

# COMPARISON BETWEEN OPTIC FLOW FIELDS AND RESPONSE FIELDS OF VISUAL INTERNEURONS IN THE LOBULA PLATE OF THE BLOWFLY *Calliphora*

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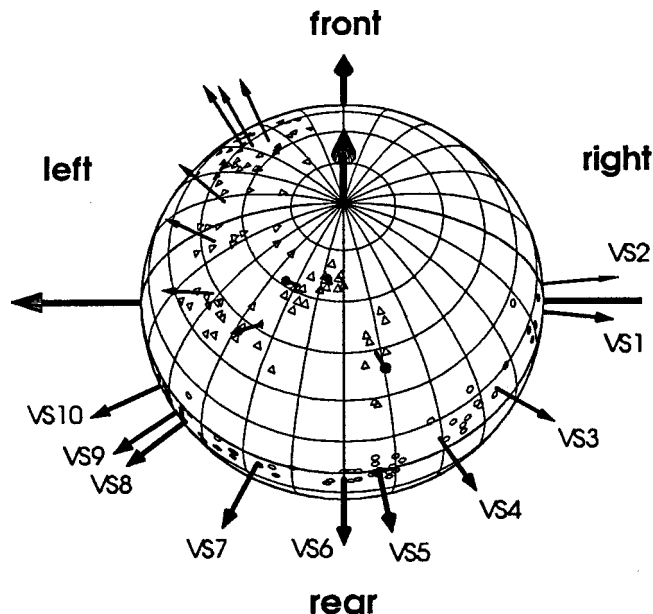
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Coordination of locomotion in a complex environment requires information about the instantaneous self-motion. Visually oriented animals, including man, may exploit 'optic flow' that is generated in the eyes when moving through structured surroundings. Optic flow fields are composed of local velocity vectors. They depend upon a set of motion parameters: (i) direction of gaze, (ii) the rotatory and (iii) the translatory component of the instantaneous self-motion; the translatory component depends additionally on the distance between visual objects and the observer (Koenderink, 1987).

The third visual neuropil of the blowfly (lobula plate) contains motion sensitive wide-field interneurons which play an important role in locomotor control (Hausen, 1993). They receive input from many direction-specific movement detectors (EMD) with small receptive fields. Wide-field neurons spatially integrate multitudes of EMD signals. Each neuron, however, integrates over only a specific set of local motion signals, each selected for its location in space and its preferred direction (Krapp & Hengstenberg, 1992).

We recorded intracellularly from a distinct subset of 10 identifiable tangential-neurons (VS; Hengstenberg, 1982), and determined the spatial distribution of local preferred directions and motion sensitivities, at 52 positions spaced equally over the ipsilateral visual hemisphere (for method see: Menzel & Hengstenberg, 1991; Krapp & Hengstenberg, 1992). The resulting response fields of the VS-neurons are remarkably similar to optic flow fields generated by specific motions in space (Krapp & Hengstenberg, 1993).

An iterative least squares formalism (Koenderink, 1987) allows to determine the motion parameters which specify the particular optic flow field resembling most closely the measured response field of a particular neuron.



For each VS-neuron the characteristic response components can be illustrated by a pair of axes (see Figure: O rotation, Δ translation) of the visual unit sphere.

The Figure shows the results for 89 recordings in the right lobula plate from 10 anatomical types of VS-neurons.

For each type the average direction of axes is shown by arrows. The relative size of response components may be indicated by the diameter of the arrows. Notice that the rotation axes (O) of VS 1-VS10 are spread along the equator of visual space between 120°-270° azimuth. The corresponding translation axes (Δ) are elevated by 40°-60° above the equatorial plane and spread from 30°-190° azimuth.

The ratio of rotatory to translatory components ranges between 1:1 and 3:1.

Apparently, VS neurons sense predominantly rotations about various horizontal axes but always accompanied by a sizeable translation, that is directed upwards and sideways with respect to the rotation axis.

The specific significance of this combination for flight control has still to be elucidated.