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Predicting Fruit Fly's Sensing Rate From Insect Flight Simulations JANE WANG, SONG CHANG, Cornell University — Without sensory feedbacks, flies cannot fly. Exactly how sensory feedback controls work in flying insects is a complex puzzle to solve. What do insects measure in order to stabilize their flight? What kinds of neural computations and muscle activities are involved in order to correct their flight course or to turn? How often and how fast do animals adjust their wings to remain stable? To understand the algorithms used by insects to control their dynamic instability, we have developed a simulation tool to study flapping flight, where motions of the insect body and wings are coupled instantaneously. To stabilize the flight in the simulation, we construct a control algorithm that modulates wing motion based on discrete measurements of the body-pitch orientation. Our simulations give theoretical bounds both on the sensing rate and the delay time between sensing and actuation. Interpreting these findings together with experimental results on fruit flies' reaction time and sensory motor reflexes, we give a sharper bound on the sensing rate and further reason that fruit flies sense their kinematic states every wing-beat in order to stabilize their flight.

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