

NiiVue Visualization

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dcm2niix, MRlcro, MRlcron, MRlcroGL & Surfice creator

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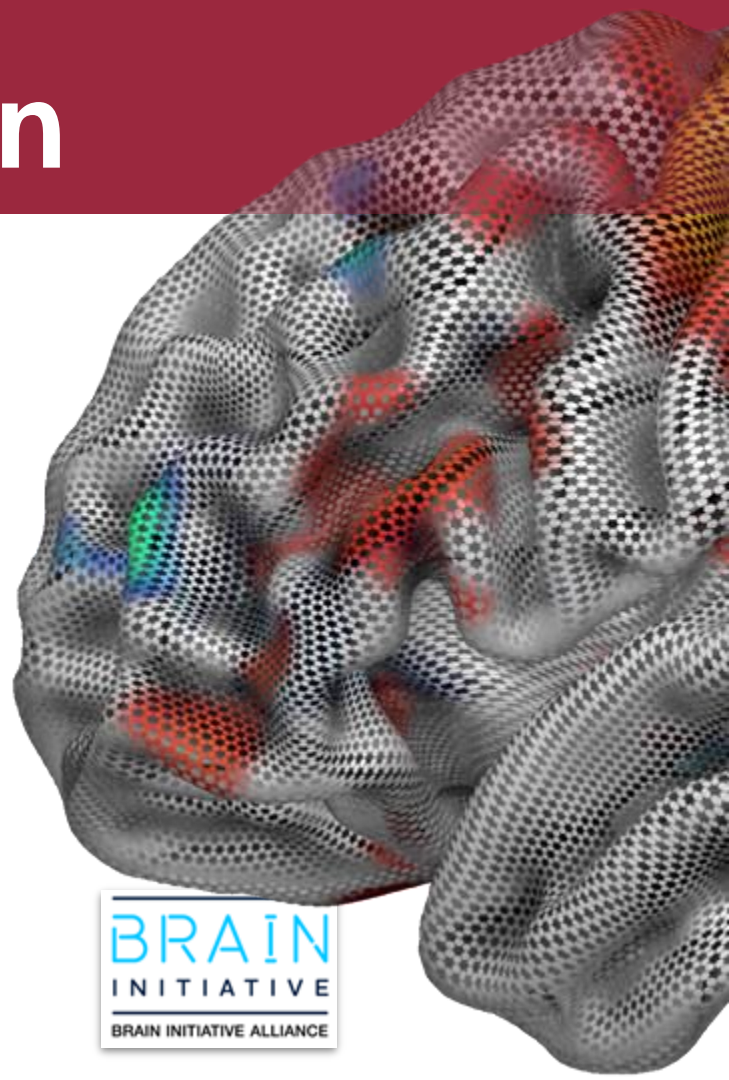
niiVue Lead developers

Franco Pestilli, Dan Levitas

ezBIDS & brainlife.io developers



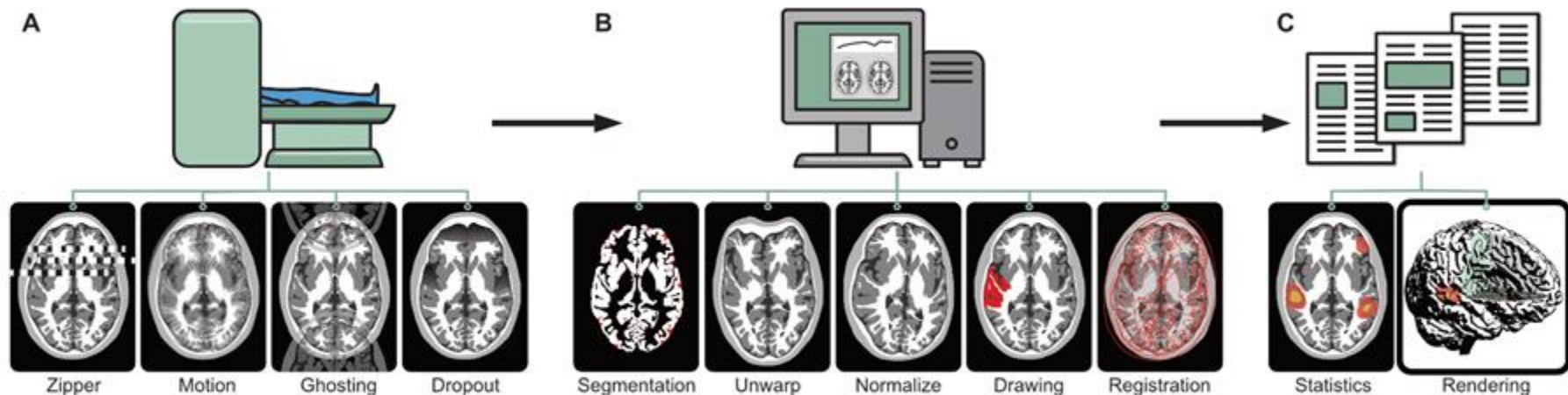
**University of South Carolina
Center for the Study of Aphasia Recovery
NIH RF1-MH133701, P50-DC014664**



Motivation

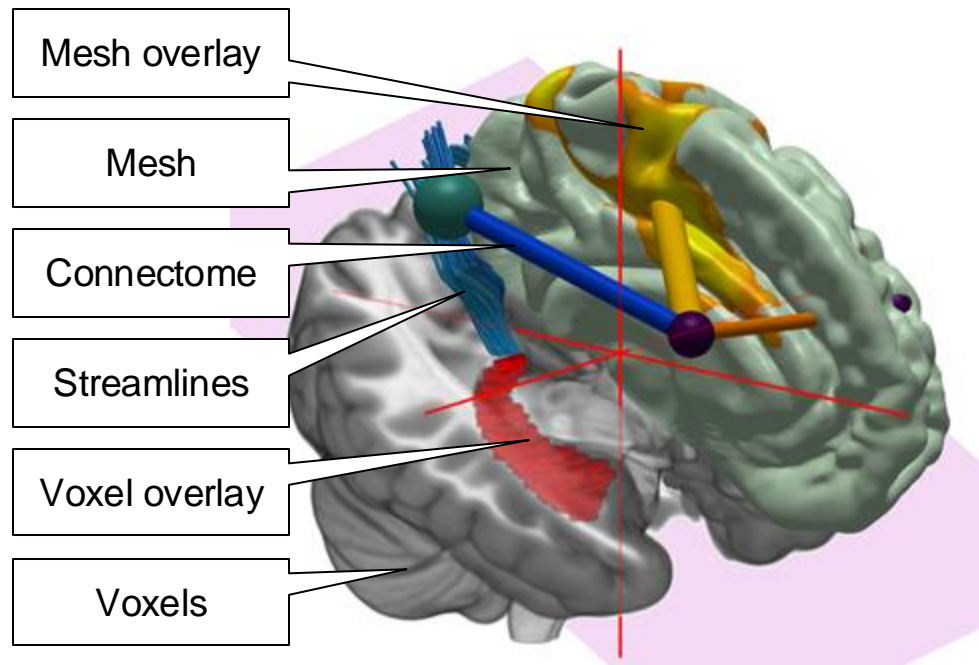
- Visualization crucial for all stages (acquisition, processing, inference and dissemination) of neuroimaging.
- Popular tools not **web-capable** and incompatible **with each other**.

MRI pipelines as self driving cars: generally robust but require human intervention to avoid catastrophic errors.



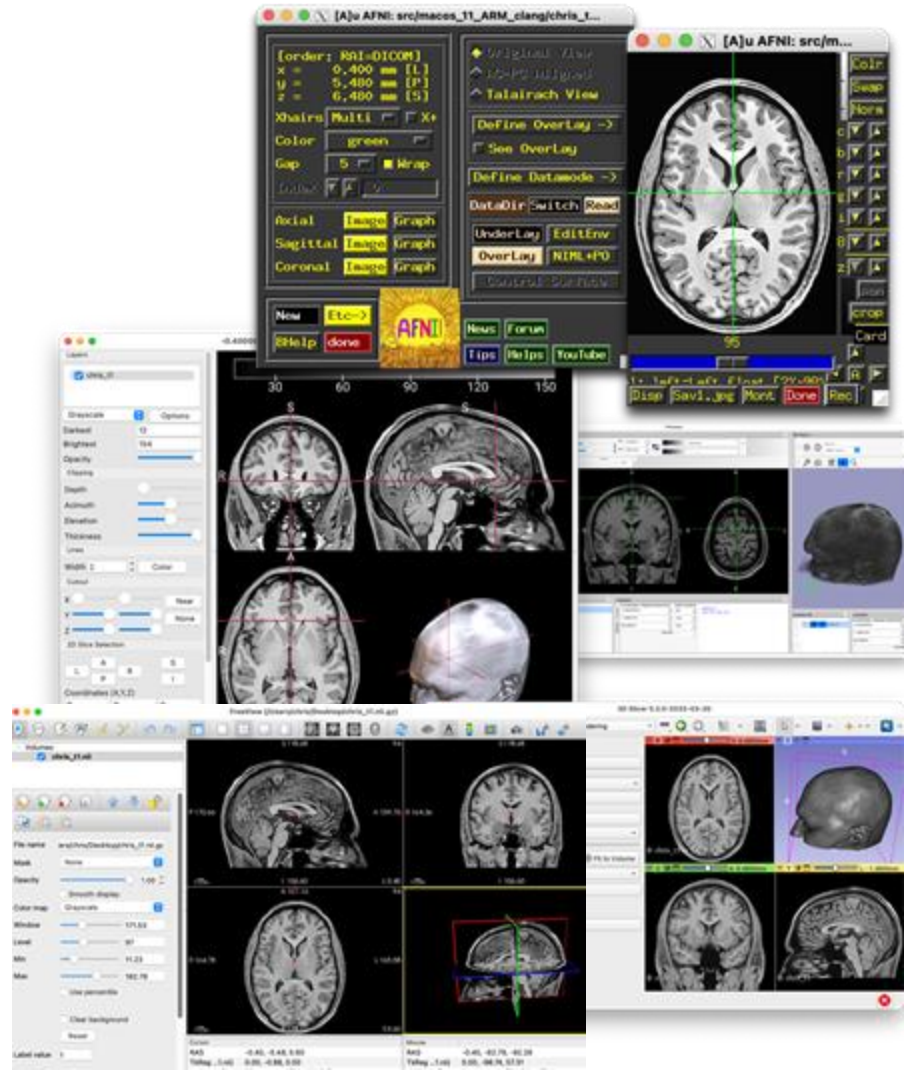
Need for Domain Specific Visualization

- Neuroimaging has (unique) formats.
- Voxels, meshes, gantry tilt, atlases, statistical maps, diffusion streamlines, connectomes.
- While most tools support some common formats (DICOM, NIfTI, GIFTI, TRX), **most tools use proprietary** formats.



Limitation of popular solutions

- Desktop-based:
 - Unsuitable for cloud or edge deployment.
- Complicated:
 - Overwhelming user interfaces.
- Inconsistent:
 - Different formats.
 - Skills don't transfer easily.
 - Redundant maintenance efforts.



Vision: web-based neuroimaging visualization

- Zero footprint neuroimaging can democratize science, scale on demand.
- Support any devices:
 - Computer: General purpose.
 - Tablet: Drawing lesions.
 - Phone: QA for cloud processing.



Community Driven Data Visualization

- Team leverages collective wisdom of traditionally isolated and competing teams.
- Modular can be embedded into HTML, react, angular, Vue, and native applications (Swift, Electron).
- Next slides are a selection of case studies.



Slice:Drop



QSMxT

quantco Q



SIENAimaging



OpenNEURO

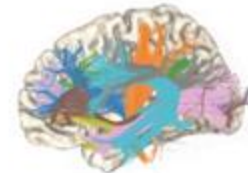
BOOSTLET.js



ProCancer-I



FreeSurfer



ni learn

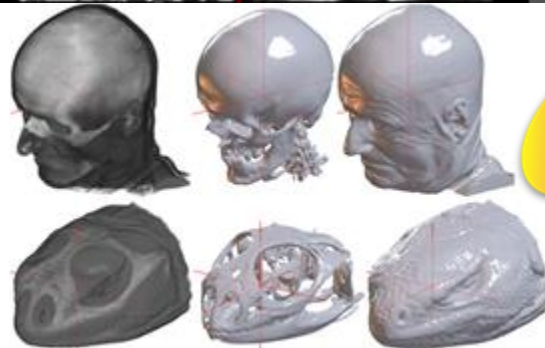


BrainLife

NiiVue in the wild 1 • brain2print.org

A tool to automatically segment MRI and send them to 3D printers

- brainchop models can segment the brain in seconds.
- our nii2mesh and niimath tools can be compiled to web assembly.
- Combine these for a drag-and-drop zero footprint solution to convert MRI scans to printable models in seconds.



PMID: 39301517

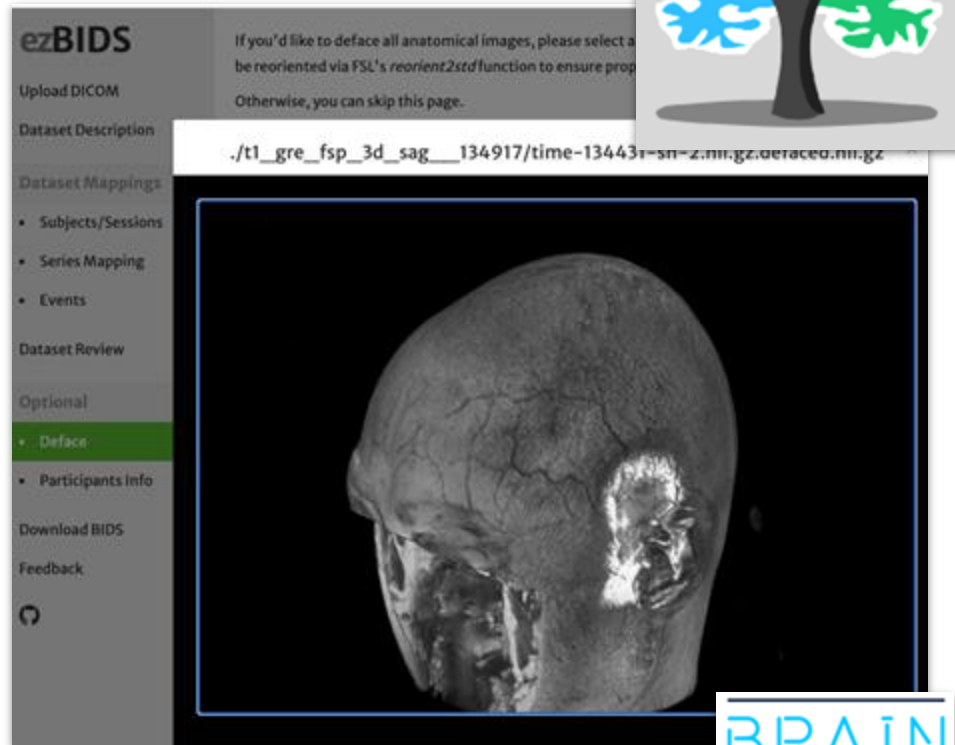


BRAIN
INITIATIVE
BRAIN INITIATIVE ALLIANCE

NiiVue in the wild 2 • brainlife ezBIDS

A tool to guide users to standardize brain data

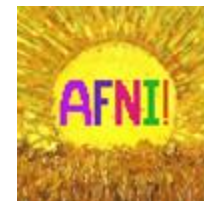
- Aid creation of BIDS datasets.
- Integrates our dcm2niix.
- Easy import to cloud processing (soon on edge).
- NiiVue volume rendering provides QA for defacing.



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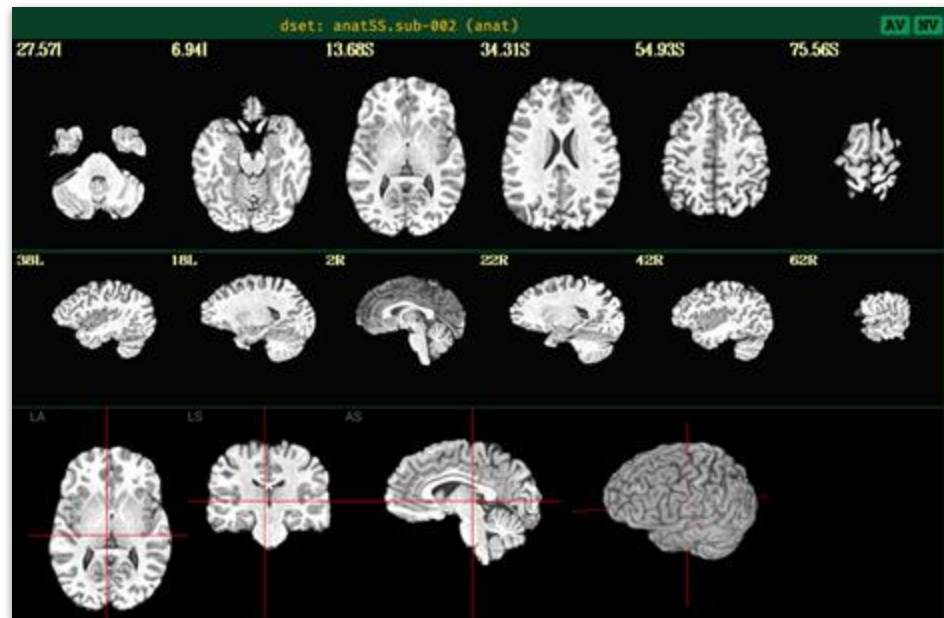
NiiVue in the wild 3 • AFNI QC

Quality Control and Annotation



- Quality control (QC) integrated with AFNI framework.
- Live demo

<https://afni.github.io/qc-demo-repo/>



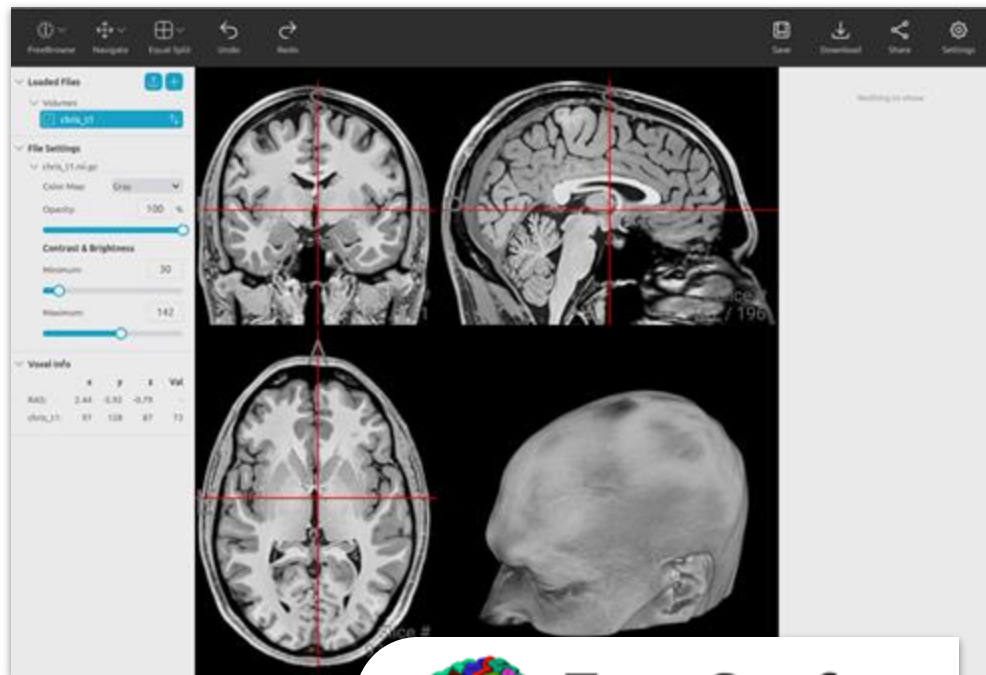
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NiiVue in the wild 4 • FreeSurfer FreeBrowse

View and edit FreeSurfer meshes and images

- Browser-based version of FreeSurfer's Freeview.
- Cloud capable, allowing integration with large and distributed backends.

<https://github.com/freesurfer/freebrowse>



FreeSurfer

NiiVue in the wild 5 • FSL docs, FSL-UI

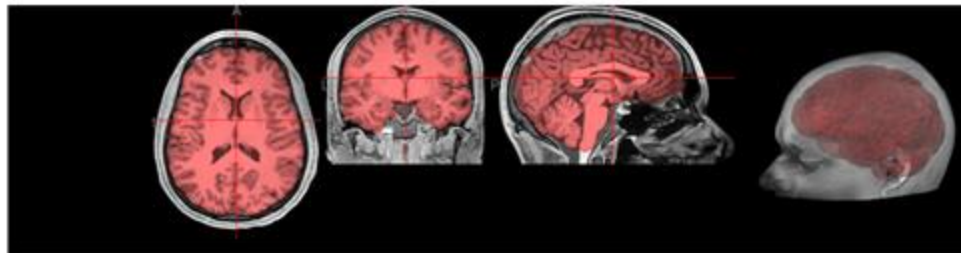
Interactive Documentation

- Interactive documentation.
- fslmaths, flirt, bet to WASM
- Replace proven but aging FSL TCL FEAT interface with interactive, high-DPI and web capable user interface.
 - Replaces bash scripting with modern Python scripts.



BET - Brain Extraction Tool Research overview

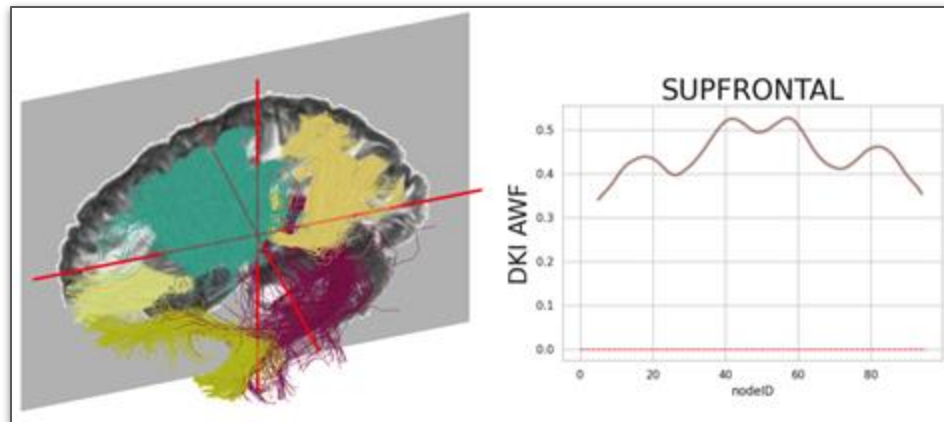
BET (Brain Extraction Tool) deletes non-brain tissue whole head. It can also estimate the inner and outer scalp surface, if you have good quality T1 and



NiiVue in the wild 6 • nrdg tractoscope

A tool to explore preprocess white matter data

- browser-based visualization tool for qsiprep and pyAFQ datasets.
- Easy access to processed Healthy Brain Network and Human Connectome Project datasets.
- Live deployment:
<https://nrdg.github.io/tractoscope/>



PMID: 38933816

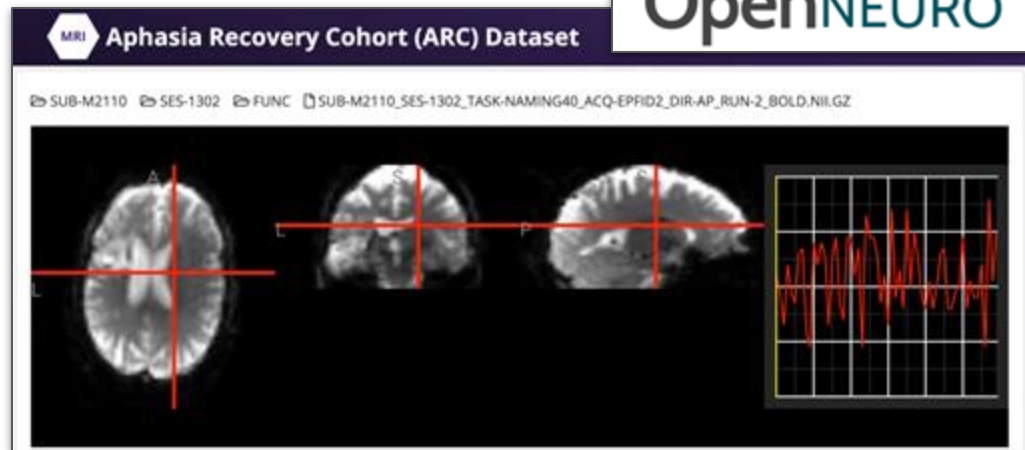
NiiVue in the wild 7 • OpenNeuro Viewer

A tool to visualize individual data files on OpenNeuro.org

- Integrated NiiVue allows users to interactively inspect each dataset.

- Live deployment

<https://openneuro.org/>

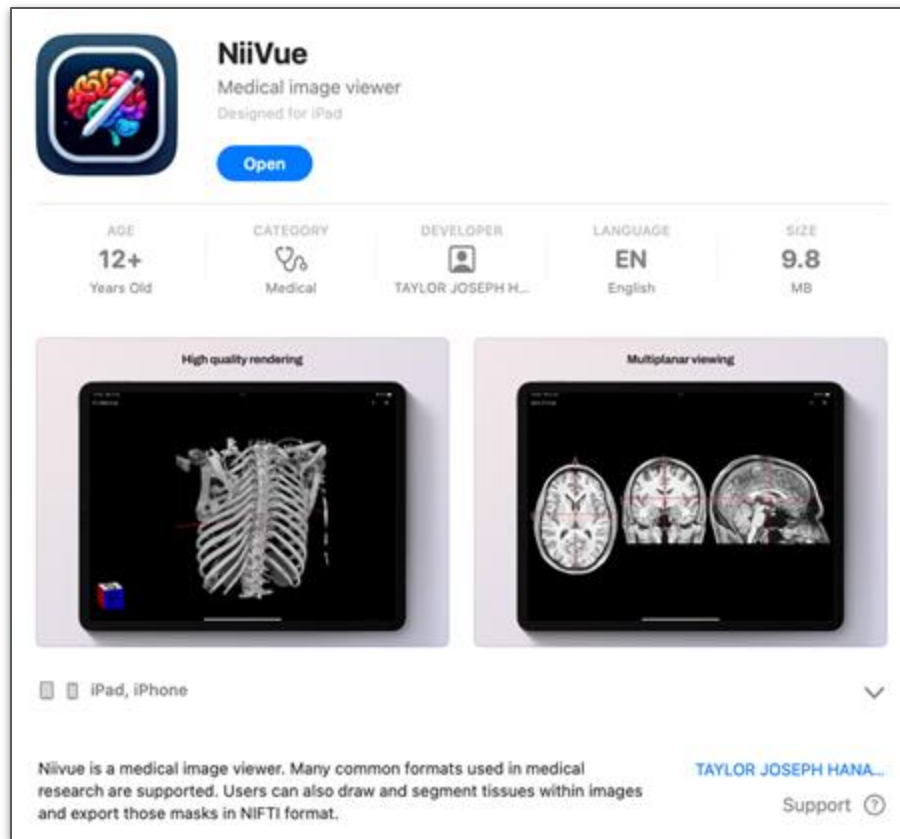


doi.org/10.1162/imag_a_00103

NiiVue in the wild 8 • iOS and MacOS app store

A desktop tool for viewing and editing neuroimaging data

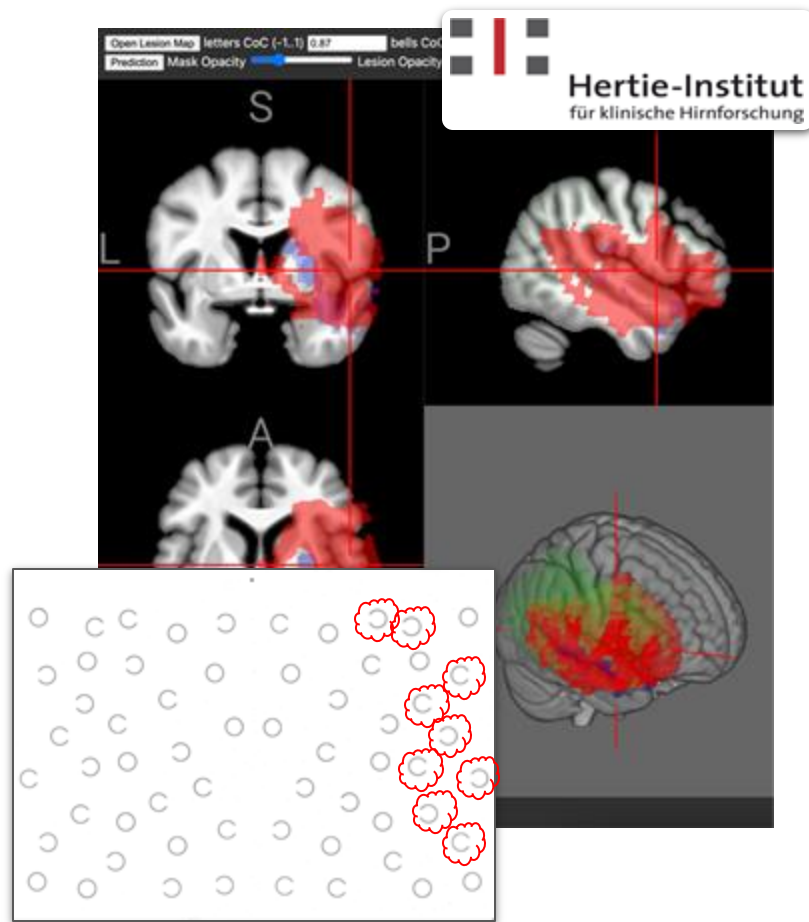
- Offline NiiVue with native user interface controls.
- Swift wrapper for webkit.



NiiVue in the wild 9 • Computer Aided Prognosis

A weblet to predict neglect recovery

- Stroke leading cause of disability.
- ~50% of right hemisphere strokes results in spatial neglect.
- While many recover, others left with long term disability.
- Stroke location and acute impairment can be used synergistically to predict outcome.
- Edge based solution allows clinical prediction without sharing data.



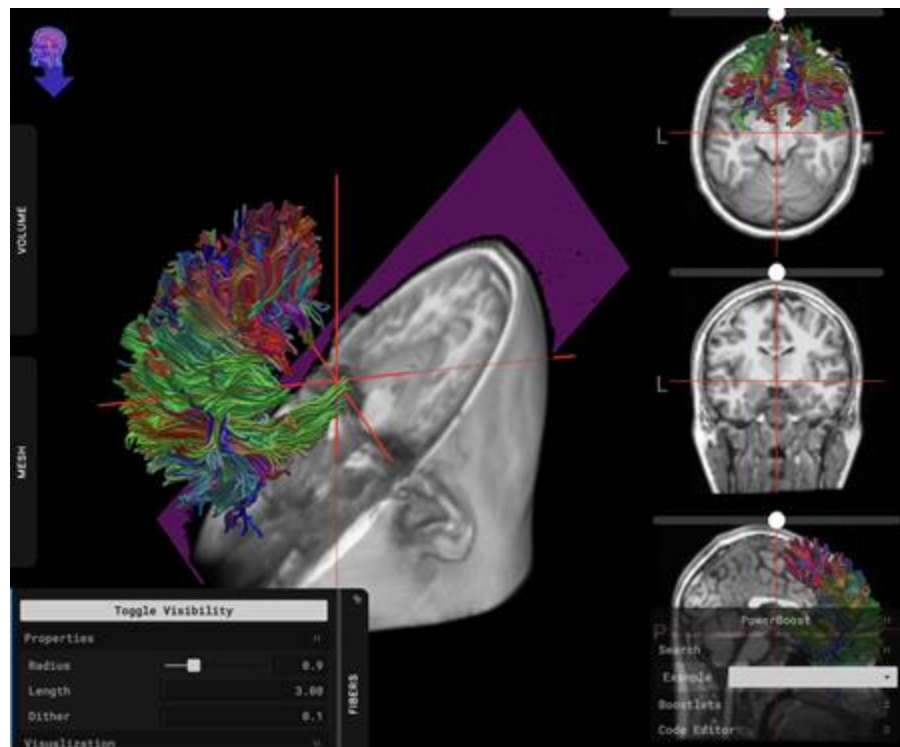
NiiVue in the wild 10 • Slice:Drop

Intuitive Medical Image Viewer



Slice:Drop

- 2013's 'Slice:Drop' and its XTK library were seminal WebGL1 medical imaging tools.
- NiiVue-based 'Slice:Drop reloaded' unleashes WebGL2 capabilities with same intuitive interface.



NiiVue in the wild 11 • ipyniivue

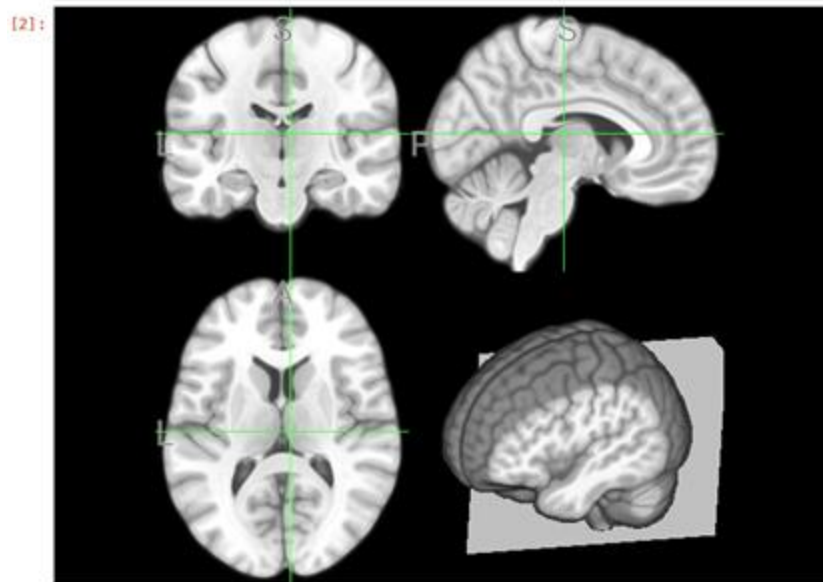
Neuroimaging visualization for jupyter notebooks

- Python notebooks empower scientists.
- Jupyter graphics must use web technologies.
- Vision: pythonic interface for NiiVue.
- [Work In Progress](#). Actively seeking developers.

Introduction

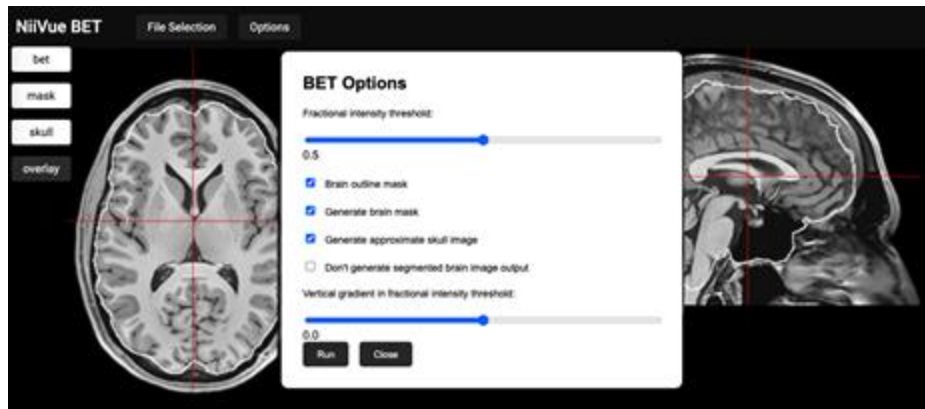
```
[1]: %pip install ipyniivue
import ipyniivue

[2]: nv = ipyniivue.NiiVue(crosshair_color=[0,1,0,1])
nv.add_volume('https://niivue.github.io/niivue/images/mni152.nii.gz')
nv
```



Feature **plugins**: proven modules to extend capabilities

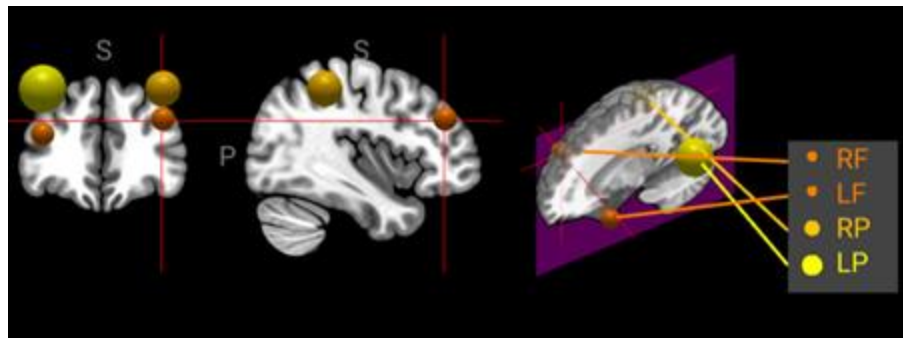
- WebAssembly for access to proven tools: bet, dcm2niix, fslmaths, flirt.
- Supports itk-wasm packages for image processing including elastix and ants.
- TensorflowJS, tinygrad and ONNX provide zero footprint AI model deployment regardless of users hardware or software.
 - AI for segmentation, parcelation, brain extraction, lesion identification and prognosis.



NiiVue can provide a visualization wrapper for proven and emerging tools.

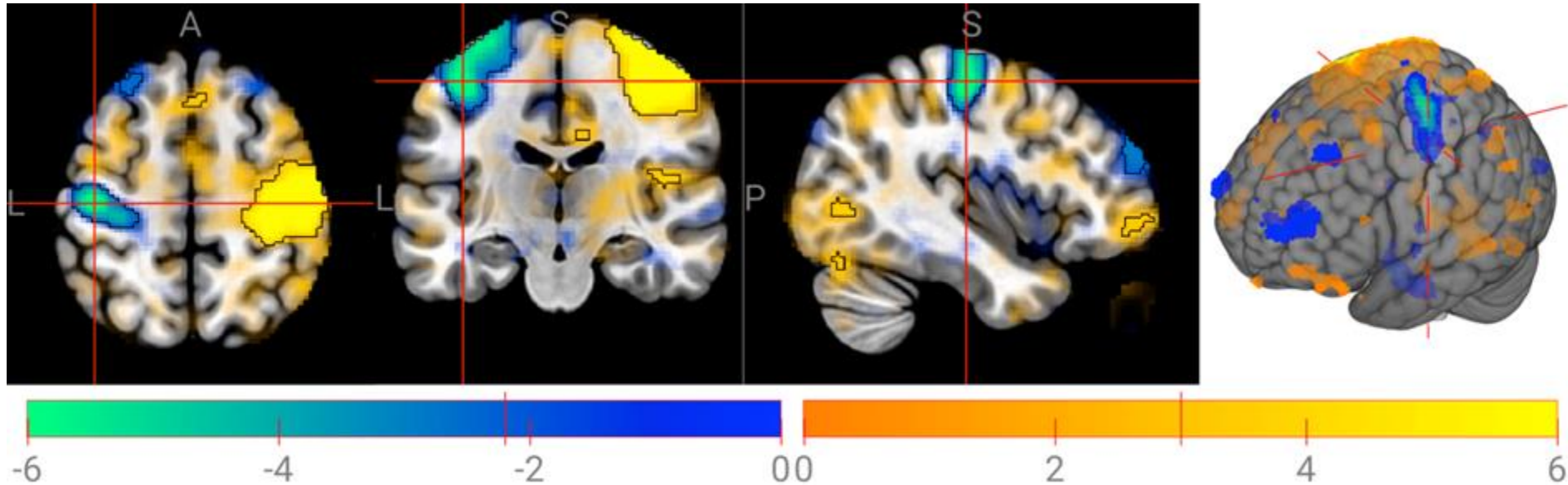
Feature documents: sharing scenes

- NiiVue can save entire scene (voxels, meshes, contrast, landmarks, drawings) as a document or self-loading interactive web page.
- Instead of sharing files, one have share the entire scene:
 - Correct AI failures.
 - Annotate images.
 - Homework tutorials.
 - Ask expert to describe anomaly.



Feature **statistics**: highlight results, don't hide them

- Accurate clinical familywise error correction with FDR and permutation will typically result in asymmetric thresholds.
- Alpha-blending to show trends.

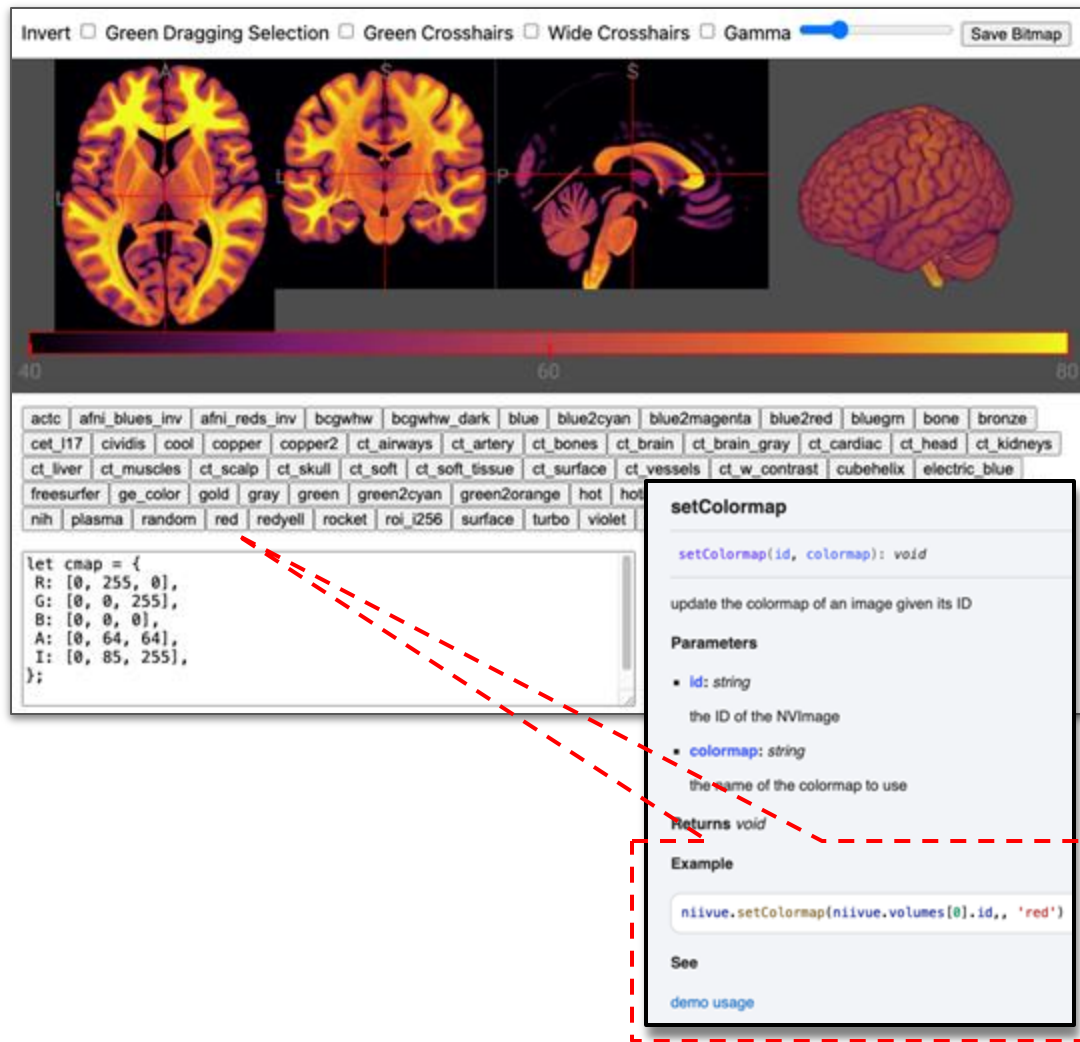


Why join the effort?

Developer Benefits:

- JavaScript is a scripting language, so you can interactively write code.
- Documentation links to minimal live demos.

<https://niivue.github.io/niivue/devdocs/>



The screenshot displays the niivue application interface. At the top, there are checkboxes for 'Invert', 'Green Dragging Selection', 'Green Crosshairs', 'Wide Crosshairs', and 'Gamma', along with a 'Save Bitmap' button. Below these are four brain MRI slices: two axial views and two sagittal views. A color bar at the bottom indicates a scale from 40 to 80. A grid of colormap names is visible, including 'actc', 'afni_blues_inv', 'afni_reds_inv', 'bcbwhw', 'bcbwhw_dark', 'blue', 'blue2cyan', 'blue2magenta', 'blue2red', 'bluegrn', 'bone', 'bronze', 'cet_117', 'cividis', 'cool', 'copper', 'copper2', 'ct_airways', 'ct_artery', 'ct_bones', 'ct_brain', 'ct_brain_gray', 'ct_cardiac', 'ct_head', 'ct_kidneys', 'ct_liver', 'ct_muscles', 'ct_scalp', 'ct_skull', 'ct_soft', 'ct_soft_tissue', 'ct_surface', 'ct_vessels', 'ct_w_contrast', 'cubeelix', 'electric_blue', 'freesurfer', 'ge_color', 'gold', 'gray', 'green', 'green2cyan', 'green2orange', 'hot', 'hot2', 'niih', 'plasma', 'random', 'red', 'redyell', 'rocket', 'roi_i256', 'surface', 'turbo', and 'violet'. A code editor shows a JavaScript snippet for defining a colormap. A red dashed line points from the 'red' colormap in the grid to the 'red' string in the code editor. A red dashed box highlights the 'setColormap' function documentation, which includes parameters 'id' and 'colormap', and an example usage.

setColormap(id, colormap): void

update the colormap of an image given its ID

Parameters

- **id**: string
the ID of the NVImage
- **colormap**: string
the name of the colormap to use

Returns void

Example

```
niivue.setColormap(niivue.volumes[0].id, 'red')
```

See
[demo usage](#)

niivue.github.io/niivue/

- 



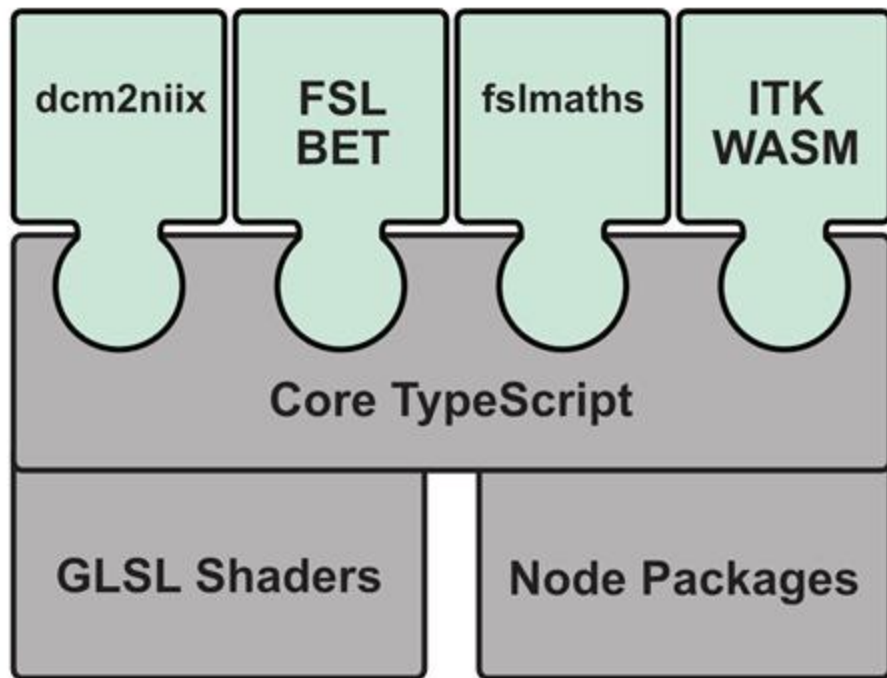
Collaborate 2: Communicate

- Create a new issue for bug reports, feature requests, and advice.

The screenshot displays the GitHub repository page for `niivue / niivue`. The 'Issues' tab is selected, showing 23 issues. A callout box highlights a specific issue titled "custom layouts / 3D Slicer-inspired layout #1082". The issue is marked as "Closed" and was opened by user `haehn` on Oct 19. The comment from `haehn` states: "Hi Devs! We are re-writing Slicedrop.com and want to use Niivue as the rendering engine." Below the text is a screenshot of the Slicedrop application, which shows a 3D medical image viewer with a central 3D view and two smaller 2D axial and sagittal views. The interface includes a search bar, a 'Go to file' dropdown, and a 'Add file' button. The repository page also shows a merge pull request by `hanayik` and a commit by `f73ee68` 4 days ago.

Collaborate 3: Embed

- Insert NiiVue into your own project.
- NiiVue has minimal dependencies.
- NiiVue can be extended with plugins.
- Minimal demos provided
 - React, Angular, Vue frameworks.
 - ONNX and TensorflowJS AI models.
 - bet, flirt, dcm2niix, nii2mesh, itk-wasm web-assembly plug ins.
 - Extend supported formats, TRAKO, CBOR file loading plugins.

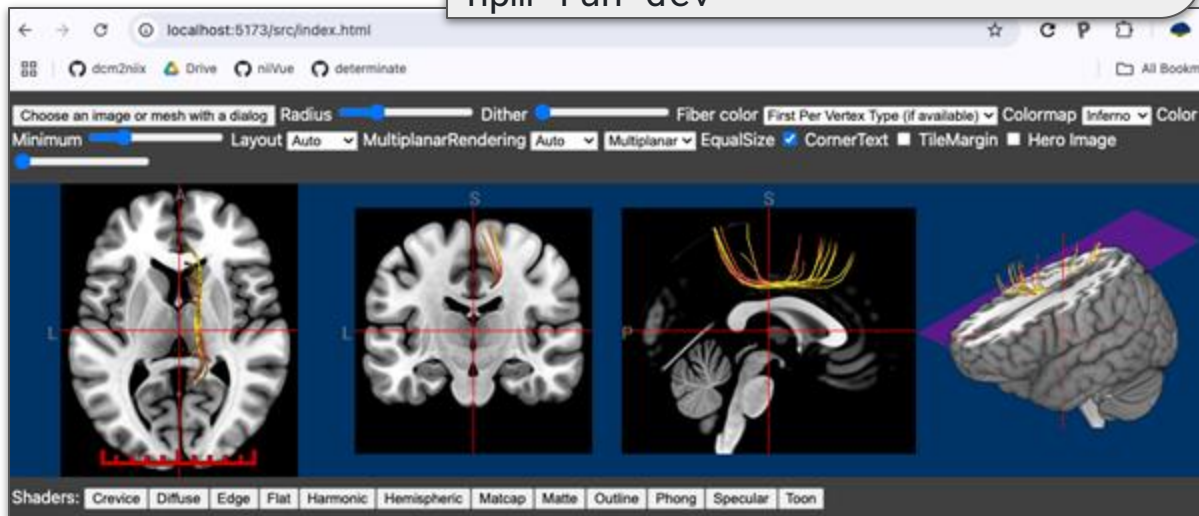


Collaborate 4: Develop

Hot reloadable development

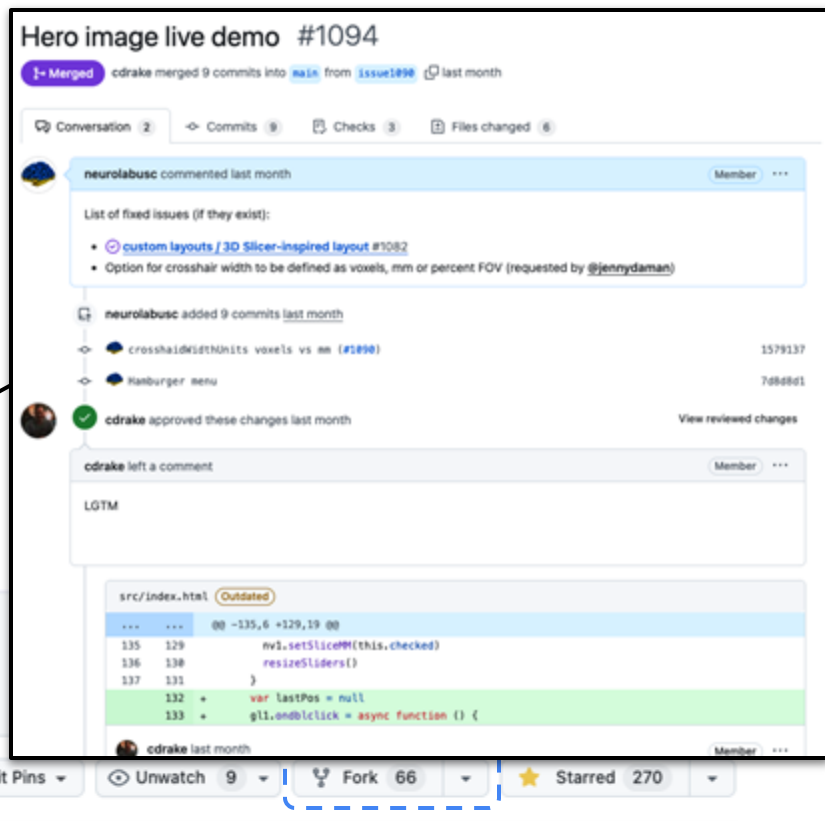
- Make sure git and node.js/npm installed.
- Download, install and run NiiVue locally.
- Saved edits instantly reflected in browser.

```
git clone  
git@github.com:niivue/niivue.git  
cd niivue  
npm install  
npm run dev
```



Collaborate 5: Contribute

- [Fork](#) the project to create your own branch.
- You can share improvements to the main branch with a pull request.



Roadmap • Annual Themes • Questions

