Fly Flight Simulators Reveal Secrets of Decision Making

March 25 2008

Even flies like video games--and it's not just child's play, say scientists at the California Institute of Technology. With the help of a unique bug-sized flight simulator, Caltech researchers are deciphering the secrets of behavior and decision making in the fly brain, and, ultimately, in our own.

Using the simulator, Michael Dickinson, the Zarem Professor of Bioengineering at Caltech, along with postdoctoral students Gaby Maimon and Andrew Straw, has discovered an algorithm that guides decision making during the flight of Drosophila melanogaster, the common fruit fly. The algorithm is basically a set of rules that determine how flies will behave when confronted with one of two simple stimuli: long vertical stripes or small spots. A paper describing the work appears in the March 25 issue of the journal *Current Biology*.

Their experiments were conducted on both free-flying flies and on flies tethered within a virtual-reality flight simulator. In the flight simulator, flies could steer toward or away from images displayed on an electronic panorama.

"We can present the fly with different scenes and the fly reacts to them, like a 12-year-old boy playing a video game," says Dickinson.

Although the insects couldn't actually fly anywhere, they were free to beat their wings, and that motion was recorded with optical sensors, providing a measure of the direction in which the flies intended to fly.

For example, a fly wanting to turn left would beat its right wing harder and vice versa.

The experiment revealed that flies are attracted to, and will fly toward, the vertical line, but are repelled by the small spots.

"One way to interpret this is that the fly's brain is programmed to fly toward big vertical edges, because it evolved in a world where big vertical edges indicate vegetation," says Dickinson. A simplistic example would be a tree--although Dickinson points out that the fly, with its tiny brain, need not have any concept of "tree."

"A vertical edge could be something to eat, or it could be a landmark of something to land on," says Maimon. "With a fly's low-resolution eyes, each equivalent to a 700-pixel camera, the world is literally a blur, so edges are a good landmark. Fly toward it and you know you're flying straight, and by following these landmarks, from vertical edge to vertical edge, you can search through space, and eventually find something good to eat."

Small blobs, however, could represent just about anything in a fly's environment that it would not want to either land on, such as a falling leaf or other debris, or to collide with--say, a spider in a suspended web, or another benign insect. If you're a flying Drosophila and you see a little blob? "You'd do well to turn away," Dickinson says.

The results are significant, Dickinson says, because they represent "an important step toward understanding processes like decision making, which we think from our own perspective should be complicated, but which in the fly emerge from a simple set of principles."

"Humans make decisions all the time, about whom to marry, where to go to school. We hope that understanding how a smaller brain makes decisions will let us understand how a primate brain works, and understand it faster. It's a jumping-off point," says Maimon.

The results also offer important insight into the origin and nature of complexity. "The mission of our lab is to understand where complexity comes from," says Dickinson. "Fly behavioral activity is relatively uncomplicated, yet flies achieve amazing aerodynamic feats with a level of complexity that is astonishing if we think about them as an engineering entity. By understanding that, we can understand where complexity comes from."

That knowledge opens other doors, Dickinson says.

"Engineers would like to be able to build simple things that behave in complex ways, like a power grid or a robot, and one of the best ways to figure out how to get complex behavior from simple things is by studying biological organisms. It's Model Biological Systems 101: study an animal that's easy to study, and then extrapolate.

"If we knew enough, could we build a fly? The answer is yes, but it will take a while."

Source: California Institute of Technology

Citation: Fly Flight Simulators Reveal Secrets of Decision Making (2008, March 25) retrieved 29 April 2024 from https://phys.org/news/2008-03-flight-simulators-reveal-secrets-decision.html