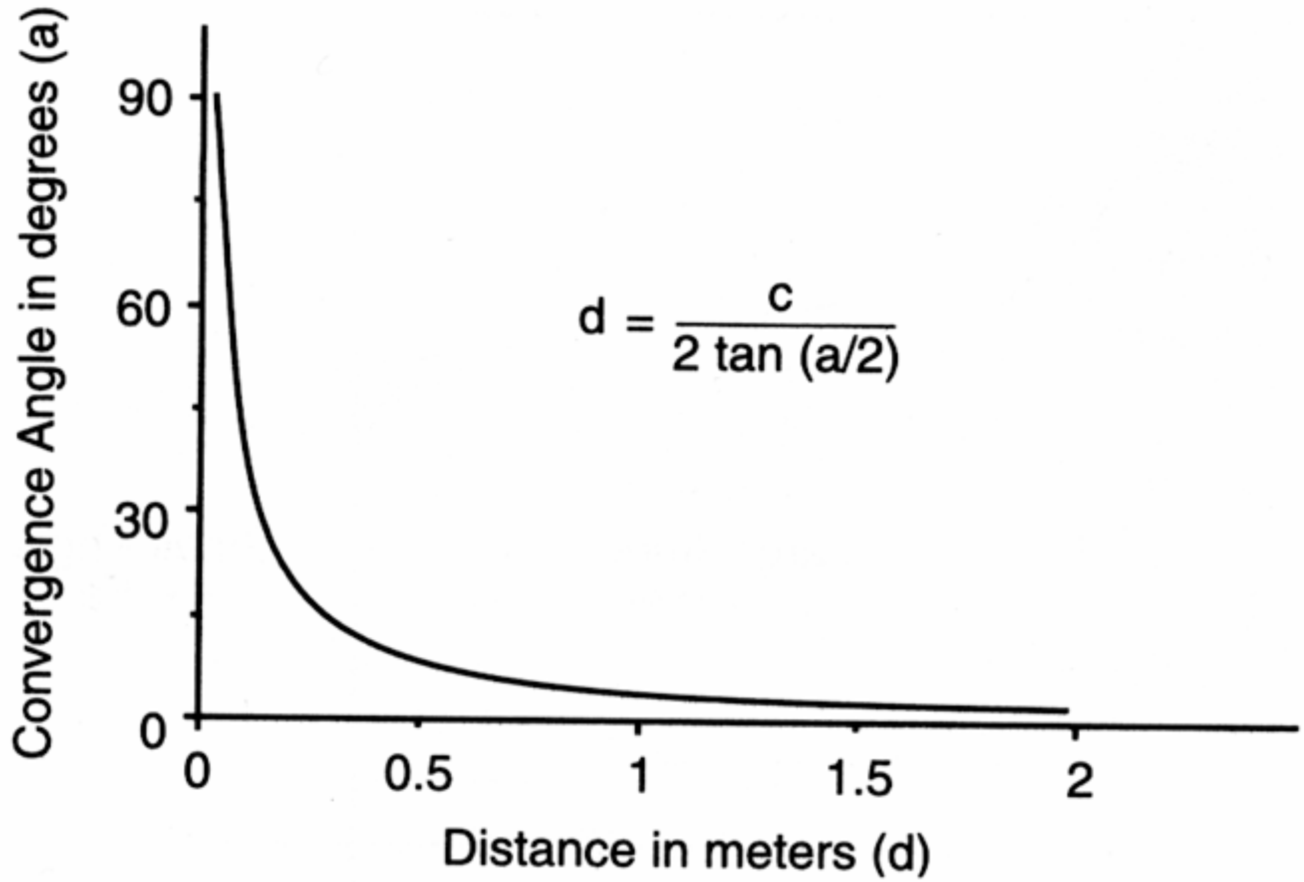
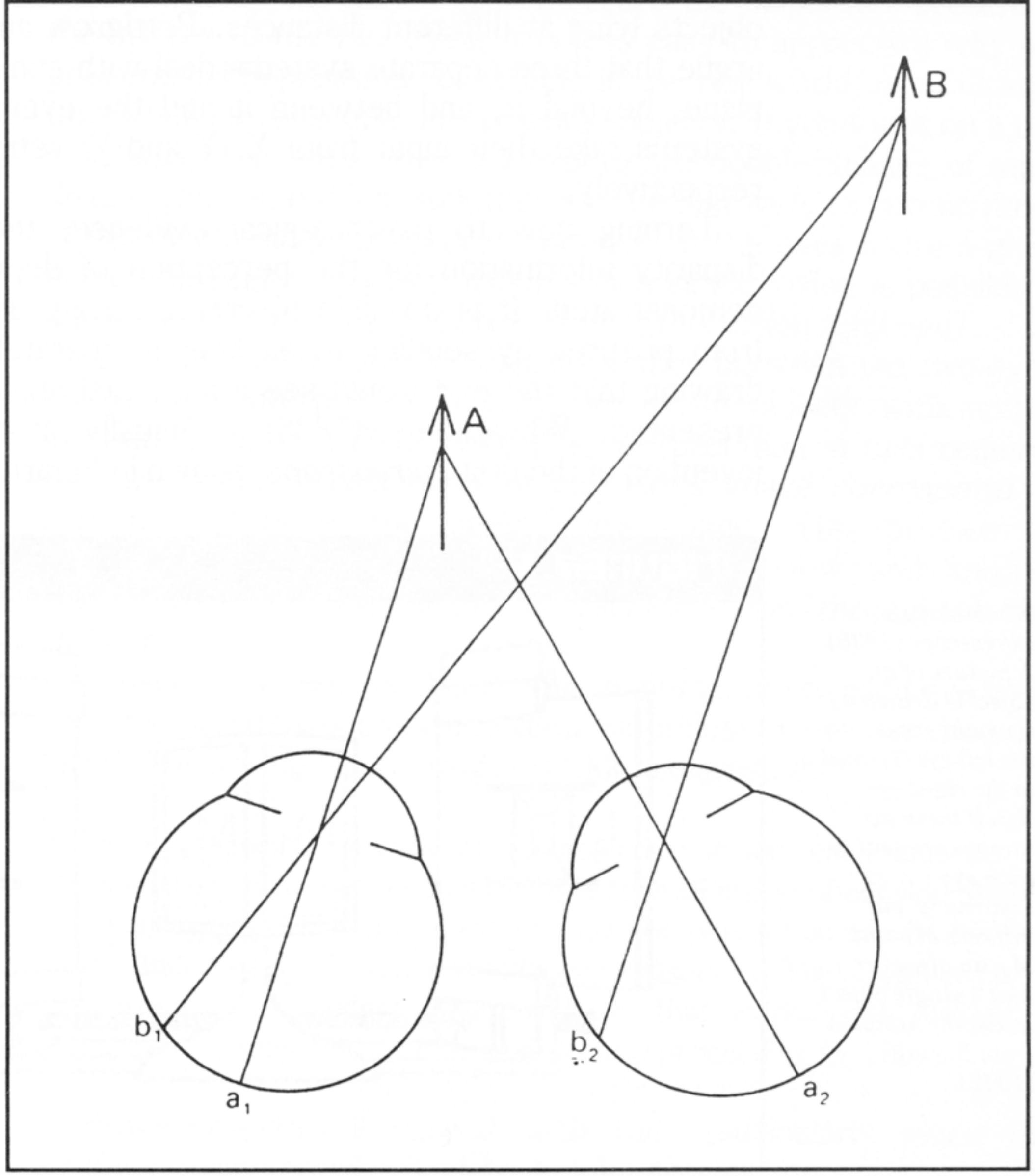


Figure 5.2.3 Convergence as a function of distance. The angle of convergence changes rapidly with distances up to a meter or two but very little after that.

From Palmer, "Vision Science", MIT Press

FIGURE 7.3



From Bruce and Green, Visual Perception, Physiology, Psychology and Ecology

Disparity occurs when Eyes verge on one object; Others appear at different Visual angles

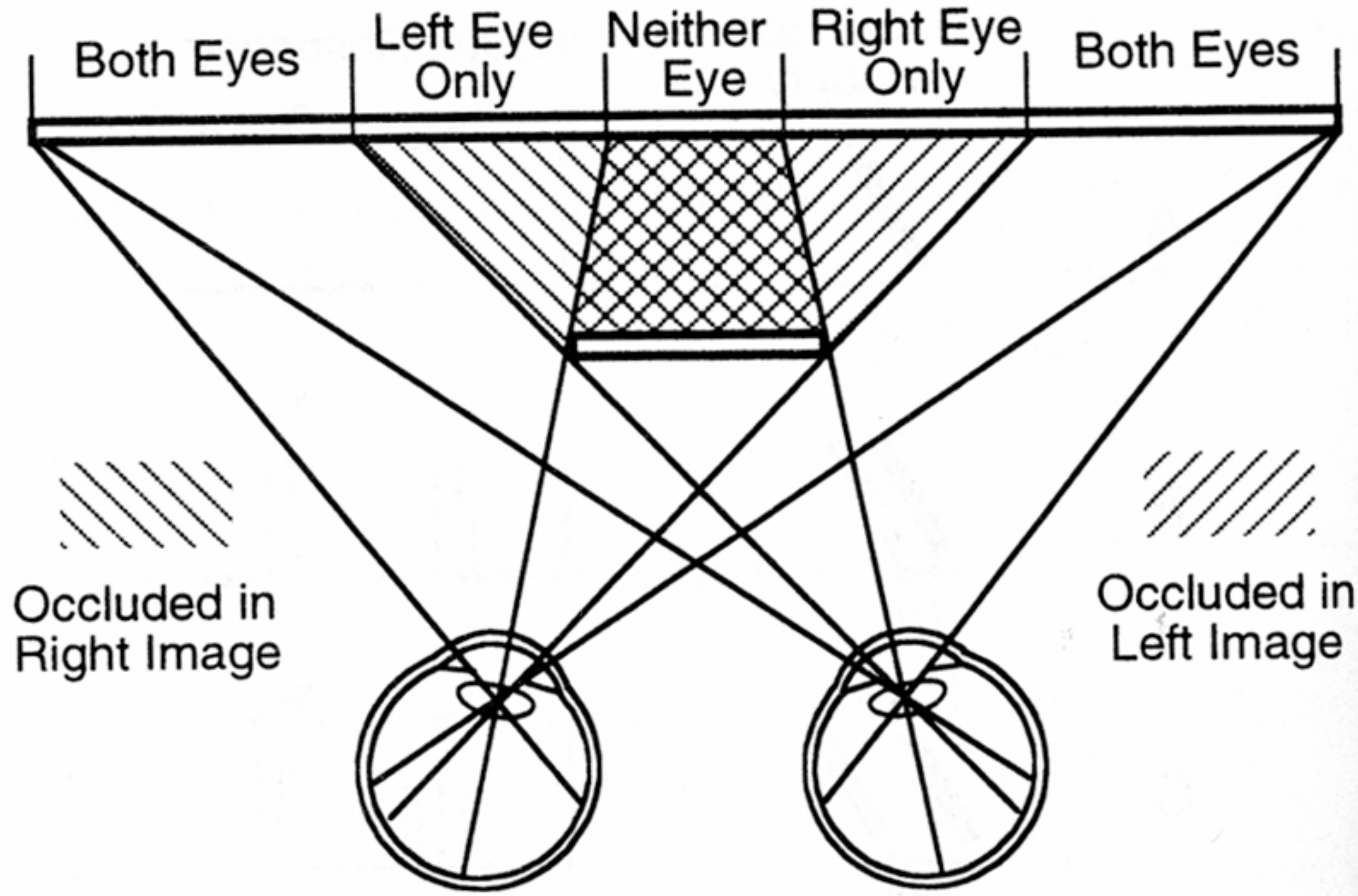


Figure 5.3.23 Da Vinci stereopsis. Depth information also arises from the fact that certain parts of one retinal image have no corresponding parts in the other image. (See text for details.)

From Palmer, "Vision Science", MIT Press

Random Dot Stereograms

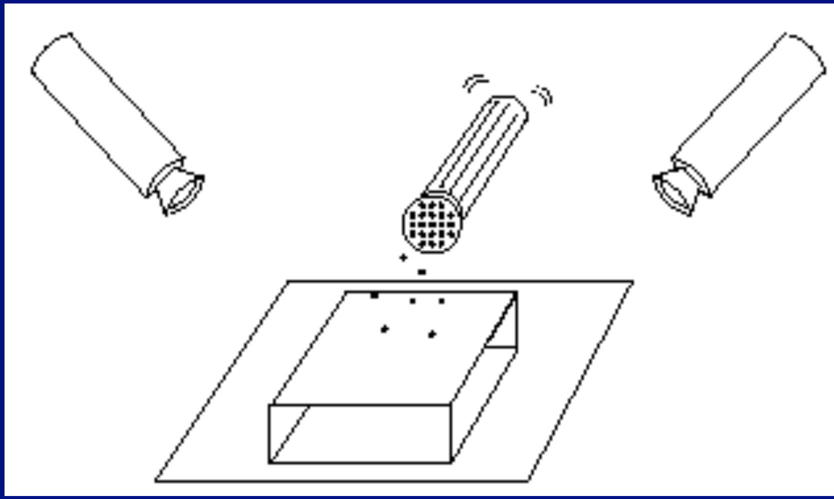


Figure 5.3.8 A random dot stereogram. These two images are derived from a single array of randomly placed squares by laterally displacing a region of them as described in the text. When they are viewed with crossed disparity (by crossing the eyes) so that the right eye's view of the left image is combined with the left eye's view of the right image, a square will be perceived to float above the page. (See pages 210–211 for instructions on fusing stereograms.)

From Palmer, "Vision Science", MIT Press

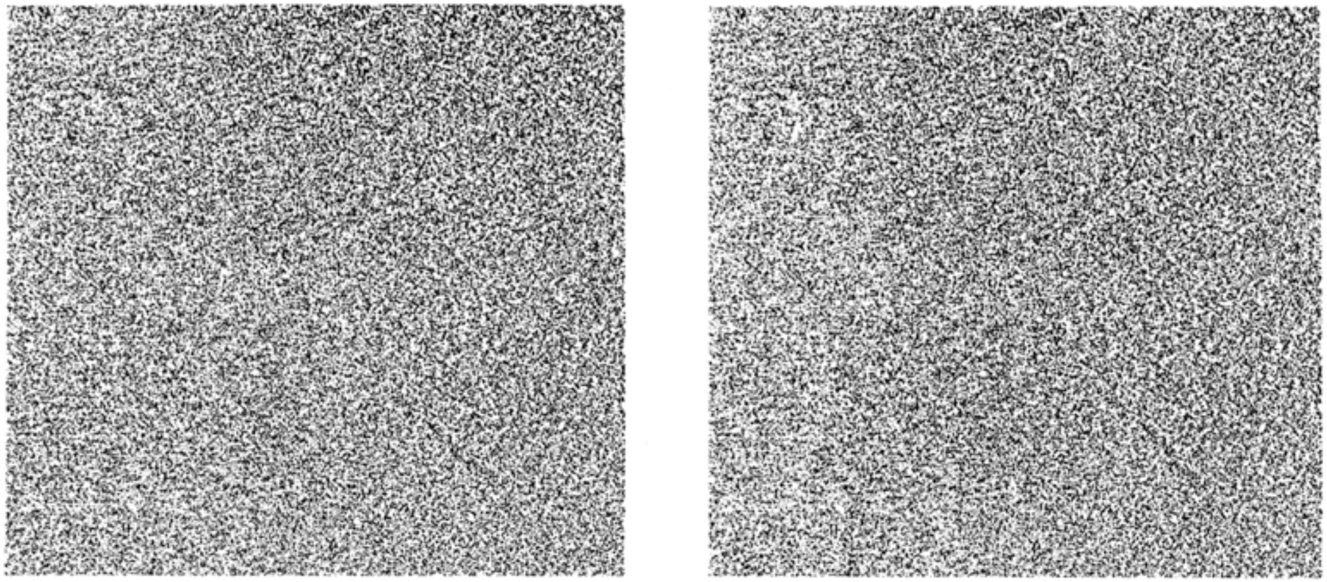


Figure 5.3.9 A random dot stereogram of a spiral surface. If these two images are fused with crossed convergence (see text on pages 210–211 for instructions), they can be perceived as a spiral ramp coming out of the page toward your face. This perception arises from the small lateral displacements of thousands of tiny dots. (From Julesz, 1971.)

From Palmer, “Vision Science”, MIT Press

The fundamental matrix

- A point in view one can lie on a line in view two
  - not anywhere
  - epipolar line
- Each point corresponds to a line
- The family of lines passes through a point
  - the epipole
- This yields an algebraic constraint
  - in homogenous coordinates

$$\mathbf{x}_{\text{left}}^{T} \mathcal{F} \mathbf{x}_{\text{right}} = 0$$