Abstract View

LOOMING-SENSITIVE NEURONS CODE FOR MOTION DIRECTION AND BRIGHTNESS CHANGE.

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Manduca sexta hover in front of flowers and use visual depth cues to control and stabilize their distance to target flowers during feeding. Perception of depth change is mediated monocularly by the apparent size change of an approaching/retreating object (looming/anti-looming). In previous studies we showed that Class 1 looming cells respond to change in edge length; Class 2 neurons respond to expansion/contraction flowfields (1).

Stimuli of expanding/contracting bulls-eye patterns reveal the sensitivity of Class 2 cells to motion direction as well as brightness. Expanding and contracting bulls-eye patterns generate a constant outward or inward motion flowfield equivalent of a constant expansion or contraction while also providing a change of edge length and brightness that follows a sawtooth pattern. A neuron that is stimulated by an expansion flowfield should respond with an increase in spike frequency to an expanding pattern, and a decrease in spike frequency to a contracting pattern. If the cell is sensitive to either the smooth change in edge length or to a change in brightness the cell will follow the fast changes in edge length and/or brightness. These response fluctuations should depend on the pattern velocity and the spatial frequency of the pattern.

As predicted Class 2 cells respond with an increase in spike frequency during the presentation of their preferred direction of motion and a decrease of spike frequency for the null direction. In addition the response is modulated, showing bursts interspersed with inhibition of spike activity. These modulations are dependent on the spatial and temporal properties of the bulls-eye pattern. Additional experiments show that the modulations are driven by change in brightness rather than in edge length. The cells thus code for both the motion direction of the pattern and the temporal frequency of the brightness change of the pattern.

(1) Wicklein M, Strausfeld NJ (2000) J Comp Neurol 424(2):356-76

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