Motion perception

PSY 310

Greg Francis

Lecture 24

How do you see motion here?

Aperture problem

- A detector that only sees part of a scene cannot precisely identify the motion direction or speed of an edge
Aperture problem

- The same thing is true for whole gratings
- It's a property of physics, not of the brain
  - Everything is the same inside the aperture

Aperture problem

- There is no real “solution” to the aperture problem
  - Only different assumptions about how the world works and how to interpret motion signals
  - Breathing square illusion
- Combing motion signals together as parts of different objects leads to different percepts
  - Two squares (right side)
  - Cross or lines?
- It's perceptual organization all over again
  - Gestalt laws
  - Figure-ground
Motion organization

- We often group together motion signals from different positions to produce a common interpretation
  - Walker
- Motion pattern of dots gives rise to more elaborate motion percepts
- Given that many different motion signals are present in a scene, how do we group them together?
  - 360 Turning kick

Movies

- The motion in movies is all apparent motion
- Individual still pictures are shown one after the other
The motion in movies is all apparent motion. Individual still pictures are shown one after the other.

The amount of movement from one frame to the next is often quite large.
Movies

- The amount of movement from one frame to the next is often quite large
- And there are many different movements
  - Head turns, Board moves, Shoulder moves back
  - Foot moves down, Body moves forward

Simplify things

- To identify the heuristics used by the visual system, use many fewer stimuli
- Apparent motion
- Occlusion heuristic
  - An object can move behind another object and disappear
  - Triangle-squares
Simplify things

- To identify the heuristics used by the visual system, use many fewer stimuli
- Apparent motion
- Occlusion heuristic
  - Objects can converge together
  - Dots converging

![Frame 1](image1)

![Frame 1](image2)
Eye movements

- Reichardt detectors respond to the motion of light patterns on the retina
  - But these patterns do not always produce a motion percept
- There are several kinds of eye movements
- Vestibulo-ocular reflex: as your body or head moves, the eyes adjust to keep an image focused on the fovea (no motion on retina, no motion percept)
- Pursuit: as an object moves, the eyes move to keep its image focused on the fovea (no motion on retina, but a motion percept!)
- Saccades: rapid movement of the eyes that focus on a new object at a new position (motion on retina, but no motion percept!)
- Vergence: rotation of the eyes together to look at an object that varies in depth (motion on retina, but no motion percept!)

Eye movements

- Your brain combines commands to move the eye
  - Corollary discharge of muscle commands
- With the motion pattern on the retina
  - To discount motion from eye movement
  - To combine motion of an image that is pursued
- It's not the actual movement from the muscles, it's the command to move the muscles

Expected motion signals on the retina

Command to move eyes

Expected motion signals on the retina

Combine equals

Motion signals from objects in the world

Actual motion signals on the retina
Afterimage movement

- An afterimage produces no motion signals on the retina
- But when you move the eyes, there is expected to be motion
- So you perceive motion as if the object were moving the same amount as the expected motion
  - As if you were tracking the object

Expected motion signals on the retina

Actual motion signals on the retina

Motion signals from objects in the world

Expected motion signals on the retina

Combine

equals

Flash lag

- It’s a complicated system and it doesn’t always work perfectly
- Perception of a flashed object seems to lag a moving object
- Flash Lab demo
Motion

- It's a complicated system and it doesn’t always work perfectly.
- Small eye movements can introduce motion signals even when the physical objects do not move.

Purdue University
Conclusions

- Aperture problem
- Movies
- Motion organization
- Eye movements

Next time

- Optic flow
- Moving through the environment
- Ecological approach to perception