Demonstration 5A

# Demonstration 5A – Perception of apparent motion

As noted in the text, motion detectors undersample the trajectories of moving objects. This means that they will signal motion when stationary stimuli are presented to their inputs with appropriate timings (so-called apparent motion).

This demonstration shows three examples of stimuli which generate the perception of apparent motion. All of them consist of two still pictures which are rapidly exchanged on the computer screen. You can start each of them by clicking on the example videos below the link to this document, and replay them by clicking on the curly arrow which appears when they stop.

## Example 1: Motion of a single spot

Image 1:



Image 2:



To see the video, click on the link to Example 1 – Single spot**:** [**http://bcove.me/ahgo67u0**](http://bcove.me/ahgo67u0)

What the computer presents is, in alternation, Image 1 briefly on the left of the screen, then Image 2 on the right, Image 1 on the left and so on. What you perceive, however, is a single dot moving from side to side. If you don’t experience this, try moving back from your computer monitor.

You can check that the computer really is following the recipe above, by blocking your view of one of the dots. Then what you see is a single dot flashing on and off repeatedly, rather than movement. Now uncover the first dot and cover the other – again you will see a single dot flashing on and off.

This is a very simple illustration of the principle underlying cinema and TV. A sequence of still pictures in which the elements are spatially displaced on successive frames creates the illusion of motion. This example is a very low budget movie with a cast of one (a single spot), not a multi-million dollar epic with a cast of thousands, but both rely on the same processes within the human visual system.

## Example 2: Competition between stimulus elements

A recurring theme in movies is that of competition for a potential lover – which of two men (or women) will get to walk into the sunset with the female (or male) star? We can introduce a competition in a simple demonstration by presenting a single object in Image 1 but two objects in Image 2 which are equidistant from the position of the single object in Image 1, as follows:

Image 1:



Image 2:



Now the visual system is faced with a choice. It could pair the red disc in Image 1 with the outline red disc in Image 2, since they are similar in both colour and shape. In that case, one would see apparent motion between the filled and empty discs, perhaps with the red filling disappearing halfway through the object’s trajectory. At the same time the blue square in Image 2 would flash on and off repeatedly. Alternatively, and counter-intuitively, the red disc in Image 1 might be paired with the blue square in Image 2, so that one sees an object in side to side motion on the right of the screen, changing its identity from red disc to blue square (or vice versa) halfway through its trajectory, with the empty red disc on the left flashing on and off. Click on the link to Example 2 – Competition demonstration: <http://bcove.me/gbwkjc7f>

The blue square wins out in the competition to capture the red disc, but why should this be, when they are so different? Remember the point made in Chapter 5 of the book that apparent motion is given by low spatial frequencies. The corners of the square are signalled by higher spatial frequencies, so that it and the red disc have similar low spatial frequency content. Of course, they are of different colours, but the M system (which signals motion – see Chapter 3) is not colour – tuned, and so the different in colour is not relevant. Despite the superficial similarity of the empty and filled red discs, their low spatial frequency content is very different. One can think of the system generating apparent motion from these stimuli as akin to a person having very blurred vision and being colour-blind.

## Example 3: Random dot kinematogram

We can increase the cast of our simple movie to dozens, if not thousands, and make a random dot kinematogram. This example is similar to Figure 5.19 in the book. Image 1 is made by filling half the squares in a matrix with black at random. Image 2 is the same as Image 1 except that a central region has been moved sideways and the hole filled in with more randomly positioned black squares.

Image 1: Image 2:

 

When the images are superimposed and exchanged on the computer screen, the central region appears in oscillatory sideways motion. Note that the edges of the central region are not apparent in each of the images, but only after the motion of the region has been perceived.

To see the video, click on Example 3 – RDK demonstration: <http://bcove.me/yc8trqpa>

The perception of motion in random dot kinematograms is evidence for a motion detecting system other than one which tracks features. In order to avoid false matches of dots in the images, the brain must solve a correspondence problem, whose nature is discussed in Chapter 5.