37 Menzel, J. and R. Hengstenberg: A fast method to determine the distribution of local preferred directions within the receptive field of motion sensitive neurons. In: Synapse - Transmission Modulation. Eds. N. Elsner, H. Penzlin, Thieme, Stuttgart, 1991, 274.



# A FAST METHOOD TO DETERMINE THE DISTRIBUTION OF LOCAL PREFERRED DIRECTIONS WITHIN THE RECEPTIVE FIELD OF MOTION SENSITIVE NFURONS

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Introduction. Self-motion of an insect in optically structured surroundings generates characteristic motion patterns on its eyes. Such patterns are analyzed by retinotopic arrays of visual small-field movement detectors with distinctly different preferred directions (Götz K.G., Biesinger R., Hengstenberg B. (1979) Biol. Cybern 35, 101). Any such small field motion signal can be generated by different movements of the animal; hence it cannot be used directly to control the insect's Iocomotion. Neural cartoons of the animal's movement in space are generated by spatial integration of specifically selected small-field signals in motion sensitive widefield neurons (Hausen K. (1984) in Ali M(ed) Photoreception and Vision in Insects, Plenum Publ. Co, pp 523-559). Conversely, the retinotopic mapping of local directional specificity in the receptive field of motion sensitive neurons reveals their characteristic function. flow can the local directional specificity of an interneuron be quickly determined and mapped at different locations in the receptive field during the limited time of intracellular recording?

Method. A circular black dot on white ground, travelling on a circular path of reasonably small diameter provides a continuous sequence of local motion stimuli. Their direction of motion varies gradually through 360° during one period of rotation (David CT (1985) Nature 313, 48). The location of the stimulus in the visual field varies simultaneously, depending upon the radius of the circular path. The effects of location and direction of motion can he separated by reversing the direction of dot rotation. This kind of stimulus was tested for its usefulness by extracellular recording from a well characterized tangential neuron (111) in the lobula plate of the blowfly *Calliphora*.

Results.

(a) dot rotations elicit a modulation of spike activity that is phase-locked with the stimulus rotation cycle.

(b) reversing the direction of dot rotation shifts the peak of activity (preferred direction) by about 180°, indicating that it is due to the neuron's directional preference and not only to the location of the dot.

(c) the latency of the response causes an additonal phase shift. This can be measured and eliminated from the directional tuning curves by time reversal of data obtained with counterclockwise dot rotation, and subsequent cross correlation with data obtained with clockwise dot rotation.

(d) for the fly's widefield motion perception system a dot of 8° diameter, rotating once per second around a circle of 20° diameter seems optimal to gather. within less than one minute, sufficient data for a local directional tuning curve.

Conclusion: The quick scanning through all directions of stimulus motion results in a faster convergence of data compared to the use of moving gratings. This is a great advantage for electrophysiological studies.