Abstract View

VISUAL PERCEPTION OF CHANGE IN DEPTH DURING HOVERING FLIGHT IN MANDUCA SEXTA (SPHINGIDAE, LEPIDOPTERA).

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Feeding hawkmoths hover in front of flowers and use visual depth cues to control and stabilize their distance to target flowers. Perception of depth change can be mediated monocularly by the apparent size change of an approaching/retreating object, looming and anti-looming. Looming is a reliable, fast and wideley used strategy for depth perception and looming sensitive neurons are found throughout the animal kingdom (e.g. sphingids, locusts, pigeons, and monkeys). Looming sensitive cells recorded intracellularly in M. sexta using stimuli that decompose looming into either change in area, change of perimeter length or motion of the object's edge report both the approach and retreat of objects. Class 1 and 2 cells compute looming in two fundamentally different ways: class 1 neurons measure change of perimeter length of the object; class 2 neurons respond to expansion/contraction flowfields. The cell classes also differ in architecture and polarity. We created a network model for class 1 cells to understand the underlying computational principals leading to looming detection. The model is based on the hypothesis that class 1 cells infer change of depth by computing change of perimeter length and incorporates anatomical and physiological properties of class 1 cells. The model captures many of the essential response properties of class 1 cells. Both cells and model show sustained responses as long as the looming/receding stimulus is presented. Neither respond to moving gratings and responses to expanding and contracting objects are qualitatively similar. The model also allows us to predict responses to looming stimuli not yet tested in class 1 cells.
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