- Friday, February 19, 1999
  Ocular Dominance Columns in V1 Revealed using fMRI

Minutes of Yorkvis for 19 Feb 1999

1.0 I would like to take this opportunity to express the hope that more of the core YORKVIS faculty might attend YORKVIS talks on a regular basis, along with their students.

1.1 There are no scheduled YORKVIS talks at this time but other talks of interest to many of us are listed on the web site.

2.0 Ravi Menon from the University of Western Ontario and the John P Robarts Institute gave a presentation entitled: "Ocular dominance columns in V1 revealed using fMRI"

2.1 Dr Menon introduced the concepts of fMRI and pointed out that it is an indirect measure of neural function since, like PET, it actually measures blood flow.

2.2 The Robarts Research Institute has access to a very powerful (4 Tesla) fMRI machine with a field some 80,000 x that of the earth's. This has enable Dr Menon to get very good resolution in his studies.

3.1 Exp 1. The response to stimuli that the fMRI measures is quite slow, of the order of 3 secs or so. But this delay does not mean that temporal resolution is limited to 3 secs. The first experiment presented visual stimuli to each hemifield of a subject with a 500ms delay. The fMRI was sampled every 100ms and, although the response indeed took a few seconds to build up, the responses to each hemifield (corresponding to responses in the two hemispheres) was delayed by 527ms +/- 34ms showing that relative temporal measurements are meaningful. Delays between 0 and 1 second were accurately reflected as well.

3.2 Exp 2. Subjects moved a joystick to move a spot to a target. Interestingly the differential timing of the brain responses between V1 and the supplementary motor area varied with variation in reaction times of the manual task. The delay between the supplementary motor area and primary motor cortex did not vary with variation in the task, however.

3.3 Exp 3. The contrast sensitivity function (CSF) is a measure of how well someone can see at different spatial frequencies. The CSF of normal people is mirrored in the inverse of a person's reaction time to detect a low-contrast stimulus as a function of spatial frequency. Amblyopes display a difference in both threshold CSF and RT between eye's and this is mirrored in the fMRI experiments.

3.4 Exp 4. By stimulating the eyes separately by alternately blocking the eyes with liquid crystal goggles, Dr Menon created cortical maps in which the activity of each eye could be visualized. These results mirror well known cytochrome oxidase staining measurements done in post-mortem subjects.

The red dots are one eye and the blue dots are the other.

4 There was some discussion about how these studies could be extended and the general applications of fMRI in solving the problems of how the brain works.

Addendum:

I asked Ravi about why he saw dots of ocular dominance 'columns' instead of the bands that we know from autoradiographs and cytochrome oxidase studies. His reply:

"I think the primary reason is that all the cytochrome oxidase stuff is on flattened cortex, while our sagittal image is merely tangential to the surface of the occipital pole. So every time the cortical surface curves into a sulcus, we lose that in the sagittal orientation. In the oblique axial plane, we are cutting the fingerprints just as one might chop off their finger with a knife (lovely thought), so now they appear as blobs. We are working on elegant flat-mapping techniques that would allow cortical unfolding and flattening. Those are probably a year away from 'production'. "

Ravi Menon