- Friday, October 16, 1998
  The Superior Colliculus

The seminar on the 16th October was by Doug Munoz on the role of the superior colliculus

5.1 Munoz outlined the structure and function of the superior colliculus, drawing attention to it as a layered structure with an organized retinotopic map over its surface and a lot of convergence between cortical and direct sensory pathways.
5.2 Munoz characterized two types of cells in the intermediate layers of the colliculus:
5.2.1 fixation cells found around the foveal representation on the collicular map which pause during saccades but which have a maintained discharge during fixation
5.2.2 saccade cells which discharge busrst of action potentials related to saccades of appropriate amplitude and direction and which can be divided into two types using a simple test called a "gap paradigm". In this test the activity of neurones is recorded in a gap between when the fixation light goes off and a target light, to which the monkey has been trained to look, comes on.
5.2.2.1 Burst neurones are essentially silent during the gap and fire in a burst during the saccade. They are also characterised as having closed movement fields. That is, they are associated only with saccades to a defined area in space.
5.2.2.2 Build-up neurones build up during the gap. These are also characterised by having open movement fields. That is all saccades beyond a certain size (which varies from cell to cell) are associated with firing of these cells. Fixation neurones may actually be a type of build-up neurone that is, there is evidence for a continuum between fixation and build-up neurones.
5.3 These cells can be taken as forming functionally separate layers (although not necessarily anatomically separate).
5.3.1 Munoz collected the activity of many of each of these classes of cells during saccades and generated a very convincing movie of their compound behaviour during a saccade. This can be viewed on his web page: http://brain.phgy.queensu.ca/doug_munoz/dpm.htm
5.3.1.1 The activity of build-up neurones describe a wave of activity across the surface. That is during say, a 20 deg saccade, all the points on the colliculus between 20 degs and 0 are activated sequentially.
5.3.1.2 The activity of the burst neurones is for only the cells at the initial location (20 degs in the example above) are active.
5.3.1.3 There was some debate about the causality relationship between these collicular patterns of activity during saccades and the saccades themselves.
5.4 Are these patterns of activity determined by local circuits? To do this Munoz stimulated the body of the colliculus and looked at the fixation area and visa versa
5.4.1. Stimulating a point in the body of the colliculus caused a lot of inhibition in the fixation area
5.4.2. Stimulating a point in the fixation area caused the bursts to be held off, build up cells to be maintained at whatever level of buildup they were at
5.4.3 Munoz interpretted these findings as indicating local collicular inhibitory circuits and put together a model relating the burst, build up and fixation cells of the colliculus to the omnipausers (cells that pause during all saccades), burst neurones and the oculomotor neurones that comprise the brainstem circuitry controlling eye movement.
5.5 Munoz made an interesting observation that during a long gap (between the fixation light going off and the target light coming on: say 600 ms), there is a correlation between the activity of fixation and buildup cells in which the fixation activity (keeping the eyes fixating) is lowest and the buildup activity has reached its highest point at about 200ms. This is a point when saccades are often elicited and demonstrates a nice relationship between neural activity and behaviour.

Doug Munoz