From Flying Insects to Autonomous Robots

MandyamV. Srinivasan
Centre for Visual Sciences, Research School of Biological Sciences, Australian National University

Although most insects lack stereo vision, they use a number of ingenious strategies for perceiving their world in three dimensions and navigating successfully in it. For example, distances to objects are gauged in terms of the apparent speeds of motion of the objects' images, rather than by using complex stereo mechanisms. Grasshoppers estimate the distance to targets by moving their heads from side to side, and measuring range in terms of the speed of the target's image on the retina. Bees distinguish objects from backgrounds by sensing the apparent relative motion at the boundary between object and background. Narrow gaps are negotiated by balancing the apparent speeds of the images in the two eyes. The speed of flight is regulated by holding constant the global image velocity as seen by the two eyes. Bees landing on a horizontal surface hold constant the image velocity of the surface as they approach it, thus automatically ensuring that flight speed is close to zero at touchdown. Foraging bees gauge distance flown by integrating optic flow: they possess a visually-driven "odometer" that is robust to variations in wind, body weight and energy expenditure. This presentation reviews some of this work, and outlines applications of some of these strategies to the design of autonomous robots and flying vehicles.