Neuroanatomy and Physiology

Monday, Jun 18: 2:45 PM - 4:00 PM
Oral Sessions
Monday - Oral Session

Presentations

2713: BigBrain: 1D convolutional neural networks for automated segmentation of cortical layers

2:45 PM - 2:57 PM
The cerebral isocortex has a six layered structure that varies depending on cortical area and local geometry(Brodmann 1909; von Economo & Koskinas 1925). BigBrain is a high resolution 3D histological dataset from which valuable insight can be gained through segmenting these layers across the entire cortex(Amunts et al. 2013). Traditionally, layer segmentation is carried out according to histological definitions that are 2D, with errors introduced by oblique sectioning. It requires expert training and involves time-consuming manual delineations. We therefore sought to automate the segmentation of cortical layers in 3D through the application of 1D convolutional neural networks(Lecun et al. 1998) to profiles of intensity extracted through the cortex of the BigBrain. We then demonstrated that gradients of overall cortical thickness in the visual cortex, first identified using in vivo MRI(Wagstyl et al. 2015), are driven by specific cortical layers.

Presenter

Konrad Wagstyl, University of Cambridge

2714: Scalable cytoarchitectonic characterization in 3D of large optically cleared human neocortex samples

2:57 PM - 3:09 PM
Microscopic volume imaging of human cerebral cortex architecture is challenging at the cellular scale owing to the large size of the human brain and the 3-dimensional geometry of the cortex. Although a recent surge of optical clearing techniques has transformed microscopic 3D imaging of small mammalian brains labelled with antibodies or transgenic techniques [e.g. 3], labelling and volume imaging of large adult archival brain samples, scalable in terms of time and cost to thousands of cubic millimeters covering a significant portion of a human cortical area, has so far remained out of reach [c.f. 1]. Here, we report MASH (Multiscale Architectonic Staining of Human cortex): a novel scalable cell-body and nuclei labeling and optical clearing approach for large archival adult human cortex samples which enables high-throughput 3D optical imaging at a range of scales from the cortical area to the single cell.

Presenter

Sven Hildebrand, Maastricht University

2772: Cerebellar organization is sensorimotor-fugal, and lobules VIII - IX/X share hierarchical principles

3:09 PM - 3:21 PM
Comprehending the relationship between macroscale structure and function is fundamental to understanding the nervous system and alleviating suffering in neurological and psychiatric conditions. One central principle in the study of the cerebral cortex is that macroscale anatomy reflects a functional hierarchy from primary to transmodal processing (Mesulam, 1998). In contrast, and despite its growing importance in basic and clinical neuroscience, the central axis of motor and nonmotor macroscale organization in the cerebellum remains unknown. The absence of intra-cerebellar anatomical connections makes it difficult to analyze intra-cerebellar progressive hierarchical relationships using anatomical techniques. We use resting-state diffusion map embedding to uncover a novel, functional description of cerebellar and cerebello-cerebral functional connectivity.

Presenter

Xavier Guell, MIT

2704: Microstructure profile covariance reflects the principal gradient of functional connectivity

3:21 PM - 3:33 PM
Structural covariance analysis, i.e. the inter-regional correlation in morphological measures across subjects, is a principled approach for in-vivo brain network approximation (Evans 2013). While the study of these networks has provided important insights into large-scale brain organization in healthy and diseased populations, progress is hindered by the reliance on group level analyses and unclear histological underpinnings. In the current work, we propose a novel microstructure profile covariance (MPC) framework to generate cortico-cortical networks. Our approach leverages inter-regional correlations of intensity profiles sampled from a 3D-histological reconstruction of the human brain. By translating histological findings to in-vivo imaging, we aim to formulate an easily reproducible method for the construction of individual, algorithm-independent cortical similarity networks which reflect variations in cell patterning across the cerebral cortex. In addition to evaluating cytoarchitectural validity of the MPC networks, we assessed their relation to spatial gradients in resting state fMRI connectivity.

Presenter

Casey Paquola, McGill University

2702: Transmitter receptors and the laminar organization of the human primary motor cortex

3:33 PM - 3:45 PM
The primary motor cortex (M1) holds an exceptional position within the primate neocortex due to its laminar organization. M1 is generally thought to be agranular, i.e., to display a layer IV during development, but not in adulthood [1]. This however, has become subject of renewed debate, since M1 is also seen as an extreme example of dysgranular cortex, i.e., with a discontinuous layer IV invaded by large layer III and layer V neurons [2;3]. Interestingly, the "typicality" of the supra- and infragranular layers of M1 has never been challenged, although layer IV cannot be viewed alone, but is part of a circuitry also including layers I-III and V-VI. Aims of the present study were to determine whether (1) the laminar distribution patterns of transmitter receptors highlight the location of cytoarchitectonic layer IV, (2) supragranular, granular and infragranular layers from multiple functional systems share common neurochemical principles, and (3) these features are also found in M1.

Presenter

Nicola Palomero-Gallagher, Research Centre Juelich

2885: Glucose metabolism in cortical white matter is linked to myelination and functional connectivity

3:45 PM - 3:57 PM

Almost half of the human brain is white matter (WM), which connects neuronal assemblies of cortical and subcortical structures. WM is composed of myelinated axons and glial cells such as oligodendrocytes that maintain myelin, a metabolically demanding process (Harris & Attwell, 2012). It has been shown that white matter fibers show stimulus-related increases in cerebral metabolic rate of glucose (CMRglc) (Weber et al., 2002). Moreover, task-related blood oxygenation changes in WM has been also observed across a range of fMRI studies (Gawryluk et al., 2014), further supporting the relevance of linking structural and functional characteristics of WM. Here we tested the hypothesis that higher WM myelination may increase efficiency of brain networks leading to less metabolic demand across subjects whereas higher regional myelination would be associated with higher CMRglc within participants. We also hypothesized that the extent of distal (but not local) functional connectivity in WM would be related to WM CMRglc.

Presenter

Ehsan Shokri Kojori, National Institudes of Health