BrainBrowser
A distributed, web-based neurological data visualization tool.

Natacha Beck, Robert D. Vincent, Jonathan Lurie,
Lindsay B. Lewis, Marc-Étienne Rousseau, Alan C. Evans

McGill Centre for Integrative Neuroscience, Montreal Neurological Institute, McGill University

Introduction

In recent years, large and distributed datasets have become common in neuroimaging research, while the methodologies to analyse them have become more collaborative and exploratory, benefitting greatly from visualization capabilities.

To that effect, BrainBrowser (Sherif 2014a) was created at the MCIN (http://mcin.ca/) as an open source (https://github.com/aces/brainbrowser/), lightweight, high-performance JavaScript visualization environment, leveraging modern technologies to visualize 3D surfaces and volumetric neuroimaging data in any modern web browser.

BrainBrowser has undergone numerous improvements and upgrades and currently includes the following 2 components:
- The Surface Viewer (Fig. 1): a WebGL-based 3D viewer capable of displaying 3D surfaces to which various sorts of vertexwise data may be mapped.
- The Volume Viewer (Fig. 2): an HTML5 Canvas based viewer allowing slice-by-slice viewing for 3D or 4D volumetric data.

Surface viewer

The Surface Viewer supports a variety of different formats: MNI OBJ, FreeSurfer (binary and ASCII), Wavefront OBJ and custom JSON. Direct support of these formats allows the Surface Viewer to remain independent from any server-side infrastructure.

BrainBrowser then uses Three.js (a 3D graphics library for JavaScript) to prepare the data for display as polygons (surface) or lines (tractography data). If per-vertex intensity data are to be mapped, a colour map is loaded, after which intensity data are loaded and parsed. The following formats are supported: text, GIfTI, and FreeSurfer (binary or ASCII). The model can then be manipulated, rotated, and translated easily with the wireframe view, providing a clearer visualization of the model´s geometry (including the capability to set the opacity of each shape to improve visualization of nested shapes).

The Surface Viewer also has a point picking mechanism that selects arbitrary x and y coordinates on the canvas and returns the information about the vertex closest to this point. This feature is used to dynamically visualize relationships between scientific measurements extracted at the selected vertex and the rest of the surface, and has been used (for example) to visualize the MACACC dataset (Lerch 06).
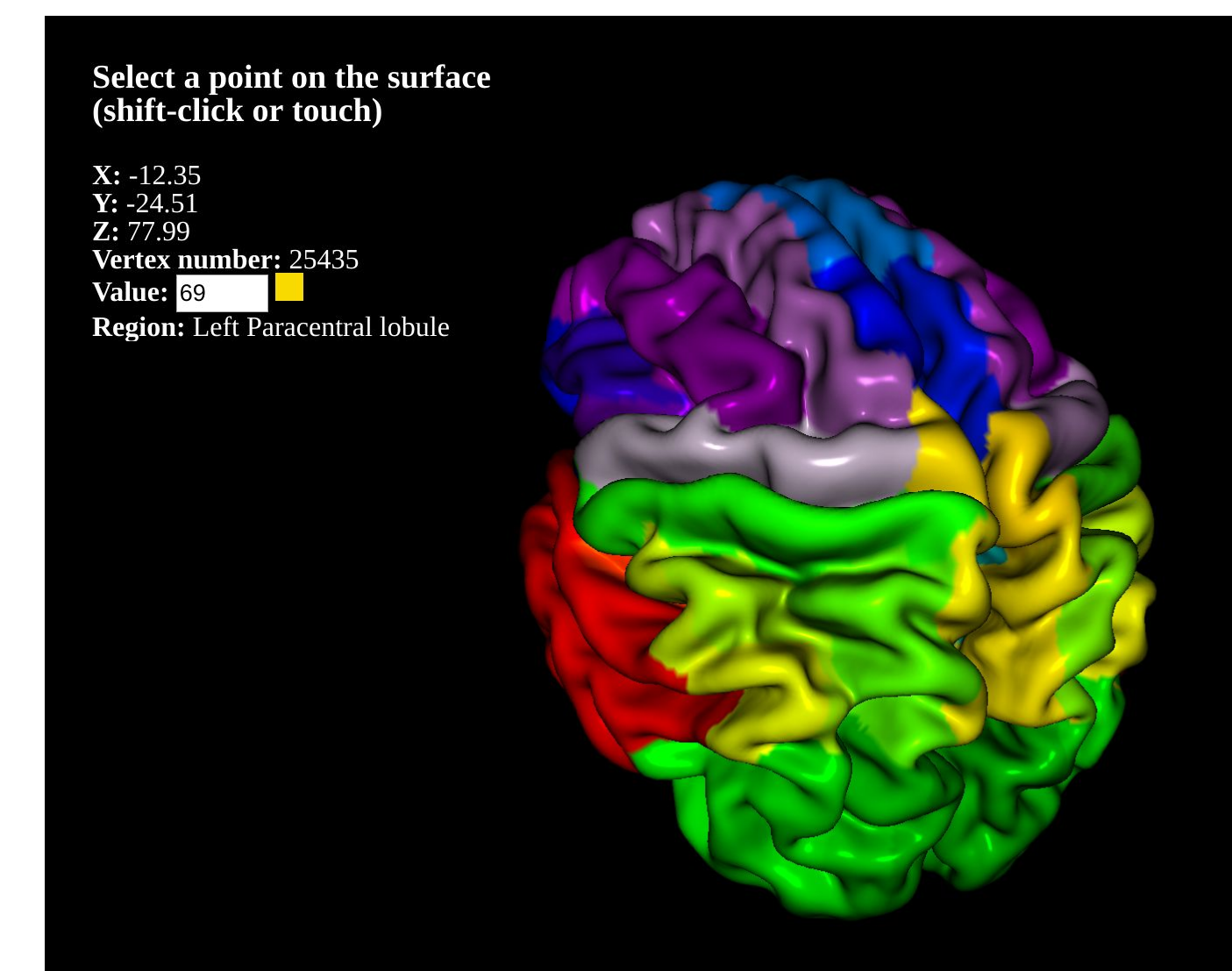

Figure 1: Surface Viewer

Volume viewer

The Volume Viewer supports MINC, NIfTI, and FreeSurfer (MGH) formats, compressed or uncompressed.
It now implements a reader for a subset of HDF5 so that it can read MINC2 files directly from a file or URL.

Leveraging the HTML5 Canvas to display volumetric data, and using a color map to assign a color to the scalar intensity of each voxel, images can be rendered for a given slice through the volume.

It is possible to overlay multiple volumes to compare them and to perform quality control.

The viewer allows for navigation across slices, or across time (for 4D data); intensity thresholding can be set to focus on a particular range.

A measurement tool is available to determine the size of structures such as tumours.
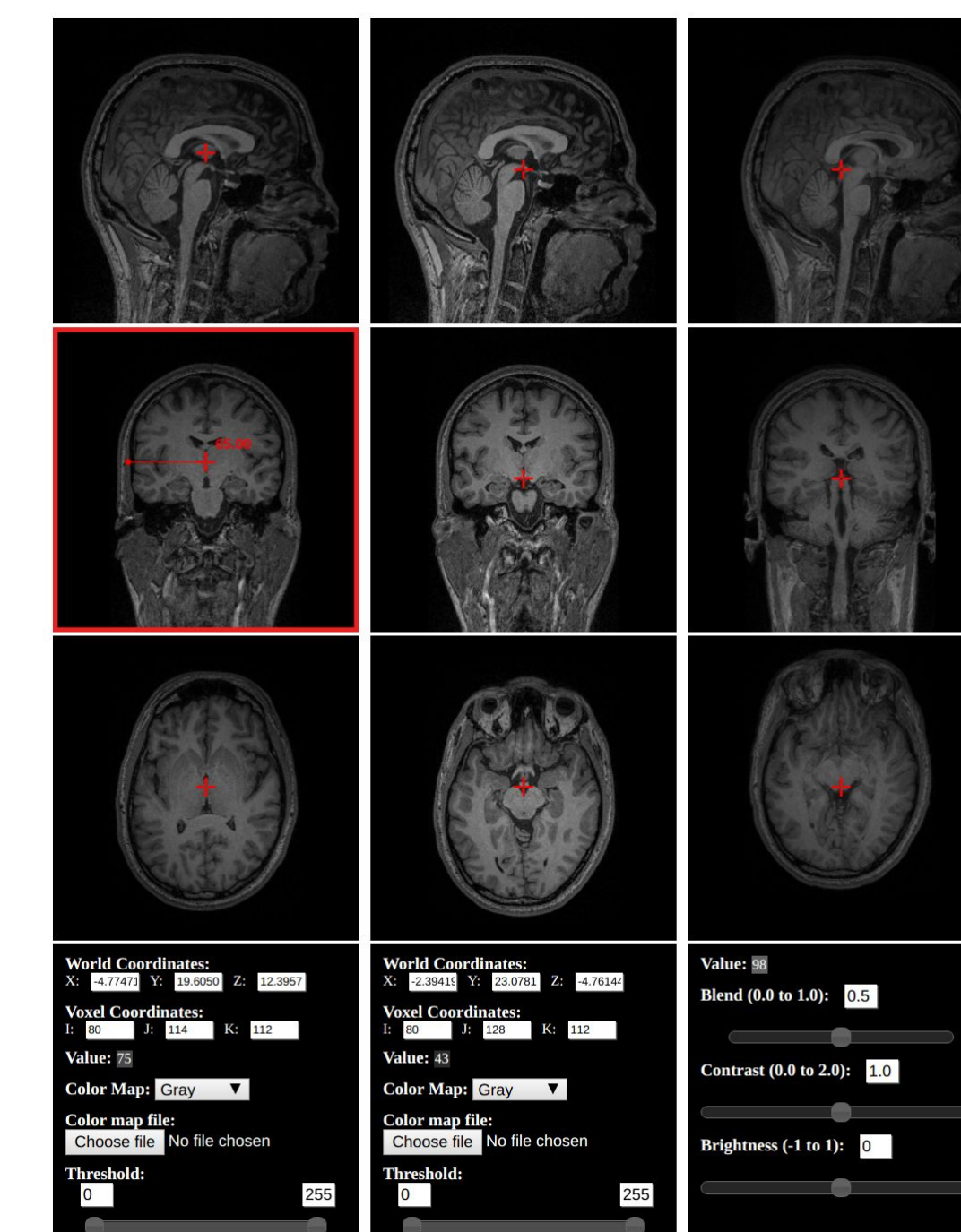

Figure 2: Volume Viewer

Additional work, oblique visualization

Additional recent progress in our lab regarding web visualization (by Jonathan Lurie) includes the capability to manipulate MINC or NIfTI volumes, performing oblique slicing in real time with client-side JavaScript.

This visualization tool uses WebGL and Three.js to display and manipulate the slices, and allows for the user to set and save arbitrary slicing. Furthermore, this tool is compatible with the BigBrain (Amunts 2013) at 200 microns (Fig. 3).
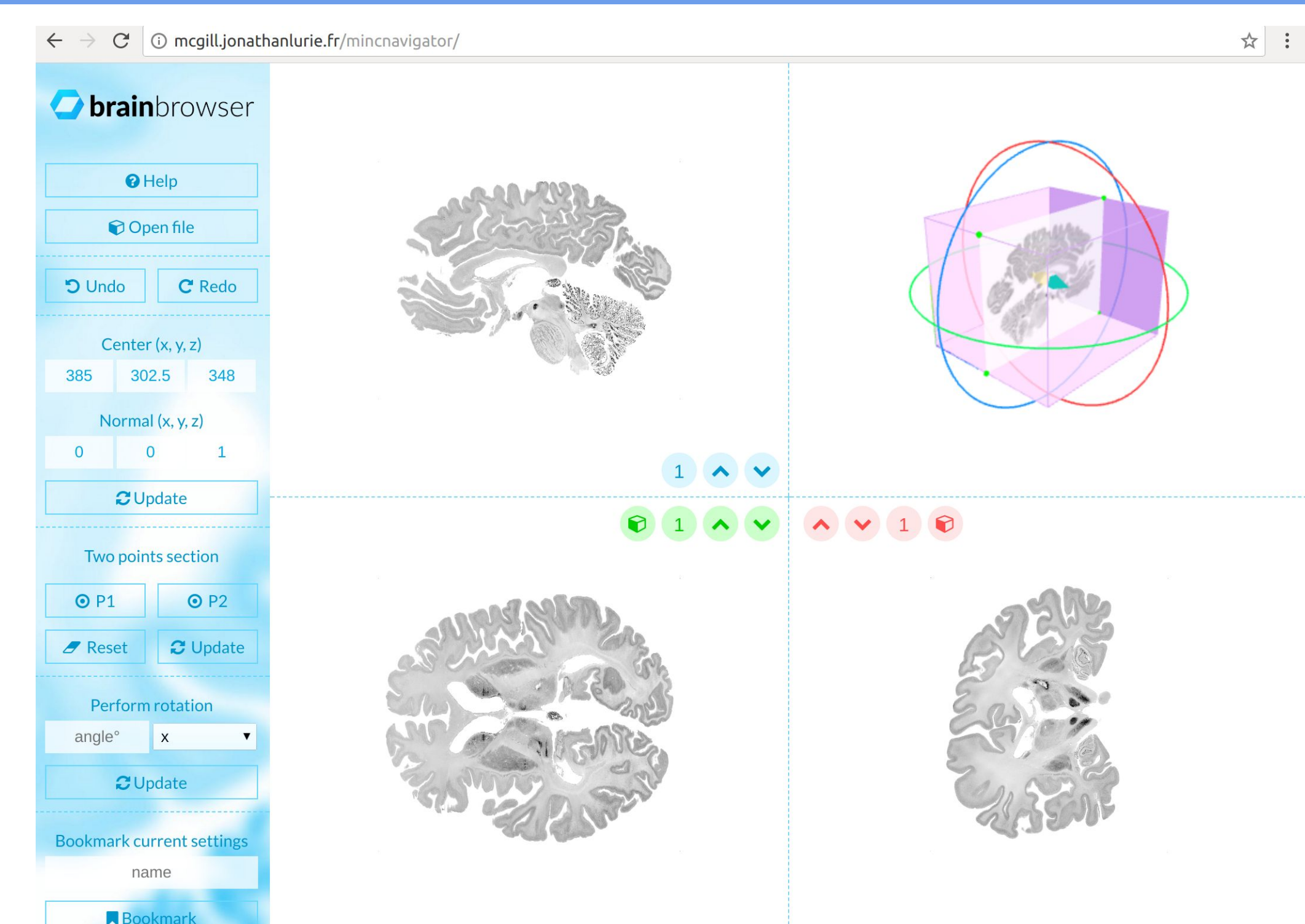

Figure 3: Oblique Viewer

Summary

BrainBrowser is a set of multiple tools that provides an accessible interface to share/visualize data just by using a modern web browser, without requiring installation of software or additional plugins. It allows users to explore different types of neuroimaging data such as 3D surface or 4D volume.

BrainBrowser is used to visualize data in CBRAIN (Sherif 2014b), a distributed, collaborative, web-based, grid computing platform, and LORIS (Das 2011), a multi-site web-based neuroimaging database system.

References

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