

VISUAL SCIENCES

Group Leader:
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A panoramic snapshot view (top) from the cockpit of a landing blowfly. A robotic gantry (seen on the right) was used to move a panoramic camera along the path flown by the insect. The image motion experienced by the fly (bottom) is colour coded (red motion to the left; green right, blue down and yellow up) and was later replayed to visual interneurons in the fly's brain.

Images by Norbert Boeddeker and Jochen Zeil.

We study vision using approaches including molecular biology, psychophysics, behavioural analysis and computational modelling.

Our work concentrates on understanding the design and function of neural circuits in relation to their biological and information processing tasks. Applications in the areas of robotics and medicine are being pursued.

We are analysing the visually guided behaviour of the bee and using the strategies we discover to design visually self-guided robots. Other areas of study include learning and memory in bees, visual ecology in fiddler crabs, adaptive vision in humans, visual processing in mammalian brains, understanding vertebrate retinal circuits and the prevention of short-sightedness.

HIGHLIGHTS

- The prevalence of myopia in young children of Chinese origin in Sydney is ten times lower than in similar children in Singapore. This suggests major differences in environmental influences on myopia, probably related to schooling intensity.
- The working memory of honeybees has been determined using a "delayed match-to-sample" paradigm. Honeybees are able to retain the memory for about five seconds – similar to the ability of humans to remember phone numbers read from a directory.
- The representation of visual space in the human cortex has been mapped with unprecedented accuracy by combining multifocal analysis with functional magnetic resonance imaging.
- We have reconstructed the cockpit-view of insects flying outdoors, and replayed these images to the fly visual system. This has revealed that under natural conditions, neurons use sophisticated context-dependent coding strategies to process information.
- We have obtained promising evidence that brief imposed myopic defocus can slow the further progression of myopia in children. This approach will now be tested in a full Randomised Clinical Trial in Singapore.

