

**RELIABILITY OF A FAST METHOD TO DETERMINE LOCALLY  
THE PREFERRED DIRECTION OF MOTION SENSITIVE NEURONS**

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**Introduction:** Flies have, in the third visual neuropil, several classes of wide-field motion sensitive interneurons contributing to visual steering. Knowing, for any of them, the distribution of directional preference over its receptive field would allow one to deduce the fly's particular notion in space which excites this cell maximally and, conversely, to suggest for this neuron a specific role in locomotor control.

**Method:** To determine quickly the local preferred direction a black dot ( $8^\circ$  dia) was moved at constant speed (1 cps) on a circular path of  $10^\circ$  diameter. When the instantaneous direction of dot motion coincides with a cell's preferred direction, the neuron is excited. Reversing the direction of dot motion allows, by comparison of responses, to eliminate the effects of dot location and of the response delay (Menzel and Hengstenberg 1991).

In order to test the robustness of this procedure, spikes were recorded extracellularly from the 'horizontal neuron' III, the 'vertical neuron' VI and other neurons in the lobula plate of *Calliphora*. Stimulus parameters were varied to reveal their influence on directional tuning curves measured at one location in the receptive field.

**Results:**

(1) The figure shows directional tuning curves of a horizontally (Fig.a: III), and a vertically (Fig.b: VI) motion sensitive neuron. Each curve was measured within 100 s, using standard parameters. The results illustrate the broad directional tuning of such neurons around different preferred directions.

(2) The shape of test objects of about the same size (dot, sector, radial bar) has no effect on the preferred direction ( $\pm 3.0^\circ$ SD).

(3) Different dot sizes ( $7.6^\circ$  vs.  $3.8^\circ$ ) moving on about the same trajectory ( $10^\circ$  or  $14^\circ$  dia., respectively) yield the same preferred direction ( $\pm 4.3^\circ$ SD).

(4) Contrast reversal of the dot yields the same preferred direction ( $\pm 3.4^\circ$ SD).

(5) Presentations of the stimulus in the range of 0.5 - 2.5 cps yield the same preferred directions ( $\pm 2.1^\circ$ SI) while the modulation of spike rate over the stimulus cycle increases with speed (2:1).

(6) Diameters of the stimulus trajectory above  $10^\circ$  are uncritical. For small objects ( $3.8^\circ$  dia) moving on a narrow circle ( $4^\circ$  path diameter) erratic results are obtained, presumably due to irregular stimulation of local motion detectors.

(7) Prolonged stimulation at low speed (0.5 cps) induces a 47 % decrease in mean firing rate of the III-neuron. The preferred direction of this neuron is not changed by this adaptation and, corresponds to the direction obtained at high dot speed (2.0 cps) where no decline of the mean firing rate can be observed.

(8) The accuracy of the procedure depends upon the number of evaluated response cycles. Evaluation of 10 times 10 cycles yields, for III, a standard deviation of the preferred directions of  $\pm 5^\circ$  and for VI  $\pm 3^\circ$ .

**Conclusion:** The preferred direction of wide field motion-sensitive neurons of flies can be estimated locally by the circulating dot stimulus within less than one minute, and with an accuracy of  $\pm 5^\circ$ . The results are robust against considerable variation of stimulus parameters.



