## 7th BigBrain Workshop: Challenges of big data integration



Contribution ID: 3

Type: Talk

## A 3D coordinate system and volumetric flatmap of the whole human neocortex with applications to data visualization and modeling

Thursday 5 October 2023 14:15 (12 minutes)

The BigBrain dataset has provided a high-resolution view of the human neocortex, promoting a shift from its conceptualization as a surface, as is common in MRI and EEG studies, to a volumetric object. This opens the door for analyses and modeling approaches previously only possible with rodent atlases.

In this work, we apply methods originally implemented for rodent neocortex to create a 3D coordinate system adapted to the geometry of human neocortex. The principal axis in this coordinate system is locally orthogonal to layer boundaries and measures cortical depth (Z coordinate). The other two axes are parallel to layer boundaries and describe a flatmap of the cortical volume, a 3D to 2D mapping in which every voxel inside the cortical volume is projected onto a flat square mesh (XY coordinates). This transformation is area-preserving and reversible, allowing not only to map 3D data to 2D for visualization purposes, but also to decompose the 3D volume based on a parcellation described in 2D. Notably, the layer structure is preserved when going from 2D to 3D, which allows easy delineation of columnar subvolumes anywhere in the neocortex.

Taking as starting point the openly available BigBrain cortical layer maps and layer boundary surface meshes, we produced cortical flatmaps and auxiliary atlases of cortical thickness, depth and orientation for both hemispheres, at a resolution of 100 um in the histological BigBrain space. We show applications of the flatmap for data visualization and for parcellation of the cortical volume. We also discuss the potential application of the auxiliary atlases for creating detailed models of human cortical circuits. Finally, we identify some challenges and caveats of our methods as applied to this and future high-resolution human cortical datasets.

Primary author: BOLAÑOS PUCHET, Sirio (EPFL - Blue Brain Project)

**Co-authors:** BARROS ZULAICA, Natalí (EPFL - Blue Brain Project); REIMANN, Michael W. (EPFL - Blue Brain Project)

Presenter: BOLAÑOS PUCHET, Sirio (EPFL - Blue Brain Project)

Session Classification: Contributed Talks 2