



HAL
open science

Uncorrelated optic flow's invariants controlling altitude in honeybees : a new experimental setup

Aimie Berger Dauxère, Gilles Montagne, Julien Serres

► To cite this version:

Aimie Berger Dauxère, Gilles Montagne, Julien Serres. Uncorrelated optic flow's invariants controlling altitude in honeybees : a new experimental setup. Insectes Sociaux - 30ème congrès UIEIS - Section française, Aug 2019, Avignon, France. . hal-03793125

HAL Id: hal-03793125

<https://hal.science/hal-03793125v1>

Submitted on 30 Sep 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

Experimental set up's aim: is baseline's splay angle rate of change involved in altitude control in *Apis mellifera* ?

two optical invariants:

- optical scrolling speed $\dot{S} = 0$
- base lines' splay angle rate of change $\dot{\omega} = 0$

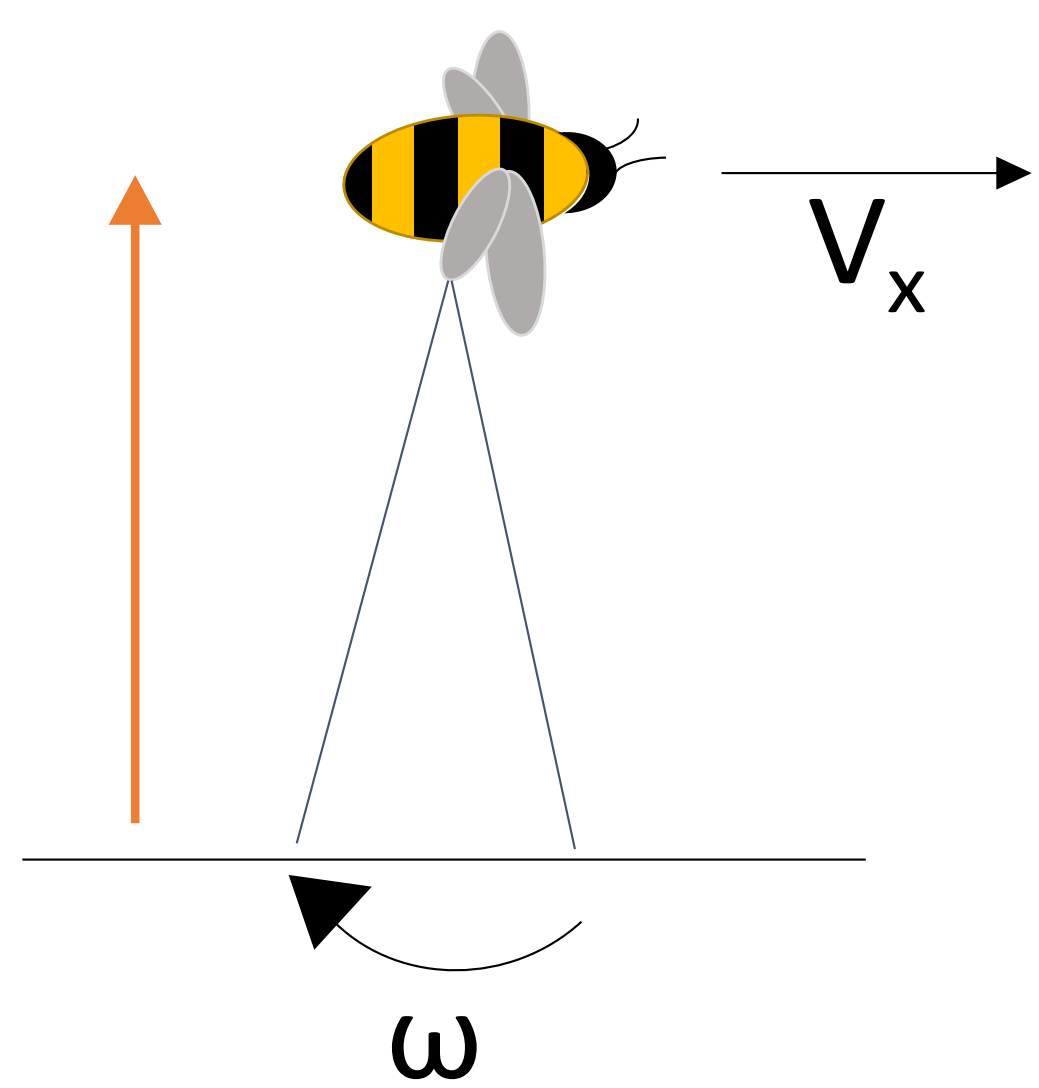
--> optical invariants can be uncorrelated

--> optical invariants can be individually suppressed

--> optical invariants can be distorted

Optical scrolling speed (OSS) experienced by a flying agent

altitude (z)



$$\omega = \frac{V_x}{z}$$

$$\dot{\omega} = 0$$

[1, 2, 3, 4, 7]

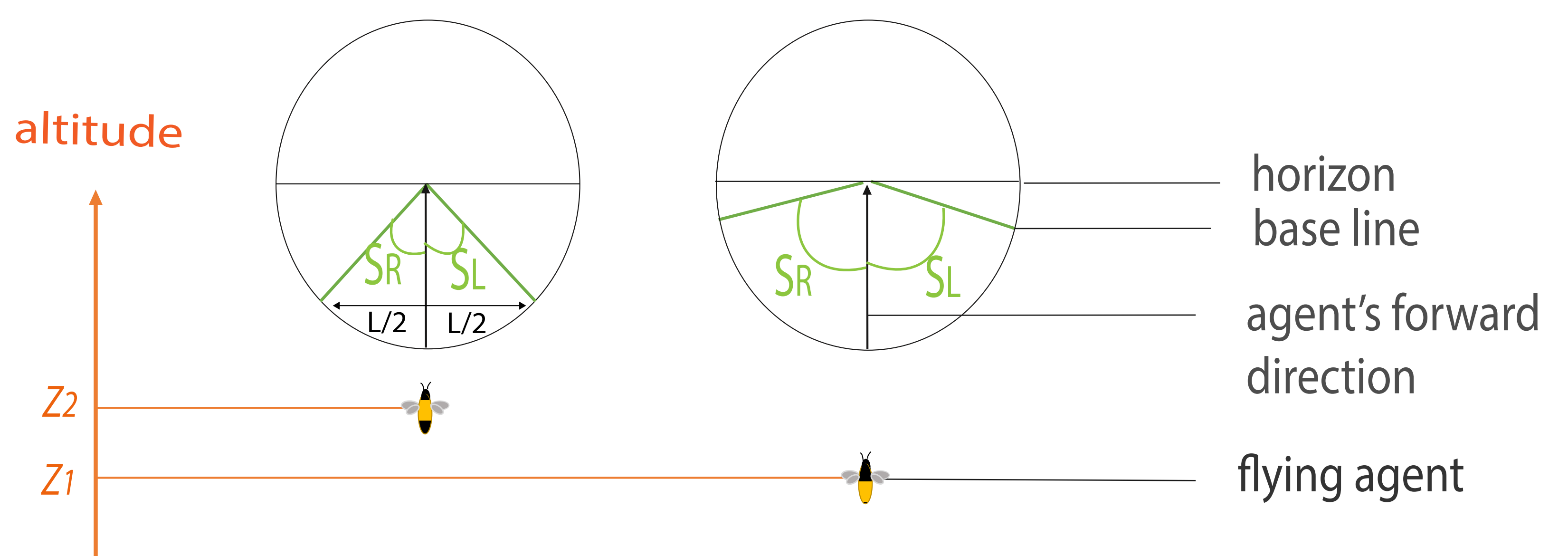
Splay angle's rate of change experienced by a flying agent

$S = 1/2$ angle formed by base lines
 $S_R = \text{right splay}$; $S_L = \text{left splay}$

$S_R = S_L = S$ for a centered bee
 $L = \text{path width}$

$$S = \arctan\left(\frac{L/2}{z}\right)$$

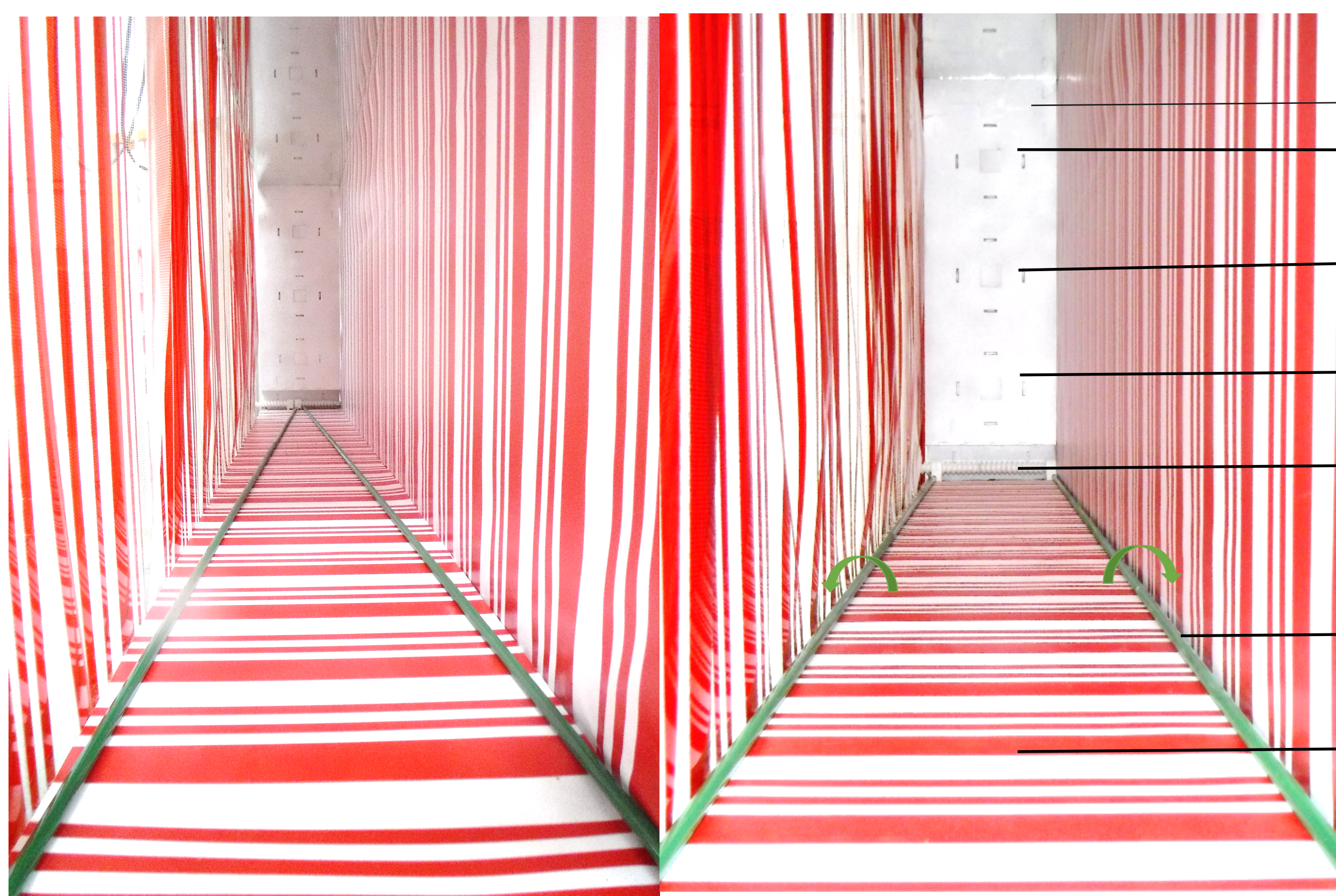
$$\dot{S} = 0$$



based on [6] in humans

[5, 6]

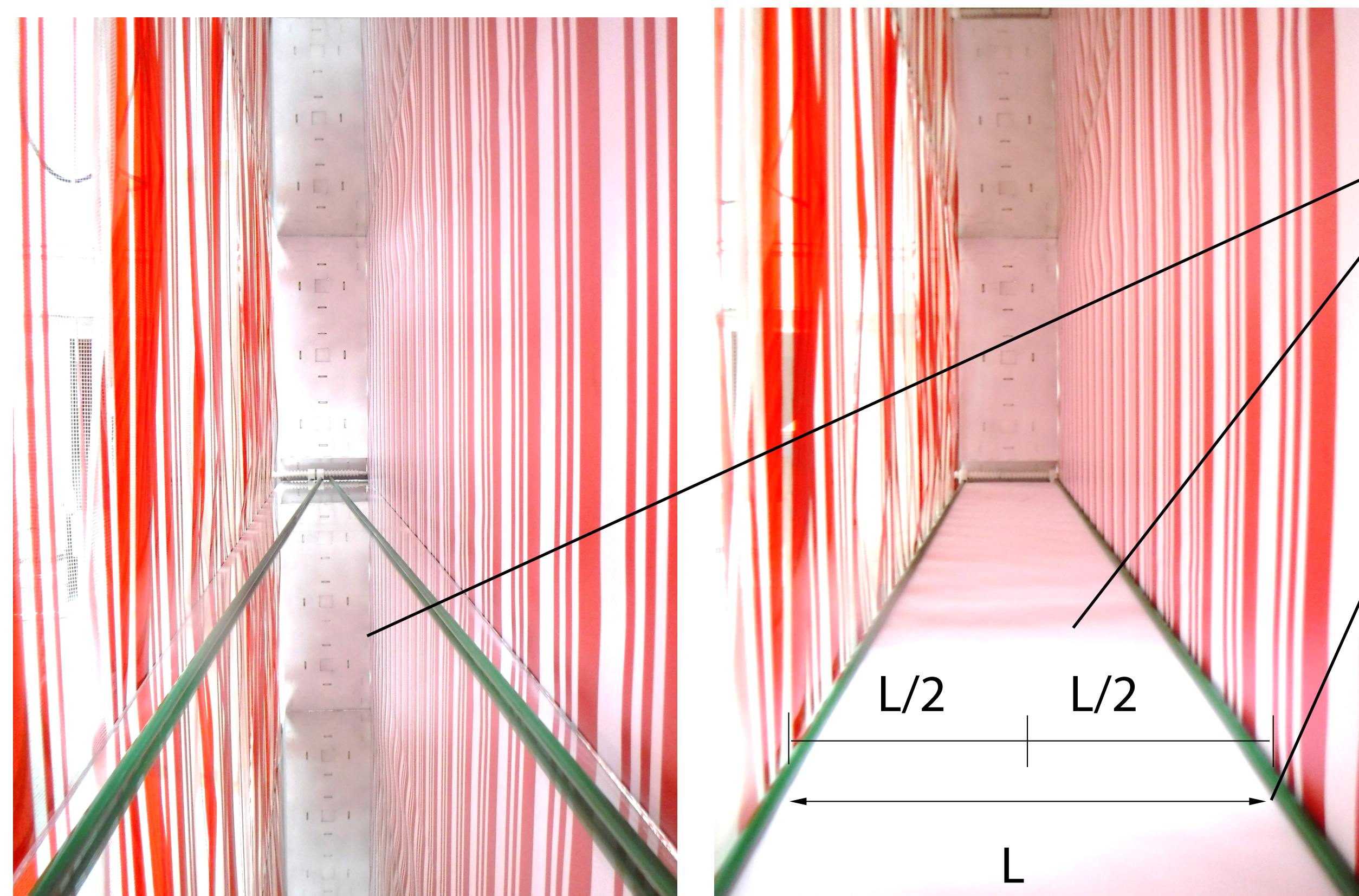
Experimental set up



- minimized visual clues
- 3 possible entrances/exits provided with food reward
- two-way metric screw operated by a brushless motor
- mobile stick
- OSS available

OSS available
Narrowed splay angle

OSS available
Real splay angle



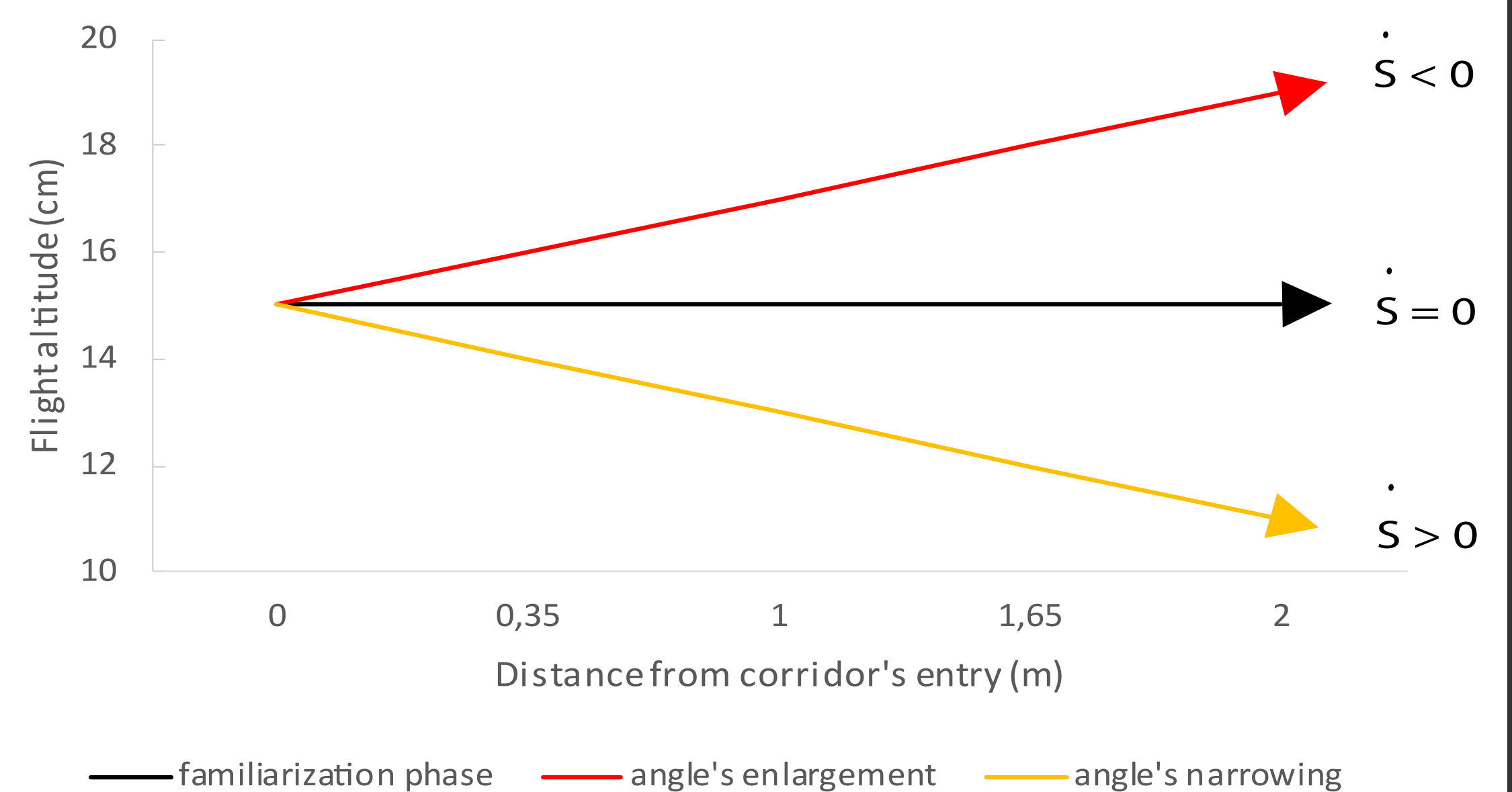
no OSS available

corridor width

No OSS available
Narrowed splay angle

No OSS available
Real splay angle

Predictive bee's altitude in response to an apparent splay angle rate of change



$$\dot{S} = -\frac{\frac{L}{2}}{z^2 + \left(\frac{L}{2}\right)^2} \cdot \dot{z}$$

Perceived	Meaning	Response
\dot{S}	\dot{z}	\dot{z}
\dot{S}	\dot{z}	\dot{z}

Question : ? < S < ? (° · S⁻¹)

[1] J. Lecoer, M. Dacke, D. Floreano and E. Baird (2019), Scientific Reports (9) 7707
 [2] G. Portelli, J.R Serres and F.Ruffier (2017), Scientific Reports (7) 9231
 [3] J.R Serres and F.Ruffier (2017), Arthropod Structure & Development (46) 5, 703-717
 [4] M.V Srinivasan (2011), Current Opinion in Neurobiology (24) 4, 535-543
 [5] A.P Duchon and W.H Warren (2002), Psychological Sciences (13) 3, 272-278
 [6] J.M Flach, R. Warren, S.A Garness, L. Kelly and Terry Stanard (1997), Journal of Experimental Psychology (23) 6, 1764-1782
 [7] J.R Serres, A.H.P. Morice, C. Blary, G. Montagne and F. Ruffier. Honeybees flying over a mirror crash irremediably. In the 4th International Conference on Invertebrate Vision (ICIV), Bäckaskog Castle, Suède, 2019