Contribution ID: **25** Type: **Talk**

HippoMaps: multiscale cartography of human hippocampal organization

Wednesday 11 September 2024 11:00 (15 minutes)

The hippocampus has a unique microarchitecture, is situated at the nexus of multiple macroscale functional networks, contributes to numerous cognitive and affective processes, and is highly susceptible to brain pathology across common disorders. The hippocampus can be understood and modeled as a cortical (archicortical) structure with a 2D surface topology [1]. Taking inspiration from neocortical informatics tools like NeuroMaps [2], here, we introduce HippoMaps, an open access toolbox and data warehouse for the mapping and contextualization of hippocampal data on hippocampal surfaces in the human brain.

HippoMaps capitalizes on a novel hippocampal unfolding approach as well as shape intrinsic cross-subject and cross-modal registration capabilities [3]. We initialize this repository with data spanning 3D histology [4,5], structural MRI and resting-state functional MRI (rsfMRI) obtained at 3 and 7 Tesla [6,7], as well as intracranial encephalography (iEEG) recordings in epilepsy patients [8].

We present 30 novel, detailed maps of hippocampal structural and functional features. Structural measures derived from quantitative MRI and histology tend to show sharp subfield differentiation, whereas functional measures such as rsfMRI and iEEG band powers show gradual anterior-posterior differentiation. We show how such maps can be related to one another using a tailored approach for spatial map association that corrects for autocorrelation. This provides a method for contextualizing hippocampal data in future work. Code and tools are compliant with community standards, and are provided as comprehensive online tutorials that reproduce the figures shown here.

Bioinformatics data are not inherently useful unless context is given, for example, by their inter-relationships and their links to disease or cognitive processes. Here we provide a common space and toolbox for such comparisons in the hippocampus, spanning methodologies and modalities, spatial scales, as well as clinical and basic research contexts. Some maps have already been generated and uploaded to HippoMaps by members of the broader research community, and we further discourse in the spirit of open and iterative scientific resource development.

1. DeKraker J, et al. Automated hippocampal unfolding for morphometry and subfield segmentation with HippUnfold. Elife. 2022;11. doi:10.7554/eLife.77945
2. Markello RD, et al. neuromaps: structural and functional interpretation of brain maps. Nat Methods. 2022;19: 1472–1479.
3. DeKraker J, et al. Evaluation of surface-based hippocampal registration using ground-truth subfield definitions. Elife. 2023;12. doi:10.7554/eLife.88404
4. Amunts K, et al. BigBrain: an ultrahigh-resolution 3D human brain model. Science. 2013;340: 1472–1475.
5. Alkemade A, et al. A unified 3D map of microscopic architecture and MRI of the human brain. Sci Adv. 2022;8: eabj7892.
6. Royer J, et al. An Open MRI Dataset For Multiscale Neuroscience. Sci Data. 2022;9: 569.
7. Cabalo DG, et al. Multimodal precision neuroimaging of the individual human brain at ultra-high fields. bioRxiv. 2024. p. 2024.06.17.596303. doi:10.1101/2024.06.17.596303
8. Frauscher B, et al. Atlas of the normal intracranial electroencephalogram: neurophysiological awake activity in different cortical areas. Brain. 2018;141: 1130–1144.

Primary author: DEKRAKER, Jordan (McGill University)

Co-authors: BERNHARDT, Boris (McGill University); CABALO, Donna Gift (McGill University); AMUNTS, Katrin (Forschungszentrum Jülich (INM-1) and Cécile and Oskar Vogt Institute for Brain Research, University Hospital Düsseldorf, Medical Faculty, Heinrich-Heine-University Düsseldorf); RODRIGUEZ-CRUCES, Raul (McGill University); Prof. EVANS, Alan C (Montreal Neurological Institute McGill University Montreal); VALK, Sofie (INM-7)

Presenter: DEKRAKER, Jordan (McGill University)

Session Classification: Contributed Talks - Mapping and Atlases (co-Chairs: Elizabeth Rounis, Thomas Funck)