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How the flapping wing kinematics and flight trajectories modulate the odor plume structure in the odor tracking flight of fruit flies? MENGLONG LEI, Villanova University, FLORIS VAN BREUGEL, University of Nevada, Reno, CHENGYU LI, Villanova University — In nature, many insects rely on their olfactory system for detecting food sources, prey, and mates. They can sense odorant plumes emitting from sources of their interest, use their highly efficient flapping-wing mechanism to follow odor plumes, and track down odor sources. The odor-tracking process typically consists of two distinct behaviors: surging upwind and zigzagging crosswind. In this study, a fully coupled three-way flight simulator is developed, which solves the 3D Navier-Stokes equations, tightly coupled with equations of motion for the passive flapping wings, and the advection-diffusion equations for the odor concentration. This simulator will be applied to investigate the unsteady flow field and the odorant transport phenomena of a fruit fly model in both surging upwind and crosswind casting. We hypothesize that the unsteady flow generated during flapping flight would perturb the odor plumes structures and significantly impact the mass transport of odorant to the olfactory receptors (i.e., antennae). Our simulation results will provide new insights into the mechanism of how fruit flies perceive odor landscape and inspire the future design of odor-guided unmanned robotic flyers for surveillance and detection missions.

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