Center for Mind,
Brain and Behavior
CMBB

Vorträge im Sommersemester 2023:

Vorlesungssaal 001, Forschungszentrum Deutscher Sprachatlas, Pilgrimstein 16

Montag, 17.4.2023, 18 Uhr ct
Neuronal mechanisms for target-landmark integration in the frontal eye-fields
Prof. Dr. Doug Crawford
York Centre for Vision Research, Vision: Science to Applications (VISTA) Program, and Department of Psychology, York University, Toronto, Canada

Student special!
Montag, 22.5.2023, 18.45 st
Treatment strategies for epilepsies over the course of time - from epilepsy surgery to immunosuppression
Prof. Dr. Felix Rosenow
Epilepsiezentrum Frankfurt Rhein-Main, Universitätsklinikum Frankfurt

Montag, 5.6.2023, 18 Uhr ct
Modelling the neural mechanisms of navigation in insects
Barbara Webb, Professor of Biorobotics
Institute for Perception, Action and Behaviour, School of Informatics
University of Edinburgh, UK

Montag 3.7.2023, 18 Uhr ct

Optogenetic dissection of sensory information processing
Prof. Dr. Markus Rothermel
Institut für Physiologie und Zellbiologie
Stiftung Tierärztliche Hochschule Hannover

Eventuelle Rückfragen bitte an Prof. Dr. Rainer Schwarting (schwarti@staff.uni-marburg.de)

Kurze Abstracts einzelner Vorträge:

J. Douglas Crawford (and Vishal Bharmauria, Adrian Schütz, Frank Bremmer): Neuronal Mechanisms for Target-Landmark Integration in the Frontal Eye-Fields

The visual system has access to two sensory cues for spatial behavior: egocentric (relative to the self) and allocentric (relative to the external world). This distinction is important in the dorsal (egocentric) and ventral (allocentric) visual streams, and for the role of hippocampus in spatial navigation. But until recently, was not considered in sensorimotor studies. Behavioral studies suggest that ego/ allocentric cues are optimally integrated for goal-directed action, e.g., when a visual landmark (the allocentric cue) shifts, movements shift partially in the same direction (Byrne & Crawford 2010; Fiehler et al. 2014; Li et al. 2016). Neuroimaging studies suggest this might happen in the parietal and frontal cortex (Chen and Crawford 2020) but cannot reveal cellular mechanisms. To investigate this, we trained monkeys to direct gaze toward remembered targets in the presence of a large visual landmark that shifted during the memory delay. Response fields (where targets modulated neural activity) were recorded in the frontal eye field (FEF), an area that employs eye-centered target and gaze responses (Sajad et al. 2015). We then determined neural codes by finding best fits between response fields and various spatial models, including target / landmark coding in egocentric, allocentric, and intermediate frames of reference. In short, most visual response fields still preferentially coded target location relative to the eye, but a substantial minority (30%) encoded landmark location (Schütz et al., in review). Further, cells that coded both targets and landmarks also showed a shift in target coding toward an intermediate target-landmark reference frame. Later, after the landmark shifted, memory delay activity showed a partial shift in the same direction (Bharmauria et al. 2020). This influence was then fully integrated into the final eye-centered motor response, which encoded future gaze position toward similarly shifted positions. Analogous results were also found in the supplementary eye fields (Bharmauria et al. 2021). Overall, these results show that prefrontal cortex retains and integrates visual landmark signals with eye-centered target signals to generate the spatial code for gaze commands. We propose this is a general mechanism for ego/allocentric integration in goal directed action, where the combination of both signals normally provides the most reliable estimate of target location.

Barbara Webb: Modelling the neural mechanisms of navigation in insects

Insect navigation has been a focus of behavioural study for many years, and provides a striking example of cognitive complexity in a miniature brain. We have used computational modelling to bridge the gap from behaviour to neural mechansims by relating the computational requirements of navigational tasks to the type of computation offered by invertebrate brain circuits. Using this approach, we have argued that visual memory of multiple views could be acquired by associative learning in the mushroom body neuropil, and allow insects to recapitulate long routes. We have also proposed a circuit in the central complex neuropil that integrates sky compass and optic flow information on an outbound path and can thus steer the animal directly home; and can support vector memories for flexible foraging behaviour. The models are strongly constrained by neuroanatomy, and are tested in realistic agent and robot simulations.

Markus Rothermel: Optogenetic dissection of sensory information processing

Sensory systems enable us to navigate through our daily life. However, how we perceive our environment does not solely depend on the sensory inputs that our brain receives but is also strongly influenced by multiple other factors like how much attention we direct towards a stimulus, how we feel in general (hungry, tired, cranky, etc.) and our previous experience. Adjusting our perception to our momentary needs is crucial for adaptive behaviors, general orientation and finally survival in a complex environment. Failure to do so can lead to severe medical conditions, such as attention deficit disorder or autism.

To study brain state-dependent modulations of early sensory processing the mouse olfactory pathway is an ideal model system; the olfactory system is the only sensory system where the first relay station of sensory information processing, the olfactory bulb (OB), is easily accessible for optical imaging approaches allowing for an interrogation of large populations of neurons simultaneously. Furthermore, as macrosmates, mice largely rely on olfaction for orientation and additionally allow the implementation of a wide variety of innovative genetic tools for optical data recording and optogenetic manipulation, rendering them the ideal vertebrate model system.

We combine state-of-the-art techniques including in vivo multiphoton imaging and newly developed tracing and optogenetic approaches with behavioral readouts to correlate neuronal network activity with behavioral performance in the awake animal. The ability to actively manipulate these processes will have great advantages for both basic and translational biomedical research.