

8. Vision: Stereopsis and Depth Perception

I. Depth scaling and depth cue types

- Ordinal
- Relative depth/shape cues
- Reversals
- Absolute depth cues, depth vs. distance

II. Depth cues

Computation (Shape-from-X) vs perception

Pictorial cues

- Relative size, Emmert's law
- Familiar size
- Relative brightness
- Occlusion
- Lighting/shadow/shading
 - Albedo, Reflectance function
 - Assumption of lighting from above
- Elevation/clarity/aerial perspective
- Linear perspective
 - Orthographic vs polar perspective
 - Line drawings
 - Generic view/general position assumption
 - Crossings
 - Parallel
 - Perpendicular
 - 2-D contour - Geodesic assumption
- Texture
 - Density gradient
 - Size gradient
 - Foreshortening
 - Models
 - Isotropicity assumption
 - Local spectral warp

Monocular physiological cues

- Accommodation
- Blur
- Astigmatism, chromatic aberration

Motion cues

- Motion parallax

- Kinetic depth effect

 - From features

 - From occluding contours

 - Types of motion inputs

- Models of structure-from-motion

 - N points/M views

 - Differential structure of optic flow

- Models of heading-from-motion

 - Decomposing optic flow into translation plus rotation

- Dynamic occlusion

Binocular cues

- Convergence

- Binocular stereopsis

 - Disparity - crossed and uncrossed

 - For a point directly in front of one eye, with no approximations:

$$\tan(\eta) = \frac{I d}{I^2 + D(D + d)}$$

 - where η is the disparity, I is the inter-pupillary distance, D is the viewing distance and d is the depth.

 - The horopter

 - Scaling

 - Cues: Vertical disparity, extraretinal

 - Types: for distance/vergence, for version

 - Technology for stereograms

 - Free fusion

 - Wheatstone stereoscope

 - Anaglyphs

 - Crossed polarizers

 - LCD shutter glasses

 - Autostereograms

 - The correspondence problem

 - Simple line stereograms, the double nail illusion, Panum's limiting case

 - Random dot stereograms and global stereopsis

 - Random dot cinematograms

 - Da Vinci stereopsis

 - Formal analogy to structure-from-motion

 - The induced effect, cue conflicts

 - The Pulfrich effect

 - Stereoacuity (as good as 2'')

 - Stereoblindness and pools of disparity detectors

 - Models

 - Discrete correspondence - Dev, Sperling, Marr/Poggio 1976

 - Multiple scale models

 - Zero crossings - Marr/Poggio 1979

 - Multi-scale correlation

 - Binocular rivalry, fusion and diplopia

Fusion vs depth
Corresponding points
Panum's area
Multiple scales
Hysteresis? Cooperativity
Binocular luster
Allelotropia - visual direction of fused features

III. Constancies

Size constancy
Shape constancy
Constancy of visual direction, lightness, color, loudness, etc.

IV. Cue combination

Veto
Disambiguation
Scaling
Averaging
Statistical models
Bayesian models