**Odor-background segregation and source localization using fast olfactory processing**

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Insects primarily rely on olfaction when locating resources such as food or mating partners. Tracking down the source of an odor poses a particular challenge: due to the natural dynamics of air flows, odors occur in turbulent plumes, intermingled with filaments of clean air and background odors, creating temporally and spatially complex patterns of different odor concentrations and mixtures. How do insects detect, recognize and find odor sources in such a complicated odor environment?
Odorants from the same source fluctuate synchronously, whereas odorants from spatially separated sources fluctuate asynchronously. I will present evidence that the insect olfactory system is capable of resolving fast odor plume dynamics, which would allow it to exploit this (a)synchrony of odor fluctuations to detect whether odorants originate from the same or separate sources. Electrophysiological recordings from insect antennae show that they (1) can respond to odorants within less than 2 ms (they are fast), and (2) follow repetitive odorant pulses above 100 Hz (they have high temporal resolution). Calcium imaging in the honeybee antennal lobe shows that projection neurons can resolve few millisecond asynchrony in the arrival of two odorants; and behavioral experiments in honeybees show that the asynchrony between odorants facilitates perceptual segregation.
I will then present the results of a preliminary computational model of the insect antennal lobe that elucidates how rapid winner-take-all dynamics in local circuits could underpin the disambiguation of synchronous and asynchronous odor inputs.
At the end I will give a brief overview of the future work in the "odor objects" project: We will use behavioral experiments to identify evolved strategies of odor-background segregation, physiological recordings to inform us about neuronal processing and computational models to provide mechanistic explanations. To overcome the limitations of simulations, we will finally transfer successful models to the embodied context of odor tracking robots.


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