Max-Planck-Institut für Ornithologie

Max Planck Institute for Ornithology

Seewiesen Colloquia

Speaker invited by: Holger Görlitz

Thursday, 9th July 2015, 13:00 h, in House 5, Seminarroom

Using Braitenberg vehicles to model bat echolocation

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Bat echolocation is an ability consisting of many subtasks such as navigation, prey detection and object recognition. We propose that to understand the echolocation capabilities of bats it is useful to isolate the minimal set of acoustic cues needed to complete each task. While many possible cues have been suggested, very little is known about the actual cues supporting obstacle avoidance in echolocating bats. We propose that the Interaural Intensity Difference (IID) as calculated on the onset of the first echo is a reliable cue for obstacle avoidance. As evidence we present a simple Braitenberg vehicle using first echo IID and time delay cues combined with alternating ear movements modelled after the constant frequency bat Rhinolophus rouxi. Using spatial simulations (2D and 3D) we show that the vehicle can be steered clear from obstacles without performing a reconstruction of the 3D layout of the scene or explicitly localizing discrete obstacles. We hypothesize that using a low level yet robust cue for obstacle avoidance allows bats to comply with the hard real-time constraints of this basic behavior while freeing up cognitive resources for the more computationally demanding detailed analysis of selected echoes as might be required by more sophisticated echolocation behaviors.

Who is Herbert Peremans?

1994   PhD Universiteit Gent, BE

1996   Marie Curie fellowship University of Edinburgh, UK

1999   Professor of Electrical Engineering Universiteit Antwerpen, BE

Selected publications:

- J. Reijniers, D. Vanderelst, H. Peremans (2010), Morphology induced information transfer in bat sonar, Phys. Rev. Letters, Vol.105, 148701.

- J. Steckel, H. Peremans (2013) BatSLAM: simultaneous localization and mapping using biomimetic sonar, PLoS ONE, 8(1): e54076.

- H. Peremans, D. Vanderelst (2013) Augmented topological maps for three-dimensional navigation, Behavioral and brain sciences, 36:5, pp. 560-561.

- S.K. Bartenstein, N. Gerstenberg, D. Vanderelst, H. Peremans, U. Firzlaff (2014) Echo-acoustic flow dynamically modifies the cortical map of target range in bats, Nature communications 18;5:4668

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