Cortical Activity Elicited by Discrimination of Shift in Complex Motion Patterns

Sanjida F. Chowdhury, Scott A. Beardsley, and Lucia Vaina

Moving through our environment, the perception of the movement is obtained because there is relative motion between the retina and the visual scene that surrounds us. This relative motion, converted to a set of projected moving points, comprise a visual motion pattern, that is referred to as optic flow. Optic flow aids our ability to differentiate between objects and provides orientation and navigation required for movement. The optic flow patterns (also known complex motion pattern) can be broken down into a set of flow fields (translational, radial, and rotational). (Wurtz et.al 1990)

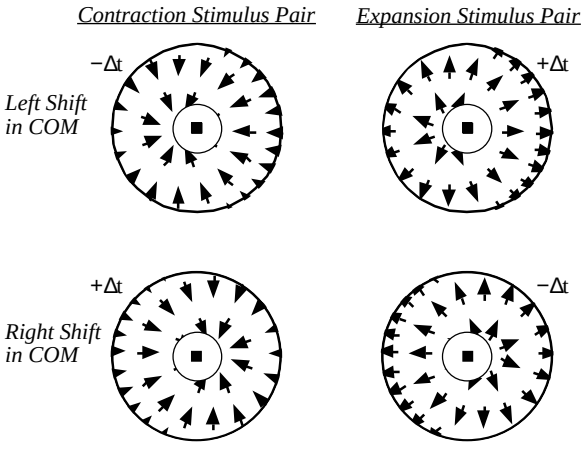
In our lab, we have conducted psychophysical studies on complex patterns (Beardsley and Vaina, 1999) and our interest now lies in finding the anatomical locations that corresponds to this the radial and rotational components of optic flow.

In this study, we used fMRI to localize the neural activation in the human brain elicited by discrimination of shift in the center of motion in complex motion patterns. Two stimuli were used: in one, the direction of motion was radial and in the other was circular. We posed the question, what is the topographical relationship, if any, between the two visual tasks?

Methods

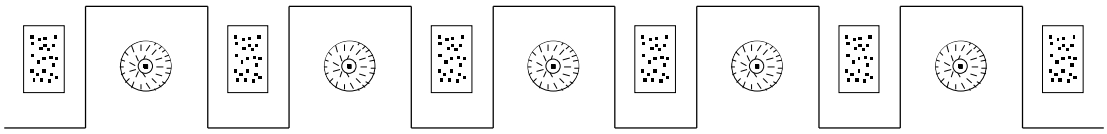
Picture of stimuli (random dot kinematograms (132 white dots, 4x4 pixels each, average dot speed of 30 degrees/second), displayed on a black background spread out from the center of motion in a 24 degree aperture display.

The stimuli consisted of expanding or contracting motion patterns for the radial task. Subjects actively performed the task of discriminating whether the center of motion (defined as the symmetrical center of the motion pattern) was shifted to the left or right from the center of the display.



Experimental paradigm:

The two experiments employed an ABABA.. design of active two alternative forced choice tasks in visual discrimination. In A, the baseline, the subjected viewed a 20sec long sequence of a static density random dot display, in which the subjects discriminated the change in dot density between the left and right hemifields. In B, a 30sec task, subjects viewed a sequence of stimuli (described in detail below), each presented for 200 ms. As in the baseline, the subjects fixated on the center fixation mark and entered their response after the stimulus .



Preliminary Results

We found several distinct foci of activation: in both tasks the strongest activation was in the hMT+ area which corresponds to the macaque areas MT, MST and FST, the latter two are known to play a crucial role in the perception of complex motion patterns. (Wurtz, 1990) Other areas in the superior temporal lobe and posterior parietal areas were also strongly activated. The patterns have shown high activation in the cuneus (V3?), lingual gyrus, superior frontal gyrus, and portions of the cerebellum during the task.