CPSC 532E — Week 11: Seminar

Motion, Movement, and Events

- Motion fields
- Apparent motion
- Object movement
- Event perception

0. Some distinctions

Motion: change in some quantity (e.g., position, colour) referenced to a fixed location

(e.g., water flowing in a stream, heat flux)

- the set of motions at all locations = **motion field**
  - can have boundaries, etc.
  - motion is surface property - motion of stuff

Movement: change in geometric quantity (position or angle) reference to a structure

(e.g., an insect, an automobile, a human)

- movement is object property - movement of things

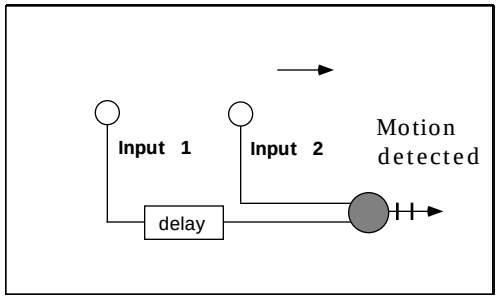
1. Motion fields

Just like luminance, colour, and texture,
motion can be measured rapidly and in parallel
across the visual field by simple mechanisms

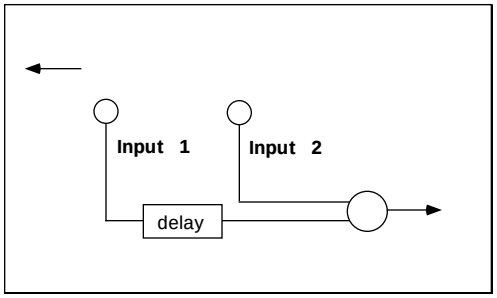
Basic mechanism: **Reichardt detector**

Reichardt detector

Input from two receptors needed to fire cell
-inputs from two different locations
-time delay on one input

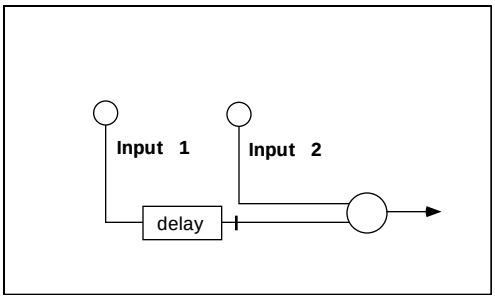


Note: won't work for reverse direction:
-needs signal from **2 inputs** to fire



-directional sensitivity:
fires for motion in one direction,
but not the other

Similarly, need to have right speed:



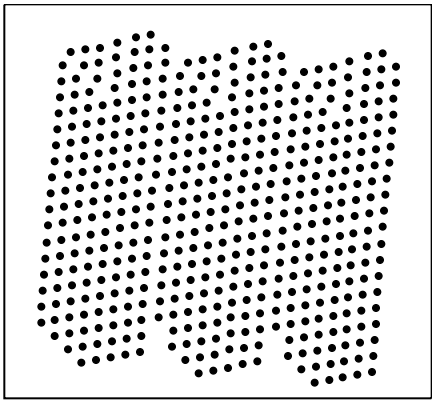
-if speed is too high, delay will cause
first spike to get there too late

-if speed is too low, delay will cause
first spike to get there too early

Bottom line: only a particular combination of **speed** and **direction** will set off Reichardt detector

-> Each motion detector has optimal speed & direction
(cf. edge detectors)

-> Array of motion detectors across the visual field
-> motion estimates at each point of the field
-> **motion field**



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Motion as Second-order property

Using motion this way is similar to using texture or colour. (Motion as a surface property.)

- Can form another low-level dimension in representation of multidimensional data
  - useful for spotting correlations, especially if two motions (e.g. vertical and horizontal) are used

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If contrast and luminance are controlled, there are limits on how motion fields can be used:

- Borders have relatively low spatial resolution
- Cannot support formation of illusory contours
- Can support perception of depth 

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Importance of context

Just like lateral inhibition does not completely account for brightness perception,

Reichardt detectors do not completely account for motion perception

Context can produce perception of motion, even if motion is not there
-> induced motion

Effect:

When two items present, smaller one is seen to move slightly,
even if it isn't moving

Induced motion demo

Explanation:

-motion is relative
-larger object assumed to be less likely to be moving

2. Apparent motion

Originally discovered by Gestalt psychologists

Effect: - a visible item suddenly disappears
- a new item appears immediately afterward at neighboring location

-percept: the original item "moves" to a new location

Apparent motion demo

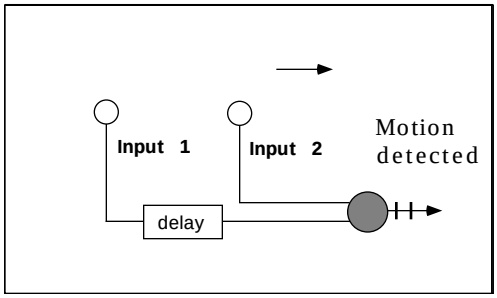
Two kinds of apparent motion:

1. Short-range
   - -not influenced by cognition
   - -based on luminance patterns
   - -short spatial range (1/10°-1/4°)
   - -short temporal range (20-80ms)
   - -many stimuli at same time

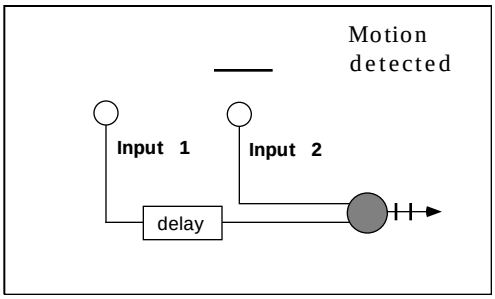
Much like "real" motion detection...

Explanation: Reichardt detector

Input from two receptors needed to fire cell
-can be fired via continuous motion



-can also be fired via sudden “jumps”...



Reichardt detector can’t distinguish them

Note: :

- Reichardt detectors can't distinguish "real" from "artificial" motion

Presenting a sequence of "frames"
(i.e., a sequence of static images)
is much the same as real motion,

provided that

Movies usually run at 12 frames/s
- separation between frames = 1/12 s
= 83 ms

Two kinds of apparent motion:

2. Long-range

-is influenced by cognition
-based on objects
- correspondence problem
-long spatial range (>1/4°)
-long temporal range (200-2000^{+} ms)
-only a few stimuli at same time

Much higher-level process (object formation?)

Note: appropriate use of distinct item types
can help avoid aliasing problems

3. Object movement

Sparse motions sufficient to **identify** objects (Johansson, 1973)

E.g., perception of biological objects in point-light displays

Biological movement demo

Displays contain no information about object shape
- if motion stops, only dots are seen

Can identify displays as human
- identify and male / female
- identify individuals (friends)

Can also identify movement patterns
- different gaits
- fake vs real lifting tasks

Not limited to humans
- perceive rotary movements of sticks
- perceive trees blowing in the wind

Seeing these patterns requires attention
- need attention to see movement
- limits to what can be seen to move

Harrison, Rensink, and van de Panne (2003)
- can't perceive acceleration directly
(only indirectly via eventual effects
on velocity and position)

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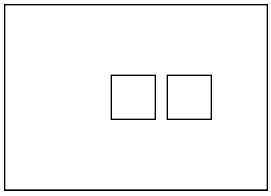
4. Event perception

Can perceive not only movement patterns, but the **reasons** behind the movements

E.g., Michotte - causality



Launching

- second item starts < 70 ms after contact
- speed, direction approximately the same

Delayed Launching

- second item starts < 160 ms after contact
- speed, direction approximately the same

No causal linkage perceived between events if separation > 160 ms

(At 10 frames/s, need frame-accuracy if causality is to be perceived)

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Triggering

- second item starts moving within 160 ms
- speed > 2x first item
- direction approximately the same

Entraining

- second item starts moving within 160 ms
- first item keeps moving; same speed as 2nd
- directions approximately the same

Beginnings of perception of agent motivations?

Heider & Semmel (1944)

- intentions, emotions via movement patterns
- basis for affective animations?

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