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Lecture 1

MEASURING BRAIN ACTIVITY BY USING IMAGING METHODS

Abstract

In this lecture, I will discuss about various approaches to measure brain activity by using imaging methods. I will begin by giving a historical perspective on the available methods in measuring brain activity. I will compare each imaging method and discuss their advantages and disadvantages. I will also try to highlight the future upcoming technologies. I will aim that the students will be able to choose the most suitable imaging technology for their experimental work by the end of my lecture.

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Lecture 2

Studying the function and connectivity of neural Circuits in zebrafish brain

Abstract

The habenula (Hb) is a brain region with increasing popularity due to its strong link to addiction, mood disorders and experience dependent fear. We demonstrated that Hb neurons respond to odors and light asymmetrically. Moreover, we showed that Hb neurons exhibit structured spontaneous activity that is spatially and temporally organized. This spontaneous activity resembles neural attractors, which can switch the preferred state of the Hb and regulate the transmission of sensory information to downstream monoaminergic brainstem nuclei. In order to explore the source of Hb spontaneous activity, we investigate the local connectivity within Hb and the global functional inputs to Hb by using a combination of functional brain imaging, optogenetics and applied mathematical tools. We showed that recurrent excitatory connections within Hb is important for maintaining spatio-temporal organization of Hb activity. Moreover, we observed that functional inputs from zebrafish forebrain regions Dm and DI (corresponding to basolateral amygdala and hippocampus respectively) and sensory inputs from visual and olfactory systems are the major drivers of spontaneous Hb activity. Our results suggested that these limbic and sensory inputs are integrated in Hb in a non-linear fashion and interact with sensory representations in Hb. We propose that Hb lies in the heart of a brain wide network and act as “a hub” or “a switchboard”, which can regulate or gate the communication of sensory systems and limbic forebrain areas with the monoaminergic brainstem nuclei that control animal behaviors.