

Contribution ID: 12

Type: **Talk**

3D Reconstruction of BigBrain2: Challenges and Milestones

Wednesday 22 September 2021 17:15 (15 minutes)

The current state of reconstruction of BigBrain2 is presented, describing the brain of a 30 year old anonymous male donor. As for the original BigBrain, cell-body stained histological coronal sections were digitized and reconstructed in 3D. Sections are first repaired at 20 microns in-plane resolution to correct for manipulation artifacts, then aligned to the MRI serving as the undistorted frame of reference. Given the time-consuming nature of the manual aspects of the corrections, including provenance tracking of the operations for reproducibility and variability assessment in section repairs, every fifth section was initially repaired and a first optically-balanced aligned volume at 100 microns isotropic resolution was obtained. This preliminary 3D alignment at 100 microns defines a transformation to the MRI which can subsequently be used for the newly repaired sections being added to the pipeline (25% completed). The transformations defined at 100 microns will be applied at full resolution to obtain a 3D volume at 20 microns isotropic resolution prior to performing non-linear section-to-section alignment at finer resolution levels once all sections have been repaired.

This multi-resolution approach can be extended for future reconstructions of BigBrain3 at full 1 micron resolution by first downsampling the 1 micron sections to 20 microns. With provenance tracking, manual repair operations carried at 20 microns can be reproduced at the 1 micron level.

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Session Classification: Contributed Talks: Reconstruction

Track Classification: Workshop Day 1 - Sep 22: Reconstruction