

The ecology of visual information processing & the organization of behaviour

Jochen Zeil

ARC Centre of Excellence in Vision Science & Centre for Visual Sciences, Research School of Biological Sciences, The Australian National University, PO Box 475, Canberra ACT2601, Australia (jochen.zeil@anu.edu.au)

Vision operates in closed-loop. Behaviour constantly influences the distribution and pattern of light on the retina. Eye, head and body movements of animals are organized to either facilitate extraction of visual information – for instance by keeping still or by separating the effects of rotation and translation in the optic flow field – or to generate specific visual information – as in the case of motion-based distance cues. I will briefly review examples of how the organization of behaviour in very different animals is driven by the same, universal needs of visual information processing in the context of flight control and image stabilization (Zeil et al. 2008).

I will then document the intimate inter-dependence of visual information processing and behavioural organization by discussing the way in which insects learn and use views for homing. Homing insects are known to be guided by visual memories of the goal environment (Zeil et al. 2003). They acquire these visual representations during highly structured and elaborate learning flights on departure. The organization and the dynamics of these learning flights are surprisingly similar across different species of wasps and bees, indicating that they reflect fundamental requirements of view-based navigation (Zeil et al. 1996). To understand what the insects are looking for during their learning flights and how they use what they see during learning to guide their return, we have used a robotic gantry to move a panoramic imaging device along the flight paths of learning and homing wasps (Zeil et al. 2007). We then determined how image differences develop throughout a learning flight and identified which views guide the insect's return.

- Zeil J, Boeddeker N, Hemmi JM (2008) Vision and the organization of behaviour. *Current Biology* 18: R320-R323.
- Zeil J, Hofmann MI, Chahl J (2003) Catchment areas of panoramic snapshots in outdoor scenes. *Journal of the Optical Society of America A* 20: 450-469
- Zeil J, Kelber A, Voss R (1996) Structure and function of learning flights in bees and wasps. *Journal of Experimental Biology* 199: 245-252 .
- Zeil J, Boeddeker N, Hemmi JM, Stürzl W (2007) Going Wild: Toward an Ecology of Visual Information Processing. In North G, Greenspan R (eds) *Invertebrate Neurobiology*, Cold Spring Harbor Press, pp. 381-403