A bee in the corridor: centring or wall-following ?

Julien Serres, Franck Ruffier, Guillaume P. Masson and Nicolas Franceschini

Biorobotics Dept., Movement and Perception Inst., CNRS/Univ. of the Mediterranean, 163 av Luminy, F-13288 Marseille cedex 09 France

Email: julien.serres@univmed.fr

To understand the logics behind the honeybee's anti-collision system, we filmed bees (*Apis Mellifera*) flying through a *wide* outdoor flight tunnel (0.95m-wide, 3m-long). We observed that bees do not centre systematically, in contrast with previous observations made in a narrower, 0.12m wide corridor (Srinivasan et al., 1991). Bees may instead follow either wall (Fig. A,B), depending on the entrance (E_L or E_R) and reward (R_L or R_R) locations. The 'optic flow balance' hypothesis (Srinivasan et al., 1991) does not account for this *wall following behaviour*. The bee's sideway motion is well accounted for by an *optic flow* based feedback loop that we called an *optic flow regulator* (Ruffier and Franceschini *Rob. Aut. Syst.* 2005; Serres et al., *IEEE Biorob* 2006). This scheme would require the bee to measure neither its forward speed nor its distance to the walls.

Fig. A-B: Bees' trajectories in a straight corridor (3x0.95x0.25m). A high-resolution digital camera placed 2.20m above the corridor recorded the trajectory of single flying bees at 20 fps over a distance of 1.5m centred halfway through the corridor. Both walls are lined with a periodic grating that consists of vertical grey-and-white stripes with a spatial period of 10cm and a contrast of 0.27. The entrance (E_L or E_R) and reward (R_L or R_R) locations are near the left (A) or right wall (B). The bees' trajectories happen to be significantly shifted (*p-value*$<10^{-10}$) with respect to the midline. Their mean ordinate is 0.65±0.08m in A and 0.24±0.08m in B. (*n* = number of bee trajectories)