Combining behavioural and robotic studies of insect sensorimotor control

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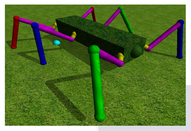
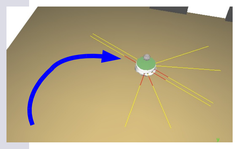
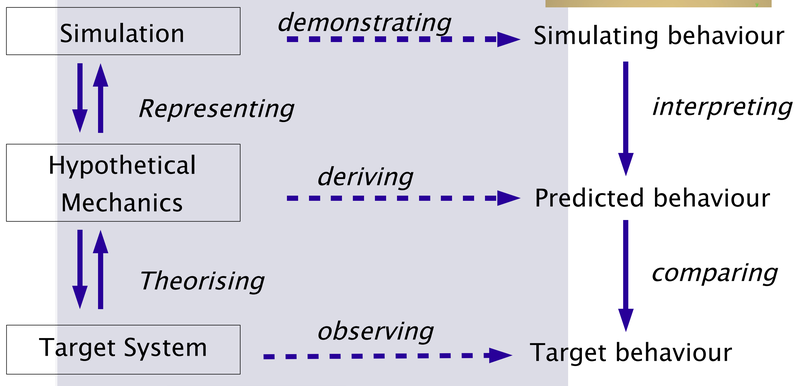
Biorobotics research in IPAB focuses on understanding sensorimotor control in the context of the complex system composed of the brain, body and environment. We choose to study insects because despite the relatively small size of their brains they are capable of performing interesting behaviours which solve problems using efficient strategies.

The aim of each project is to produce a sensorimotor controller which can function on a real robot, acting as a working model of the equivalent neural pathways in the animal. Using robots as well as simulations ensures that the controllers produced are robust to noise in real-world sensor data, and can correctly control the motion of the robot when constrained by real-world physics.

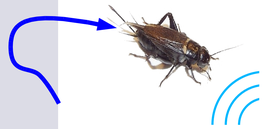
The modelling process











An essential test of the validity of a robotic model is to compare it to the real animal. Researchers at IPAB are therefore involved in behavioural testing in addition to building models. The results of insect behavioural tests are used for providing new hypotheses and for comparison with the output of the resulting artefacts.

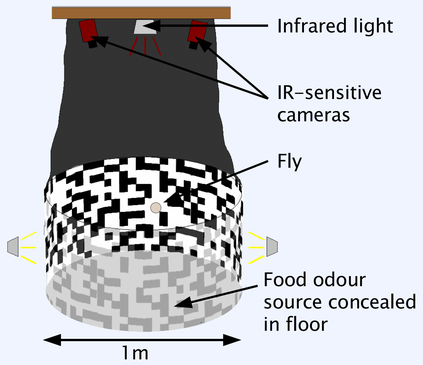
School of informatics

IPAB

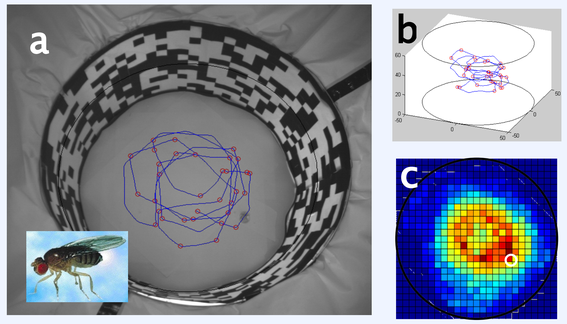
Neuroinformatics Doctoral Training Centre

Visual-olfactory integration in flying fruit flies

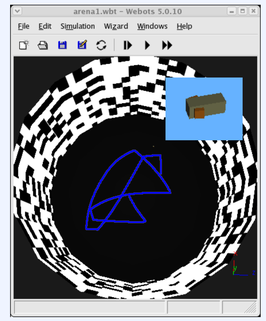
Finlay Stewart



The arena used for odour localisation experiments.



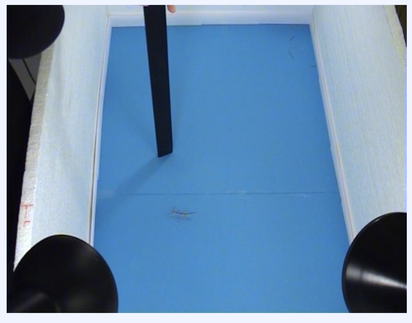
a *Fly trajectory overlaid on a shot from one of the cameras.* Saccades *(rapid yaw turns) are marked in red.* **b** *3D view of the trajectory.* **c** *Position density plot. Location of the concealed odour is marked by white circle.*



Simulated version of the experiment. The model fly uses optic flow to detect looming walls and avoid them. A robotic model is planned for the future.

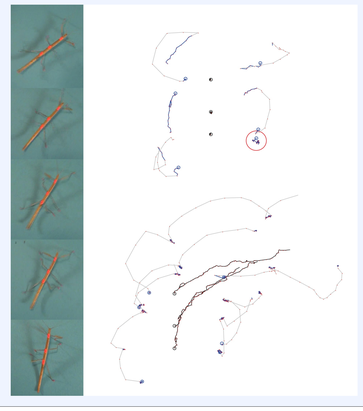
Biologically inspired six legged robot for rough terrain

Hugo Rosano

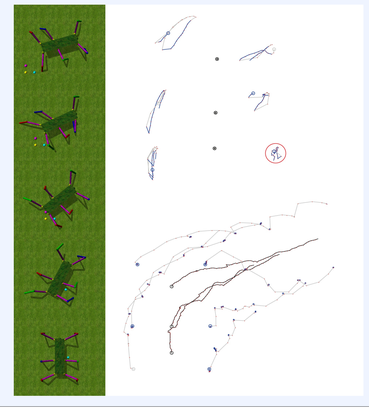


Trajectories of stick insects' body and tarsi (feet) are tracked while turning towards a movable vertical target.

Individual leg trajectories and body movements are analysed with respect to the target position.

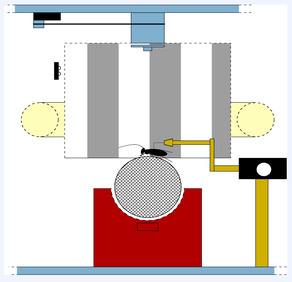


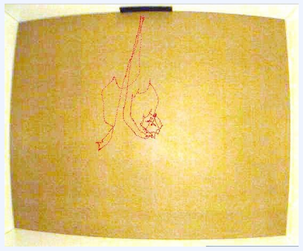
Thoracic differen-tiation and individual leg controller is tested in a 3D dynamic simulation.



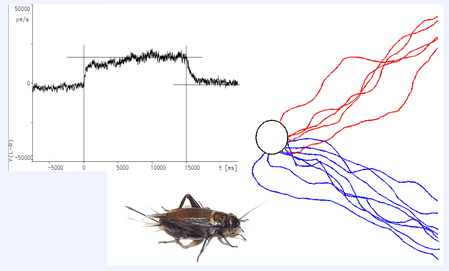
Visual-auditory integration in the cricket

Mark Payne

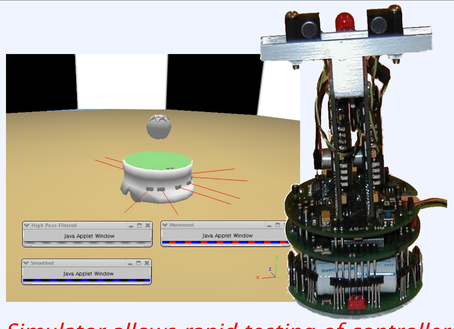




l *Cricket locomotion data are captured using an optical trackball. These tell us the instantaneous response to stimuli in "open loop" situations.* **r** *The animals are also filmed in an arena with visual patterns on the walls, and hidden speakers broadcasting calling song.*



l *Trackball data are captured in synchrony with information about the stimuli, allowing analysis at a temporal resolution of 0.3ms.* **r** *Arena tracks are digitised and statistical properties can be calculated.*



l *Simulator allows rapid testing of controllers in conditions mimicking both the trackball and arena environments.* **r** *A robot fitted with microphones and 360° camera, which can be tested in the same arena used for insect trials, allowing paths to be compared directly.*