Neural Mechanisms of Behavior

Proceedings of the 2nd International Congress of Neuroethology
September 10 – 16, 1989

25. Borst, A.: Physiology of visual interneurons possibly involved in the fly landing system. In: Neural Mechanisms of Behavior. Eds. J. Erber, R. Menzel, H.-J. Pflüger, D. Todt. Georg Thieme Verlag Stuttgart New York 1989, p. 180.

Physiology of Visual Interneurons Possibly Involved in the Fly Landing System

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When approaching a landing site flies extend their legs in order to prevent crash-landing. This reflex has been studied in tethered flying animals simulating the approach by an expanding visual stimulus in front of it. A systematic analysis of the stimulus-response relationship led to a formal model describing the release of landing on visual stimulation (Borst and Bahde 1986,1988). The proposed processing steps involve (1) movement detection, (2) spatio-temporal integration of motion information, followed by (3) a threshold device.

By extracellular recording from the cervical connective (cc) of female blowflies *Calliphora erythrocephala* neurons were found which correspond with respect to their response characteristic to elements specified by the formal model. They have the following properties: (1) They are excited by front-to-back motion in front of each eye and are inhibited by motion in the opposite direction, (2) their response to a bilateral motion stimulus is about the sum of the responses to unilateral stimulation. As a consequence the cells do not respond to rotary large field motion and respond best to expanding stimuli. (3) In contrast to motion-sensitive neurons in the third visual ganglion, the lobula plate (lp), their response rises slowly at stimulus onset and decays slowly after the end of motion stimulation. In these neurons motion information obviously is already spatio-temporally integrated in the predicted way. They are, thus, likely to be involved in the landing system of the fly.

References:
Borst A, Bahde S (1986) What kind of movement detector is triggering the landing response in the housefly? Biol Cybern 55: 59-69
Borst A, Bahde S (1988) Visual information processing in the fly's landing system. J Comp Physiol A 163: 167-173

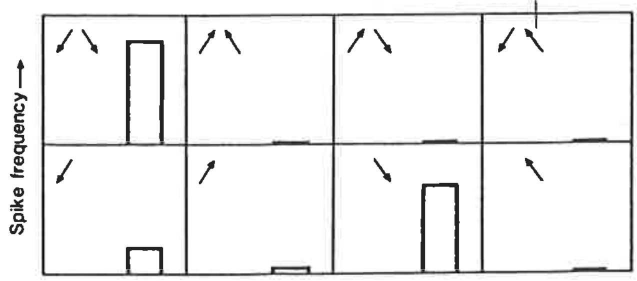

Fig.1 Responses of a neuron in the cc to different motion stimuli. The cell responds best to bilateral front-to-back motion which is opti-mal for the release of landing.

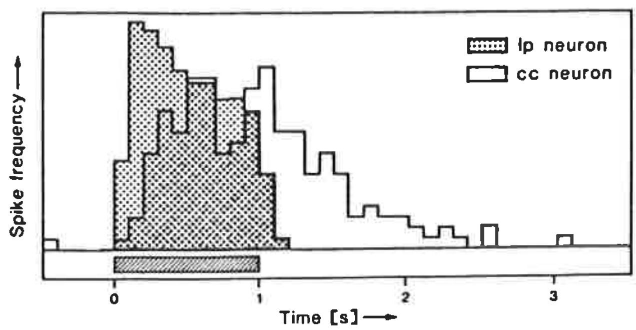

Fig.2 Time-course of the response to motion stimulation of a cc neuron compared to a lp neuron.