Stereoscopic Techniques

Embedding Depth into Pictures

Talk Overview

- Stereoscopic Vision
- Cinematography Equipment
- 3D Cinematography concepts
- ~~Preproduction~~
- Principal Photography
- CGI & VFX
- Editing 3D

Stereoscopic Vision

- Depth feeling in 2D
- The Term of Parallax
- Range and Limits
- When Stereoscopic Vision Goes Wrong

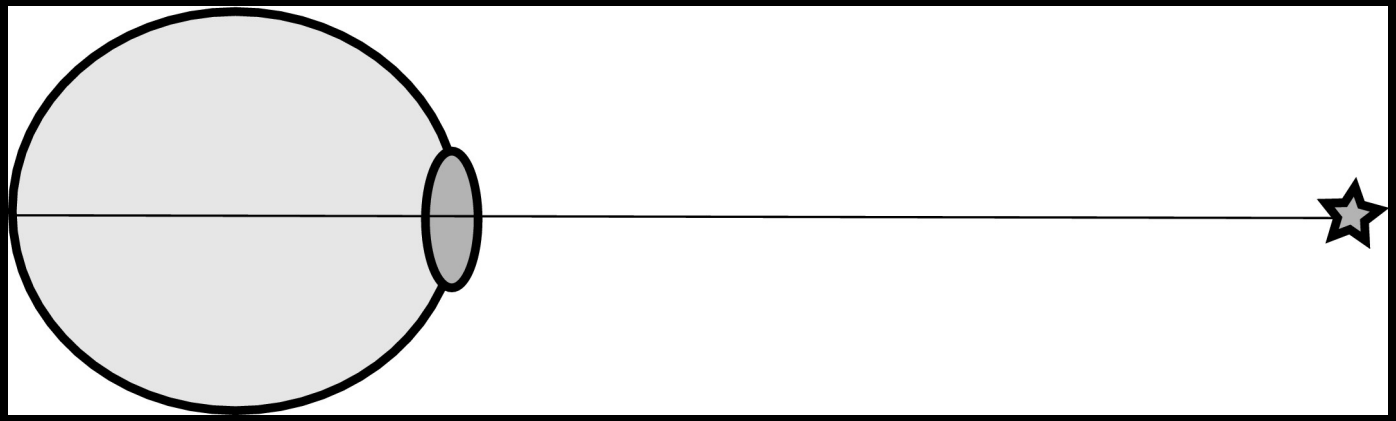
Depth Feeling in 2D

- Physiological cues, binocular vision
- Psychological cues, monocular cues

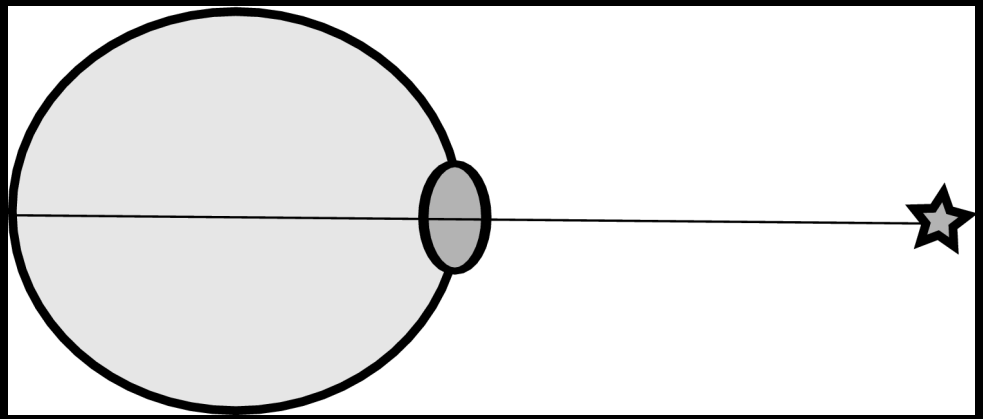
Physiological cues

- Accommodation
- Convergence
- Binocular disparity
- Motion parallax

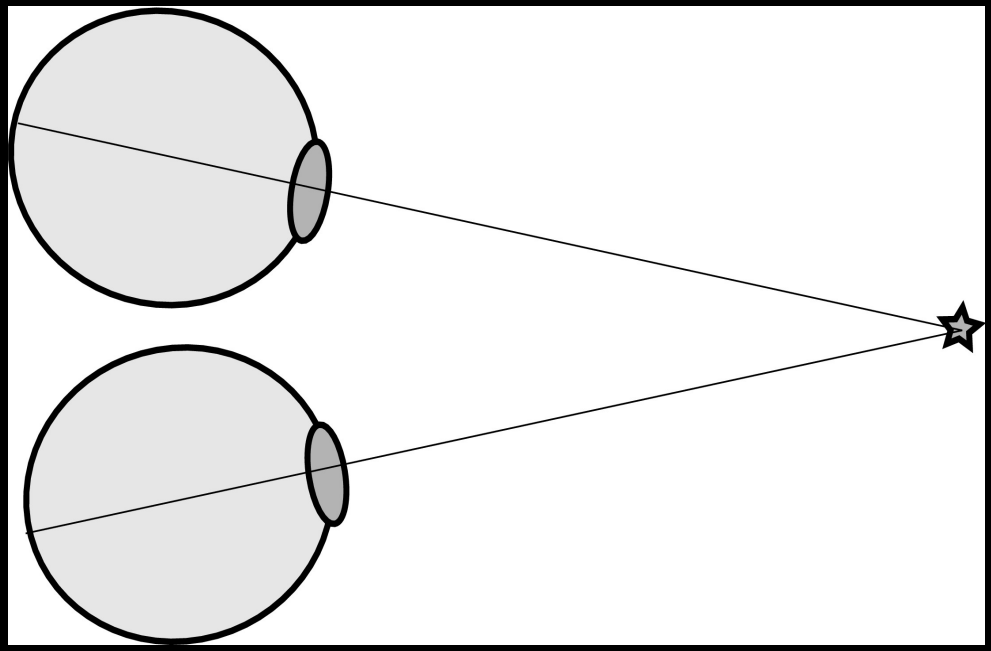
Accomodation

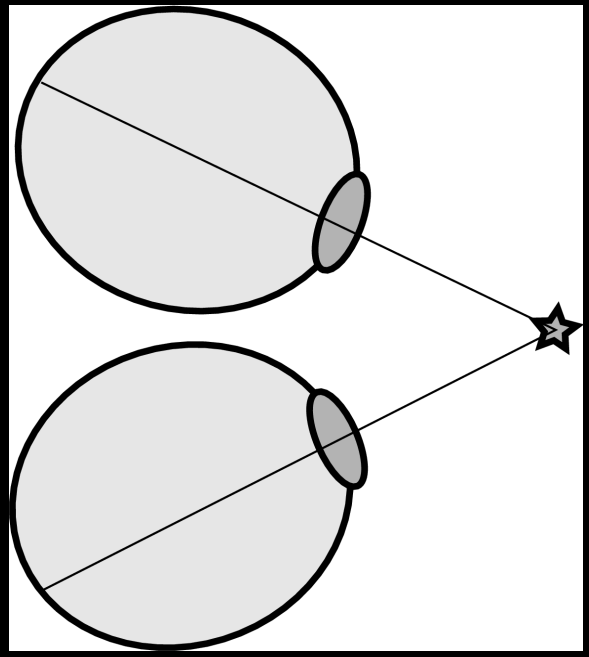


The lens changes its shape



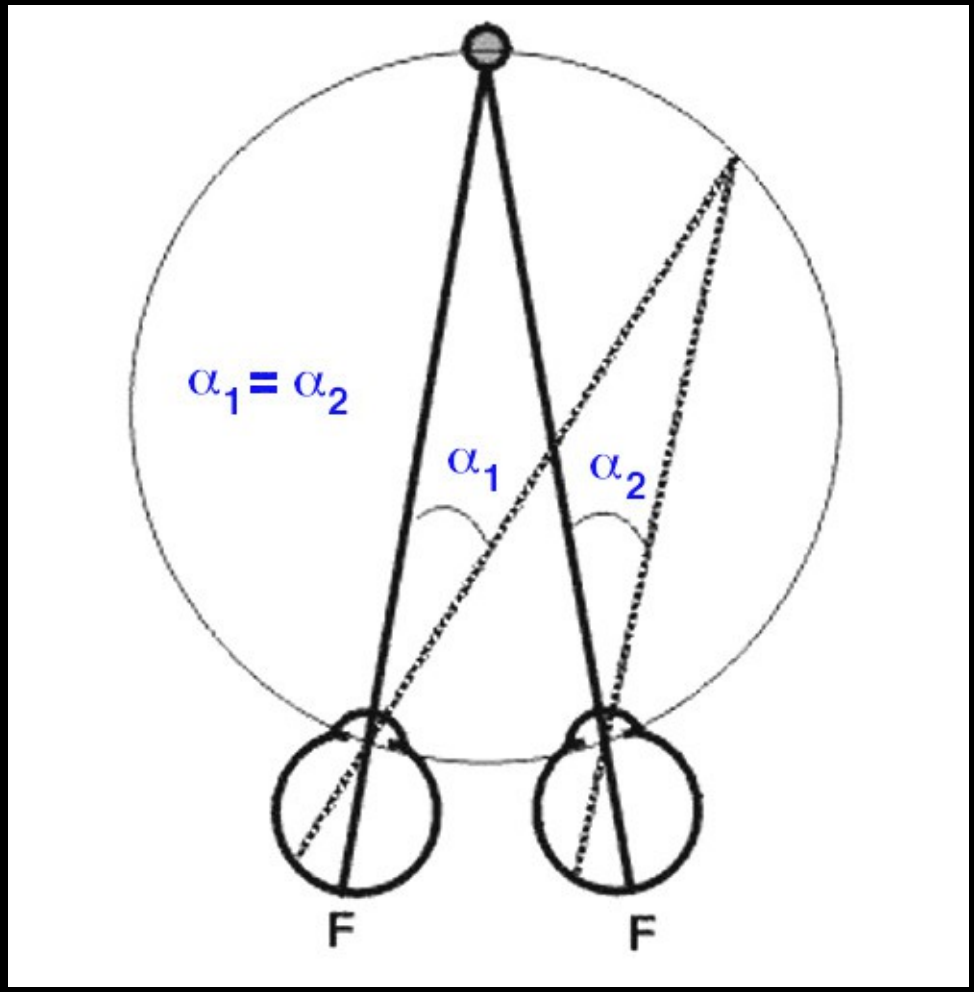
Convergence





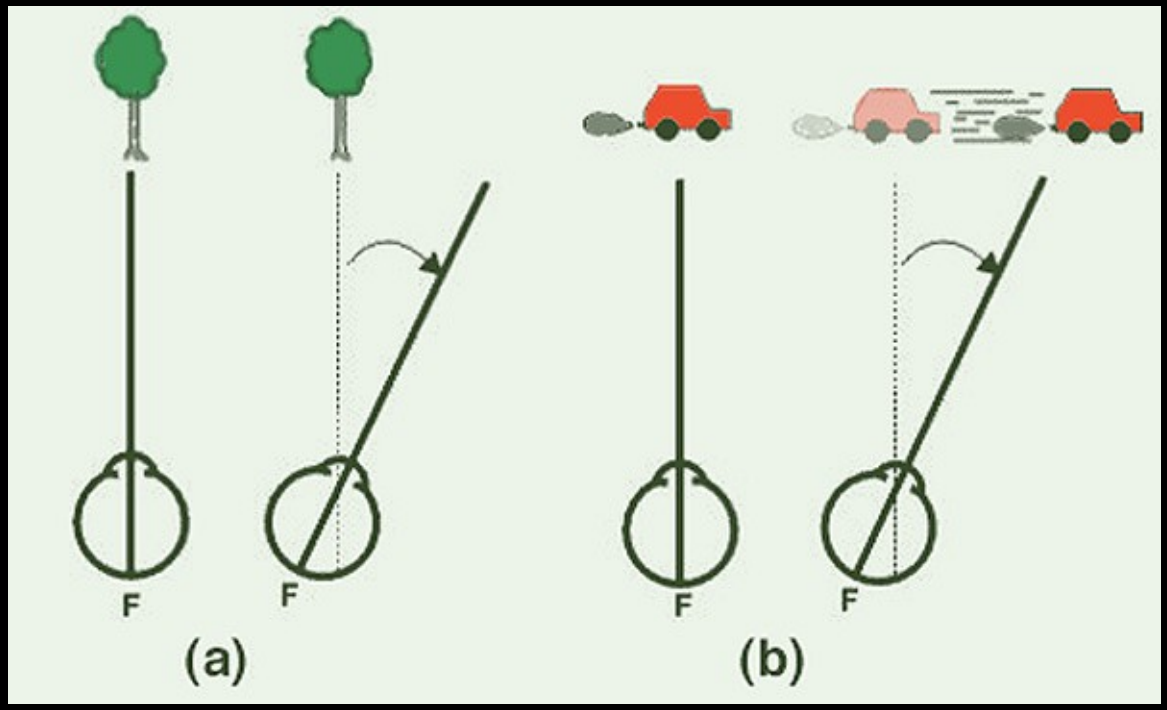
The interaxial angle changes

Binocular disparity



Binocular disparity – horopter – the points laying on the horopter are perceived at the same depth

Motion Parallax



Motion parallax – objects moving in larger distance are perceived as being slower then closer objects with the same velocity

Psychological cues

a)Light and shadow

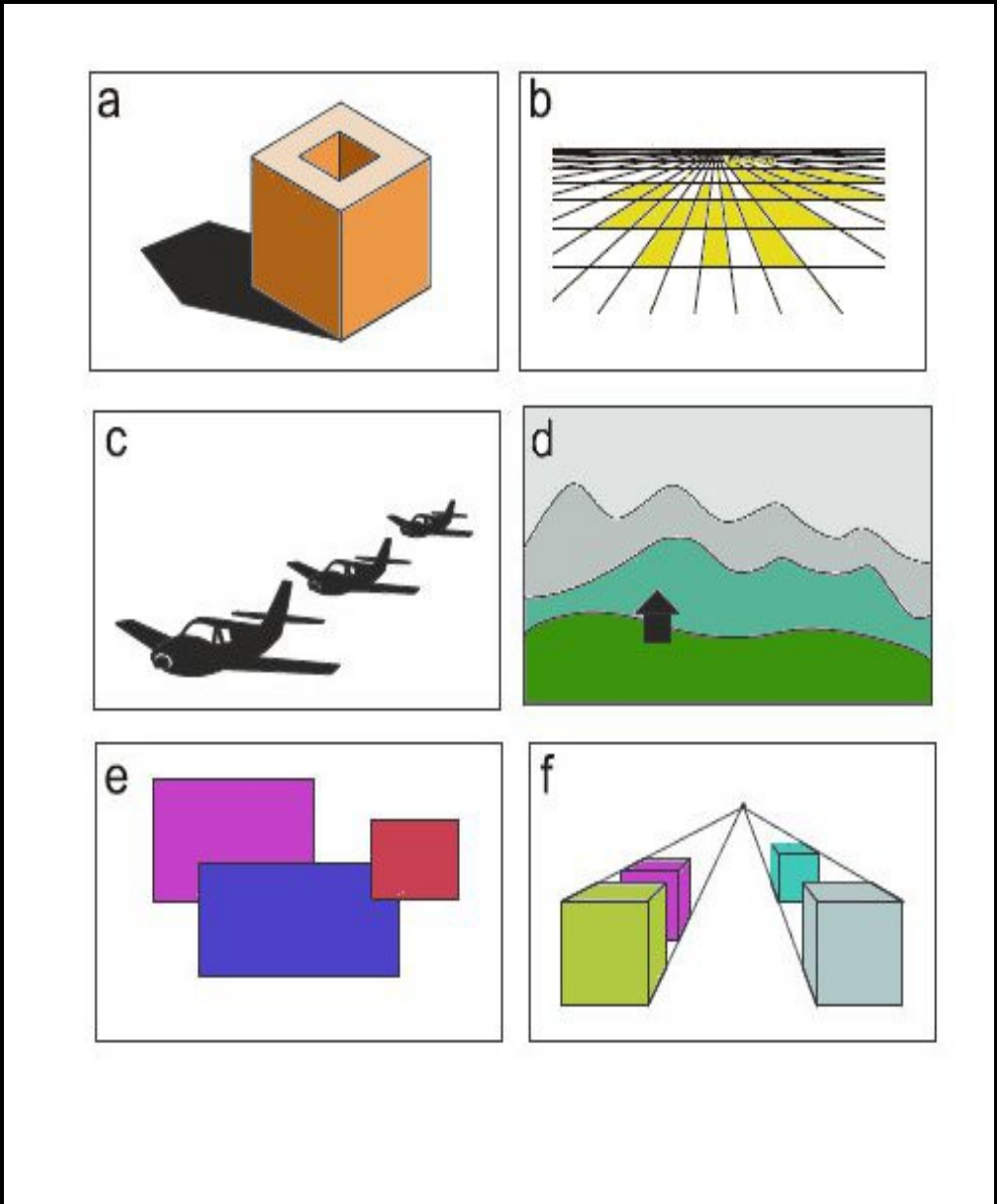
b)Texture gradient

c)Relative size

d)Aerial perspective

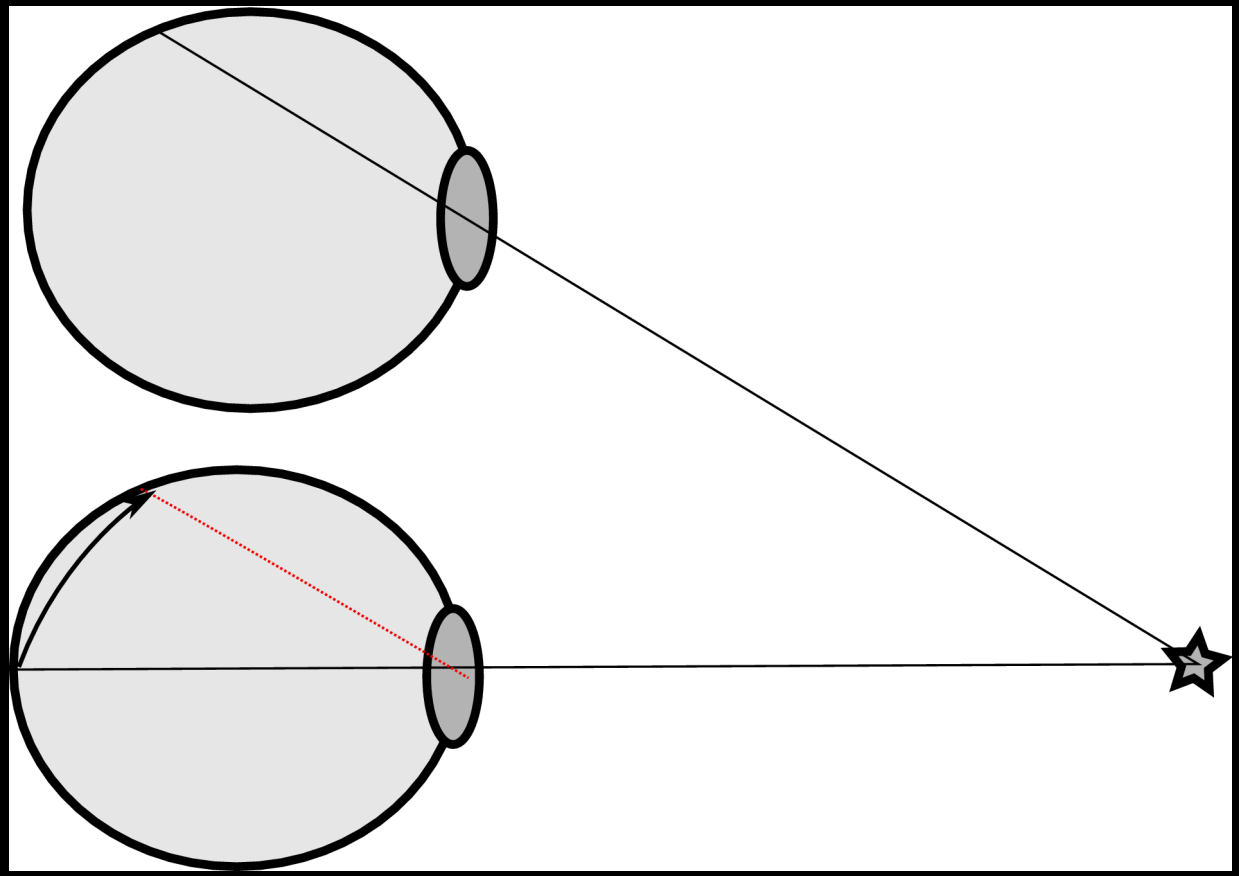
e)Overlapping

f) Linear perspective

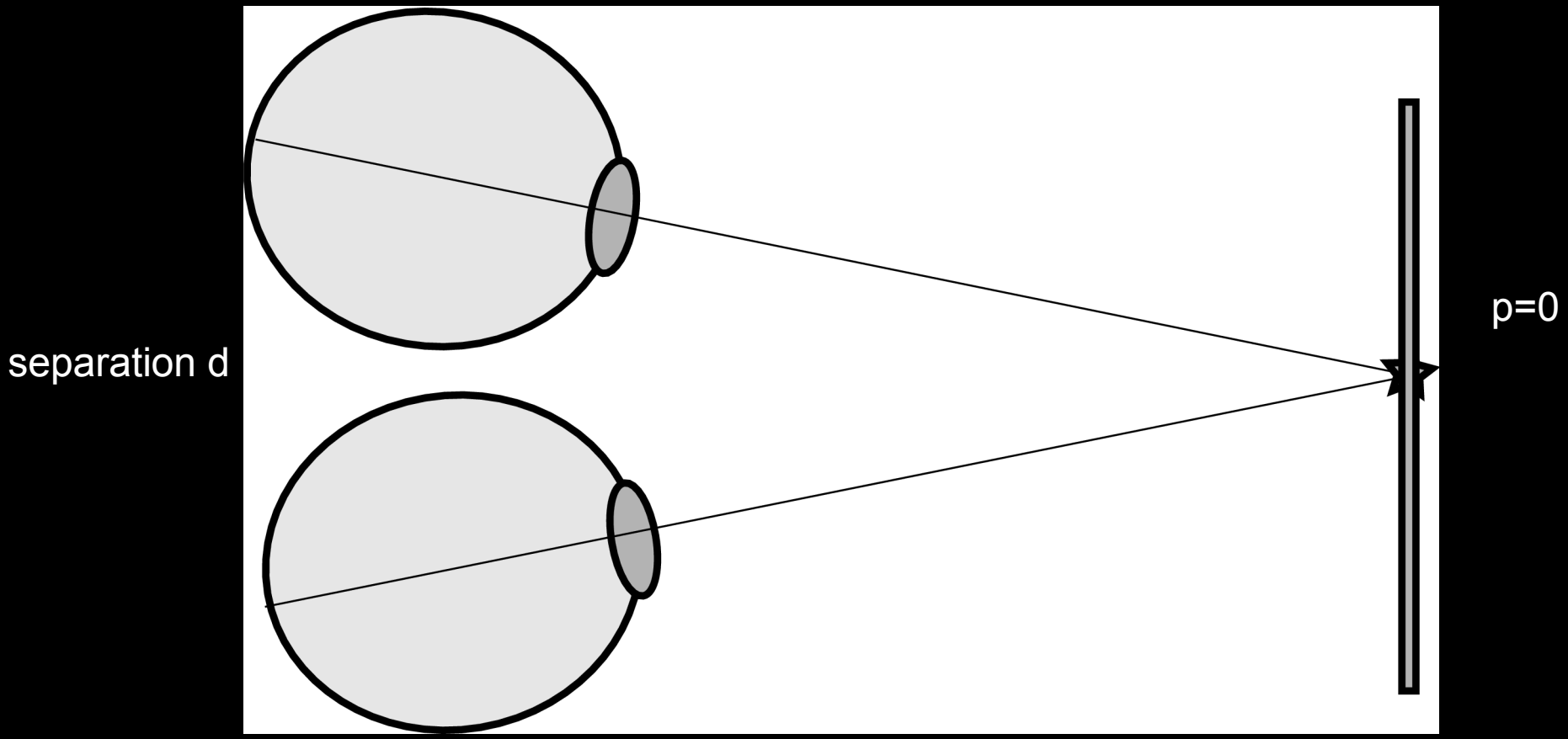


Parallax

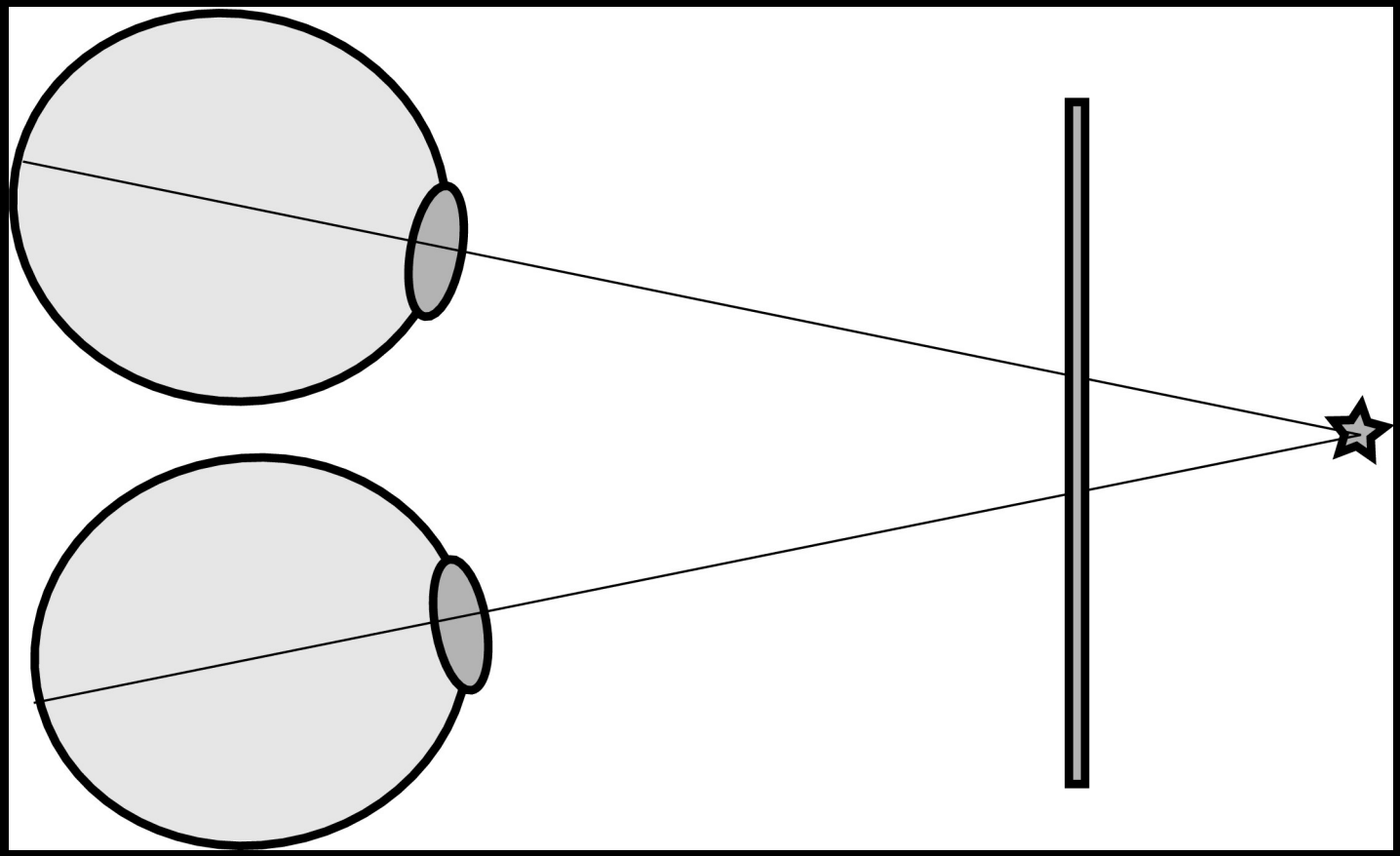
horizontal distance between two corresponding images of a point on the retina



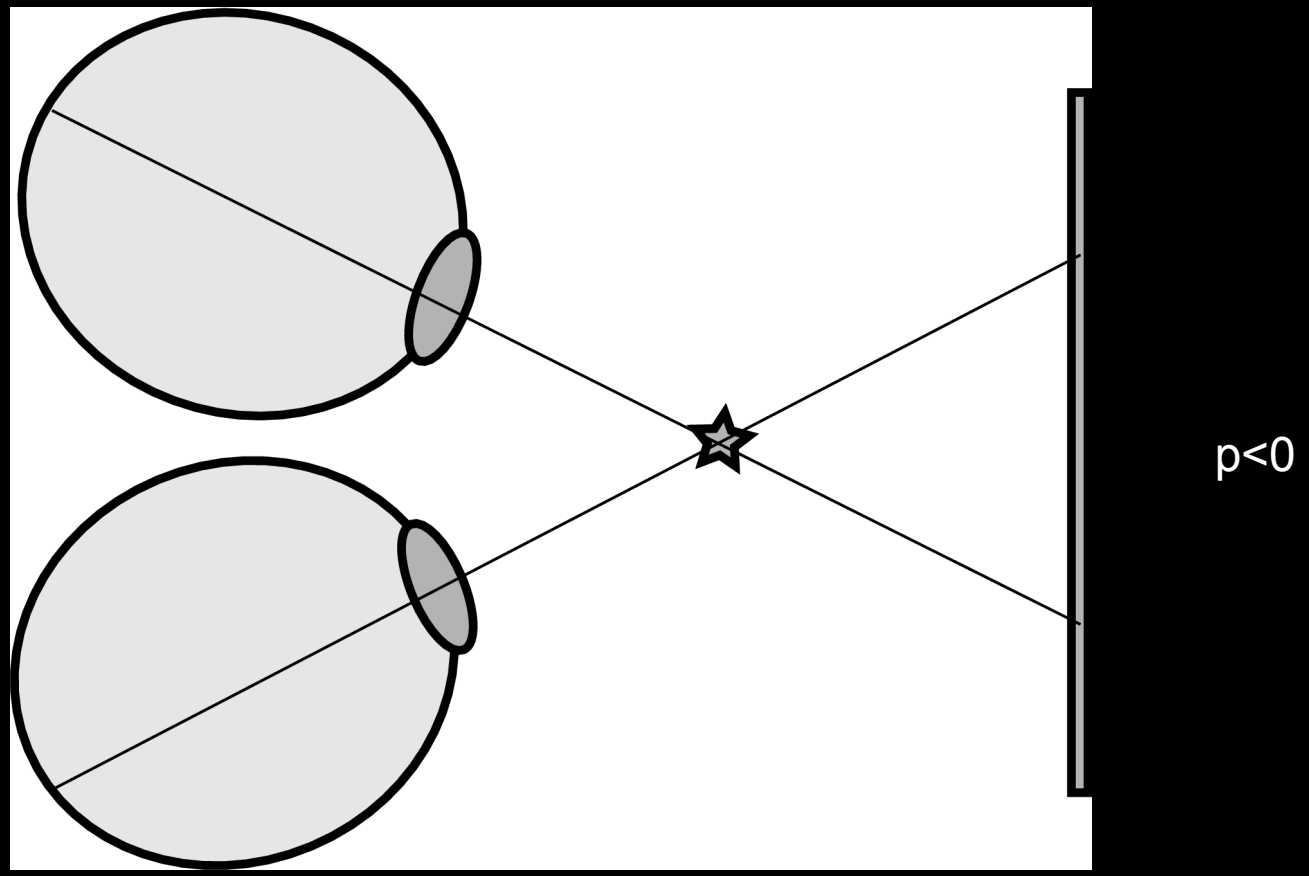
Zero Parallax



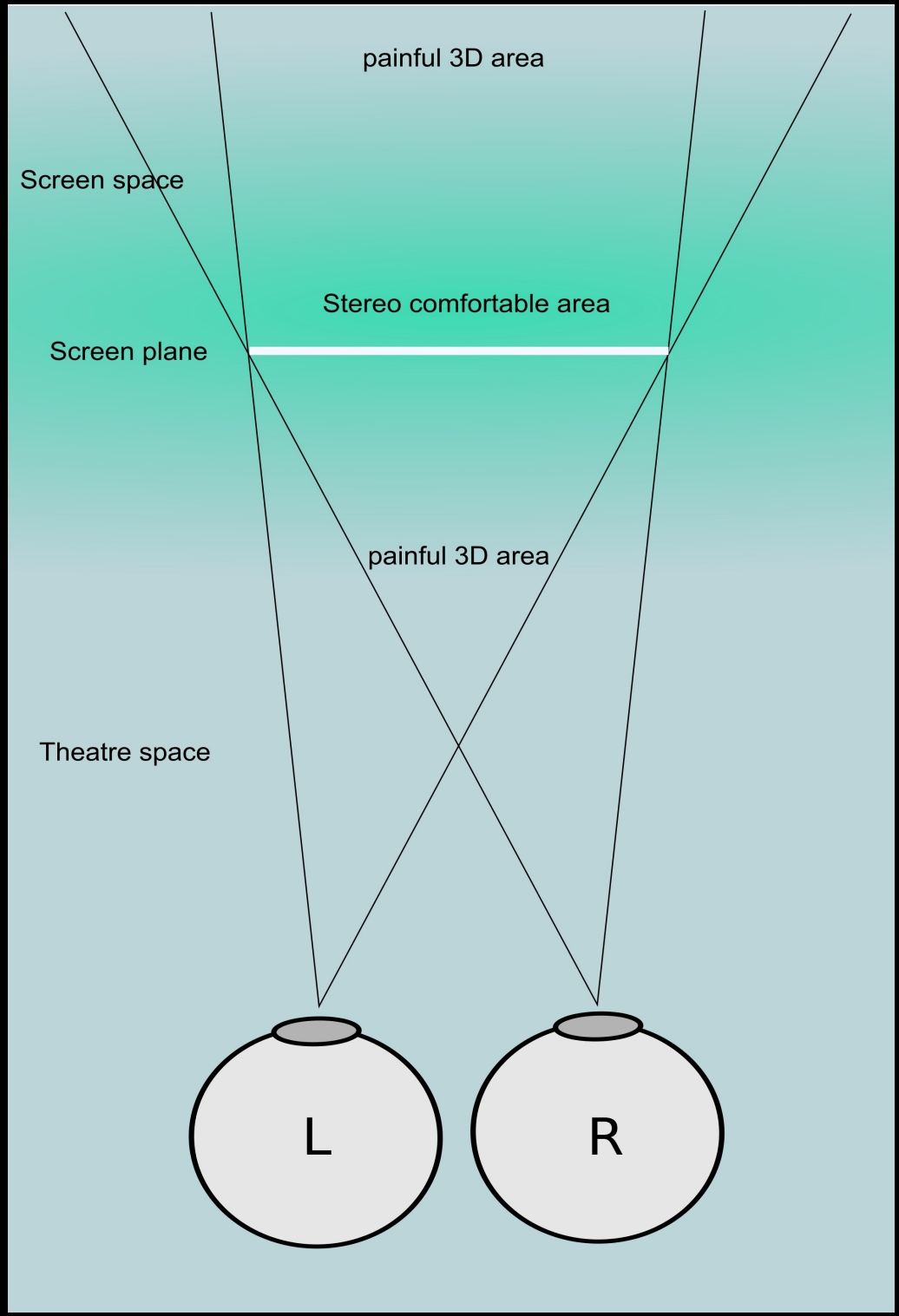
Positive Parallax



Negative Parallax



Limits


painful 3D area
Screen space
Stereo comfortable area
Screen plane
painful 3D area
Theatre space
L
R

Wrong Feeling of 3D

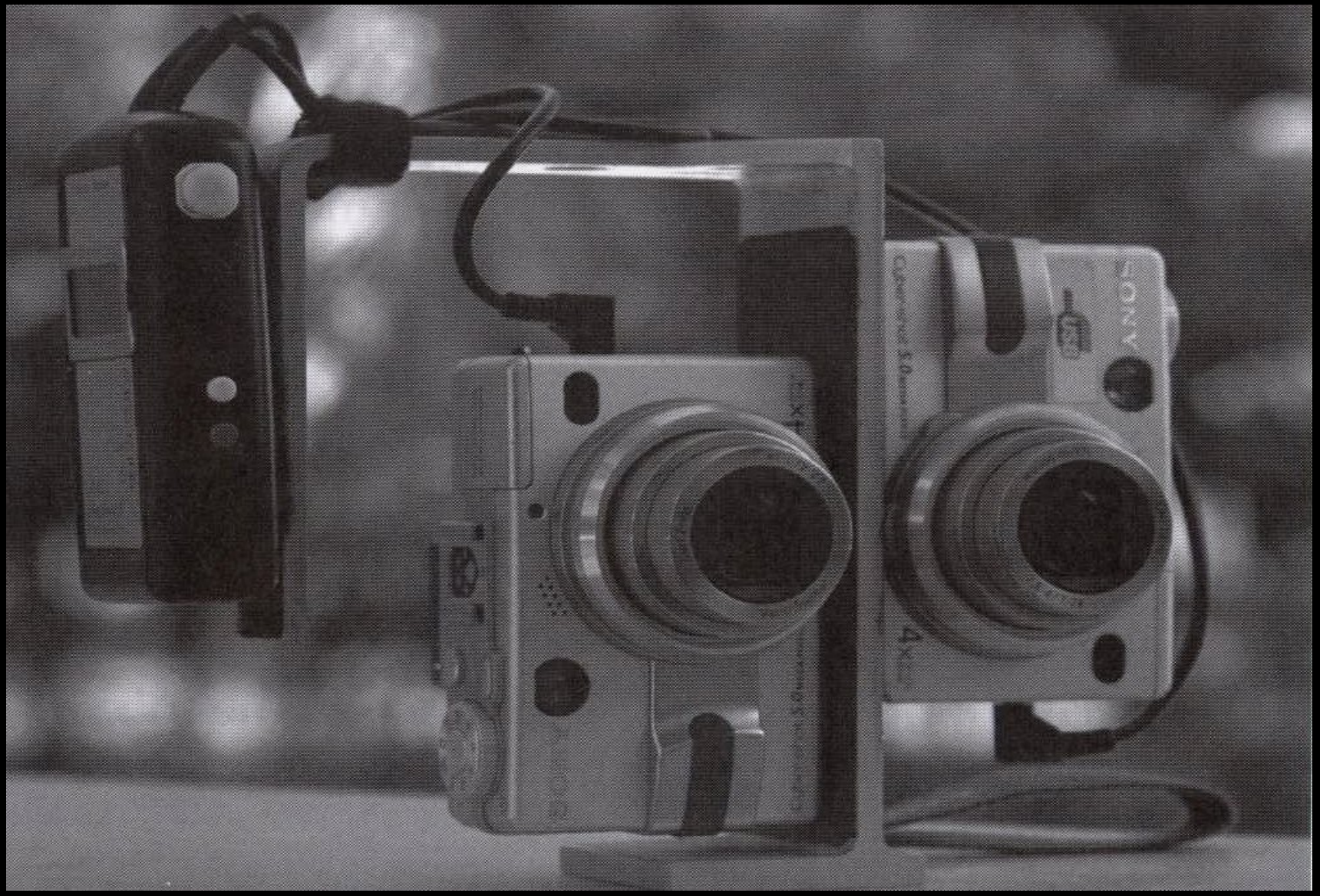
- Stereo blindness (3-15% population with binocular vision disability)
- Incorrect setup
  - locating objects outside comfort stereoscopic zones
  - calorimetric and photographic settings
  - specular objects, reflections, glossy surfaces
  - inverted stereoscopy

Tools

- Hardware
- Software

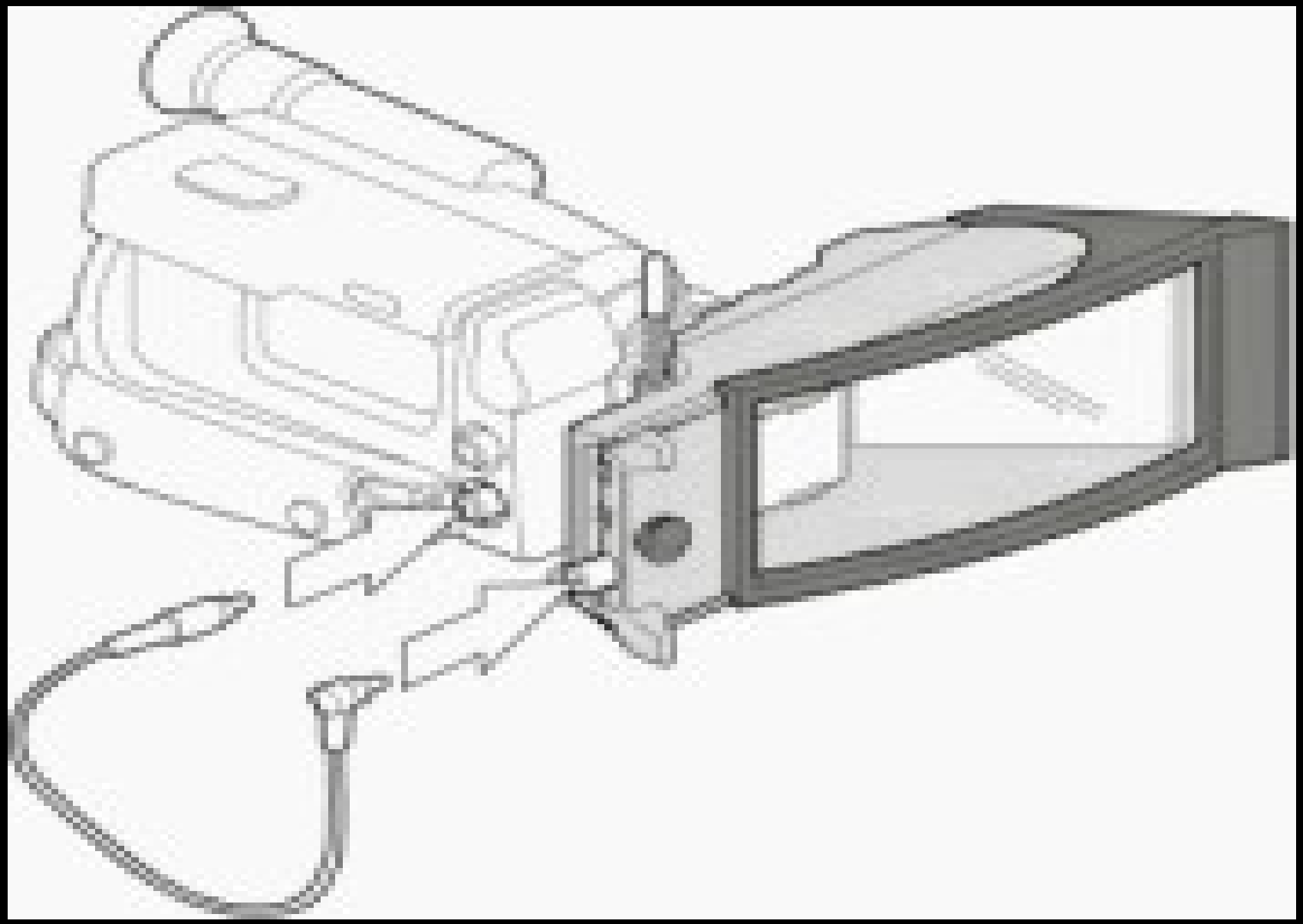
Thornton Pickard 'Imperial Perfection' stereoscopic folding camera, with a mahogany case
England, approx. 1910

Stereo Camera Rig




SONY
SONY
SONY
VCT-1170RM


I AM THE LIGHT
BAR
RED



Panasonic P2 HPX170 Pro 3D

Panasonic HDC-SDT750

Software

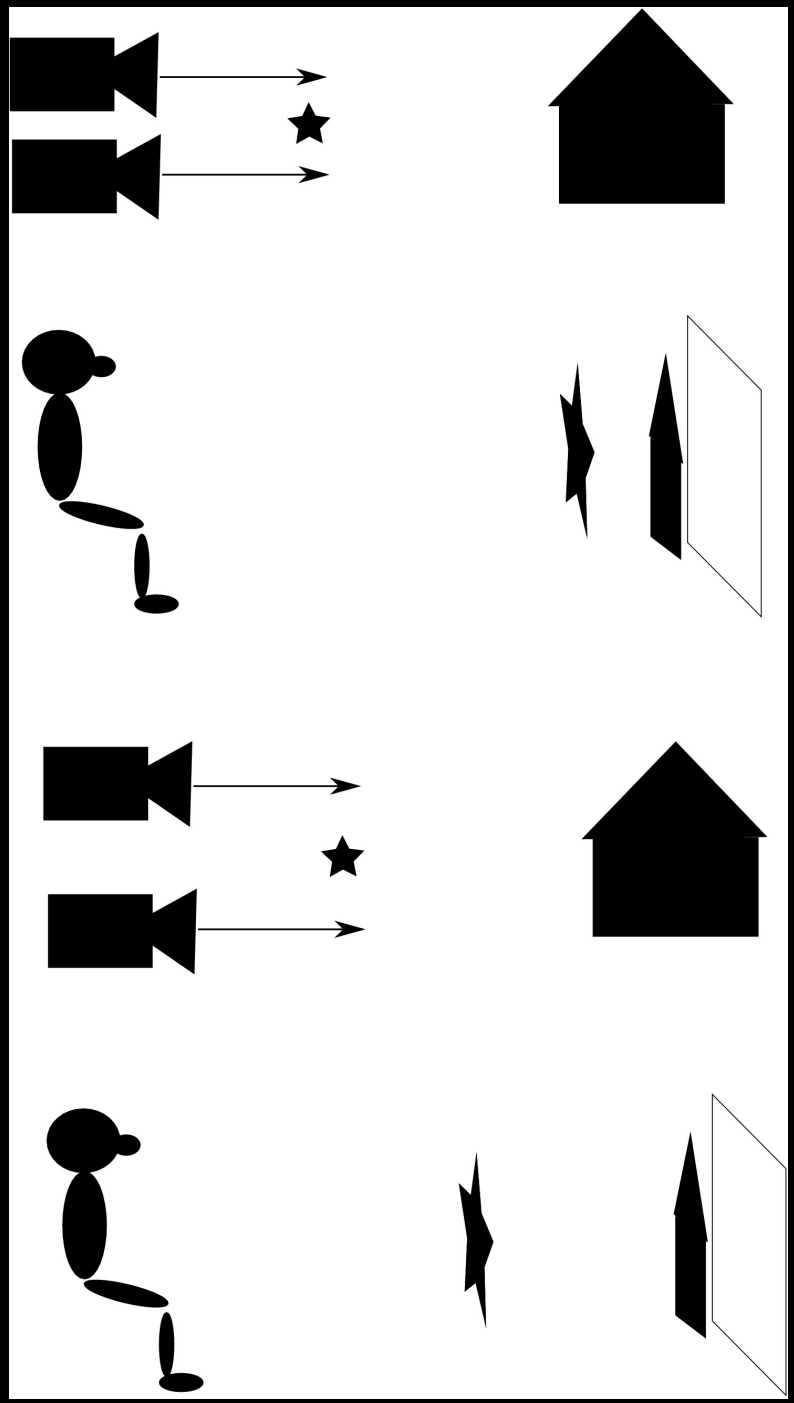
- Stereoscopic player (Peter Wimmer) – *www.3dtv.at*
- Adobe Creative Suit
- Sony Vegas – Make3D – *www.medtron.org*
- Assimilate – *SCRATCH*
- IRIDAS – D.I. Solutions
- Autodesk Maya
- Avid
- Quantel
- Foundry – Nuke – Occula
- EON Fusion – Frantic Films Awake

3D Cinematography Concepts

- Camera Setup (separation, distances)
- 3D Screenspace
- Calculating Parallax

Camera Separation

- Increasing separation the depth of the scene increases



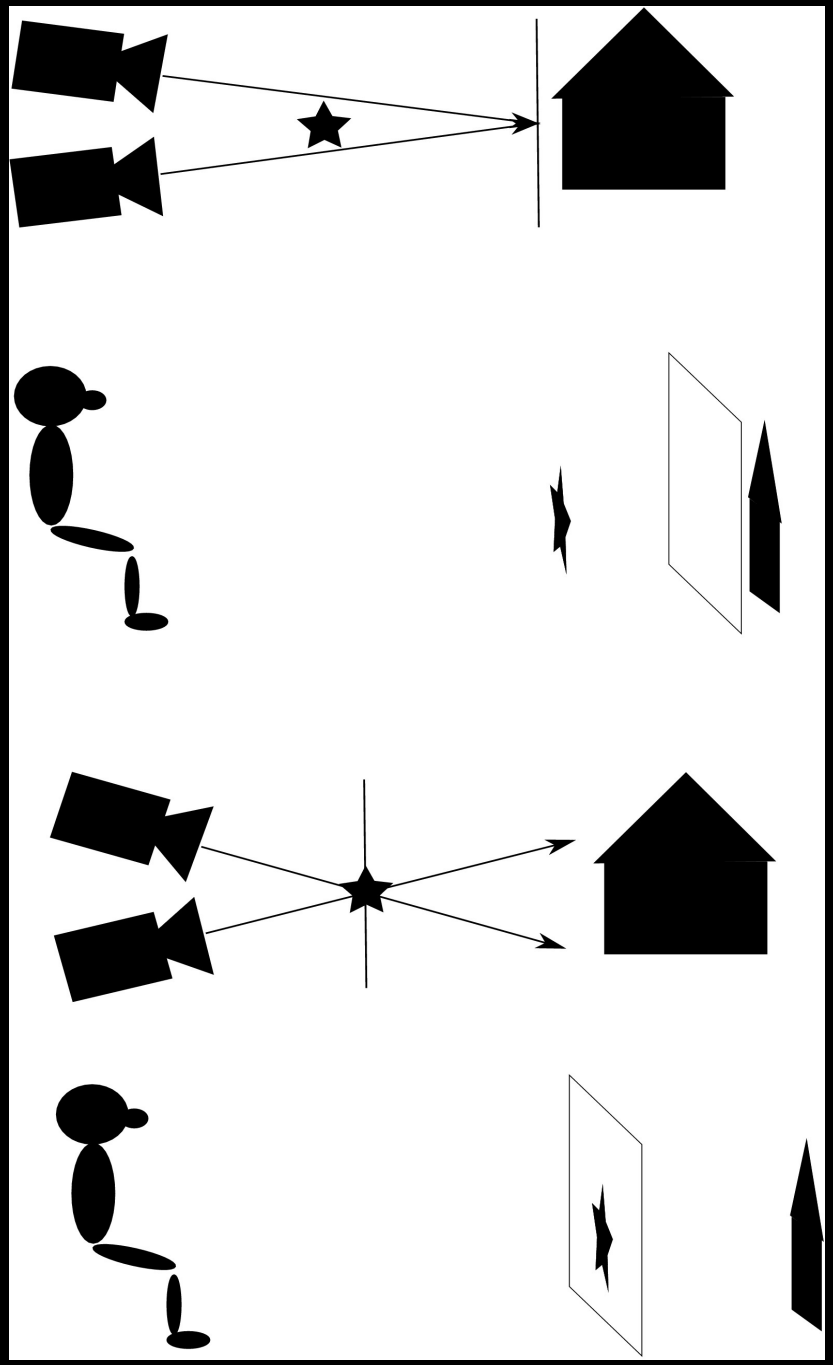
Camera Convergence

- Parallel cam axes

  => objects in front

  of the screen
- All objects behind the convergence point will be behind the screen
- Convergence

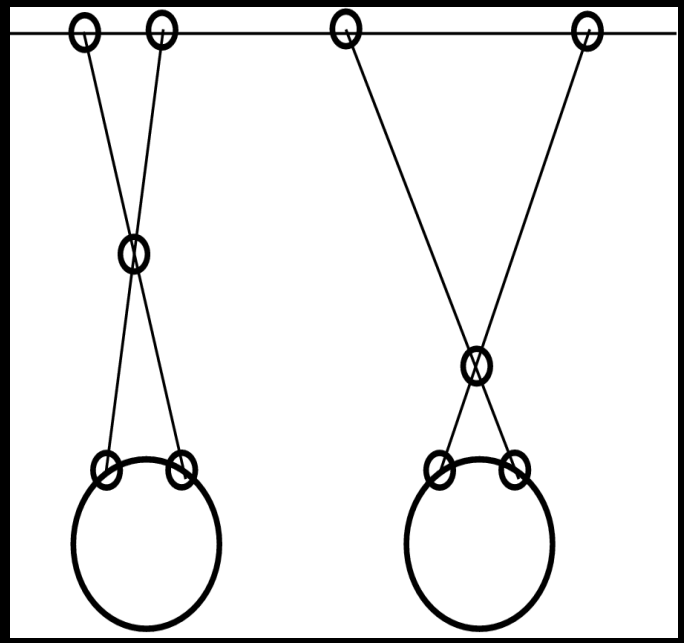
  produces vertical parallax



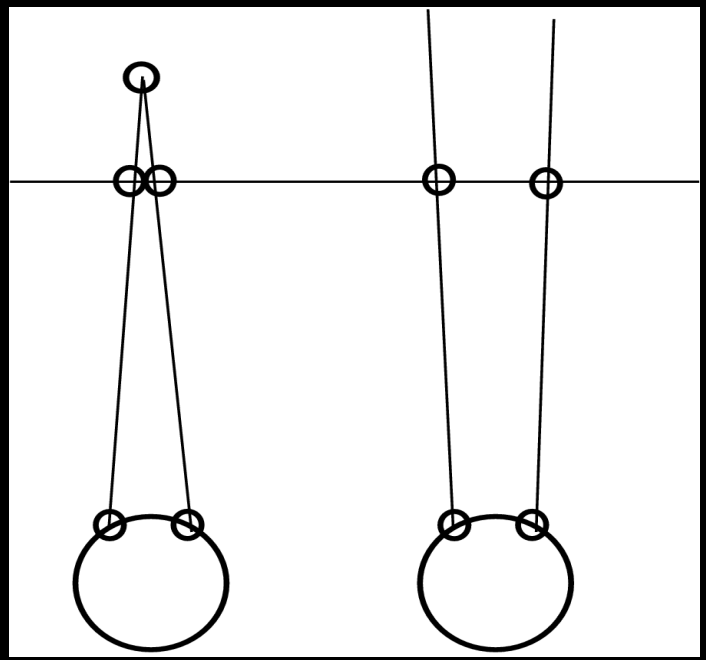
3D Effect of the Screen Size

- with the increasing screen the depth of the scene grows

Negative parallax

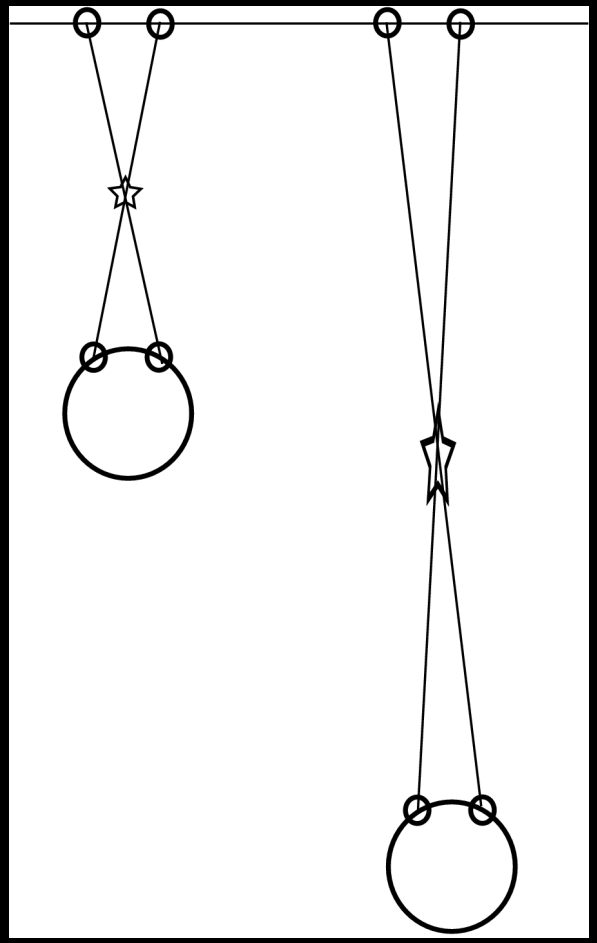


Positive parallax



3D Effect of the Screen Distance

- The growing screen distance increases off-screen 3D effect



Native Pixel Parallax

- native separation/screen width x screen resolution
- 6.5cm/9m x 2k ~ 0.7% x 2048 = 14.8px
- for positive parallax double eye distance is acceptable
- for negative parallax up to hundreds of pixels is possible
- for small screens the reference parallax is reduced from 6.5mm to 10mm

Preproduction

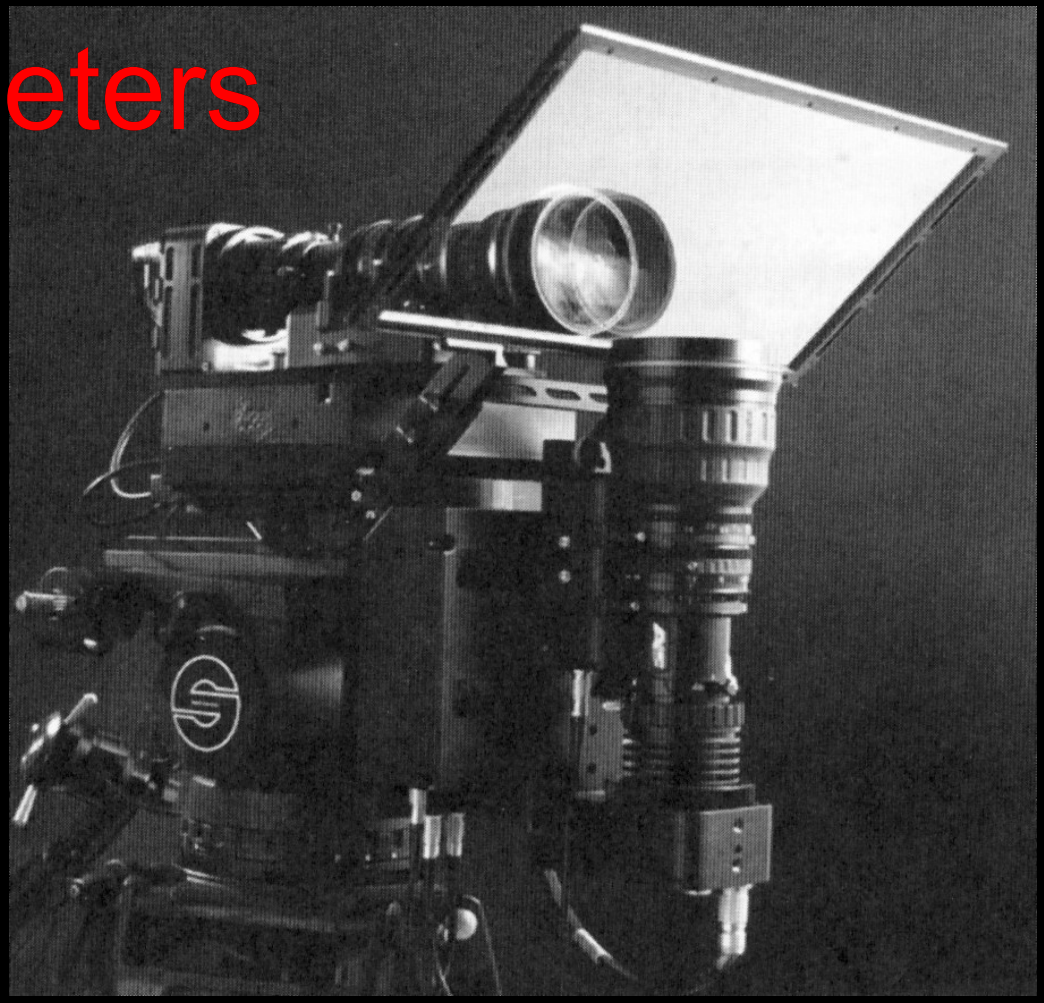
- preparing shots for 3D

3D Photography

- Parameters of camera equipment
- Camera Configuration
- Animating 3D Effects

Equipment parameters

- matching lenses
- zoom
- matching focus & iris
- using mirrors
  and half mirrors
- polarization,
  reflections
- synchronization



Camera Setup

1. the 1/30th rule
2. initial 3D camera setup
   - camera position, axis, composition
   - setting depth bracket - interaxial distance, convergence
3. visual evaluation
4. fine tuning depth effects

Animation of 3D Effects

- when motions of objects change 3D parameters
- animation of convergence
- animation of interaxial distance
- key positions & velocity of camera

CGI & VFX

- Virtual Camera
- Stereoscopic Composing
- 2D-3D Conversion

Virtual Camera Rig

- used in modelers (Maya, 3DS MAX), also Blender
- uses front, back and screen planes
- live previews (anaglyph, side-by-side,...)
- Maya 2009 - …

Stereo Composition

- setup the effects for one eye
- replicate for second eye
- tune the depth settings in 3D view

Editing 3D

- Depth Continuity
  - forward and backward depth jump cut
  - active depth cut
- Transition
  - cross-fade +
  - wipe, split screen -
- Sound – stereo picture and sound does not match

Packaging

- Formats for 3D

References

- Bernard Mendiburu: ***3D Movie Making: Stereoscopic Digital Cinema from Script to Screen***, Focal Press; Pap/Dvdr edition (May 6, 2009), ISBN: 0240811372
- Daniel Laubr: *Stereoskopická projekce*, Diploma thesis, CTU in Prague, 2006