SEEWIESEN

LECTURE SERIES

FALL/WINTER 2019/2020

Max Planck Institute for Ornithology

MAX PLANCK GESELLSCHAFT

THURSDAY | April 2nd, 2020 | 13.00 | HOUSE 4 LECTURE ROOM

LAURA BUSSE

LMU Munich | Host: Dept. Gahr

Video capture and analysis of the mouse´s natural visual environment

For any given species, the design of an animal's visual system reflects the challenges of its ecological niche; thus, a promising approach to study visual system function is to probe the system with natural stimuli. Mice have become an important model in vision research, but it is still rarely considered that, compared to primates, they live in a different environment and therefore have different visual needs. For example, unlike primates, mice are dichromatic and perceive UV light. Moreover, the mouse retina is subdivided into a mostly "green" sensitive (peak at 510 nm) dorsal and UV sensitive (peak at 360 nm) ventral retina. Therefore, presenting naturalistic stimuli in laboratory settings to non-primate species, such as mice, is challenging.

Under the assumption that a substantial fraction of mouse eye movements serves to stabilize the retinal image, we built a gimbal-stabilized, spectrally-calibrated hand-held camera to explore the natural habitat of mice in the relevant spectral bands. We intensity-calibrated the camera with LEDs of defined wavelengths and brightness using a power meter / spectrometer combination. The camera was moved close to the ground along mouse tracks and UV/green movies of the mouse habitat were recorded for different representative scenes and at different times of the day. By analysing contrast statistics of the movies, we found, for example, that contrast in the two chromatic channels (UV/ green) diverged greatly in the upper but not in the lower visual field. This resonates well with reports of a higher fraction of colour-opponent retinal ganglion cells in the ventral mouse retina and superior behavioural colour discrimination in the upper visual field. In addition, we found that during dusk and dawn, "predators" coming from the sky should be more easily detectable in the UV compared to the green channel, which emphasizes the UV's role for mouse vision. Finally, we designed different unsupervised models, and when fitting them to our recordings, we mainly found color-opponent filters with training data of the upper visual field.

In the last part of the talk, I will also show ongoing efforts to established a light-weight, head-mounted camera system, which can capture the visual environment from the perspective of freely roaming mice.

WHO IS LAURA BUSSE?

2007	Postdoc, Smith-Kettlewell Eye Research Institute, San Francisco, CA, USA
2008	Research Associate, Institute of Ophthalmology, UCL, London, UK
2010	Junior Research Group Leader, Centre for Integrative Neuroscience, Tübingen, Germany
2016	W2 Professor, Department of Biology, LMU Munich

SELECTED PUBLICATIONS

1) Román Rosón, M., Bauer, Y., Kotkat, A.H., Berens, P., Euler, T., and Busse, L. (2019). Mouse dLGN Receives Functional Input from a Diverse Population of Retinal Ganglion Cells with Limited Convergence. Neuron 102, 462-476.e8.

2) Erisken, S., Vaiceliunaite, A., Jurjut, O., Fiorini, M., Katzner, S., and Busse, L. (2014). Effects of Locomotion Extend throughout the Mouse Early Visual System. Current Biology 24, 2899–2907.

3) Busse, L., Ayaz, A., Dhruv, N.T., Katzner, S., Saleem, A.B., Schölvinck, M.L., Zaharia, A.D., and Carandini, M. (2011). The Detection of Visual Contrast in the Behaving Mouse. The Journal of Neuroscience 31, 11351–11361.

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