

Generation of 3D models with Vaa3D

Peng Xie

The broad application of 3D models

3D printed heart



Entertainment



Food



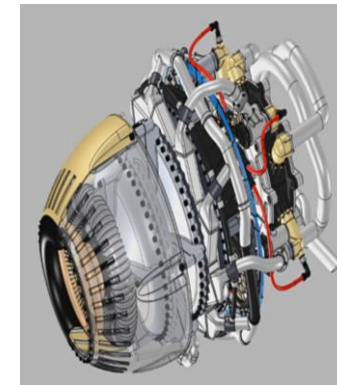
Health



Art



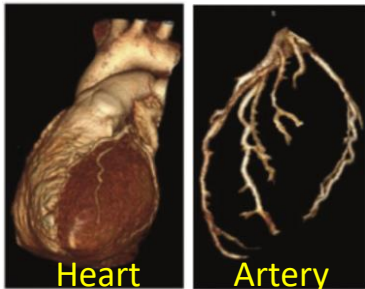
Industry



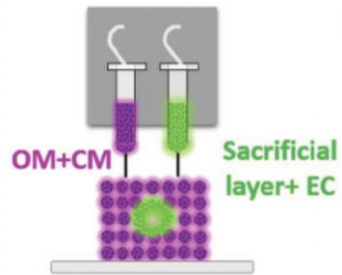
History



3D Models



3D printing

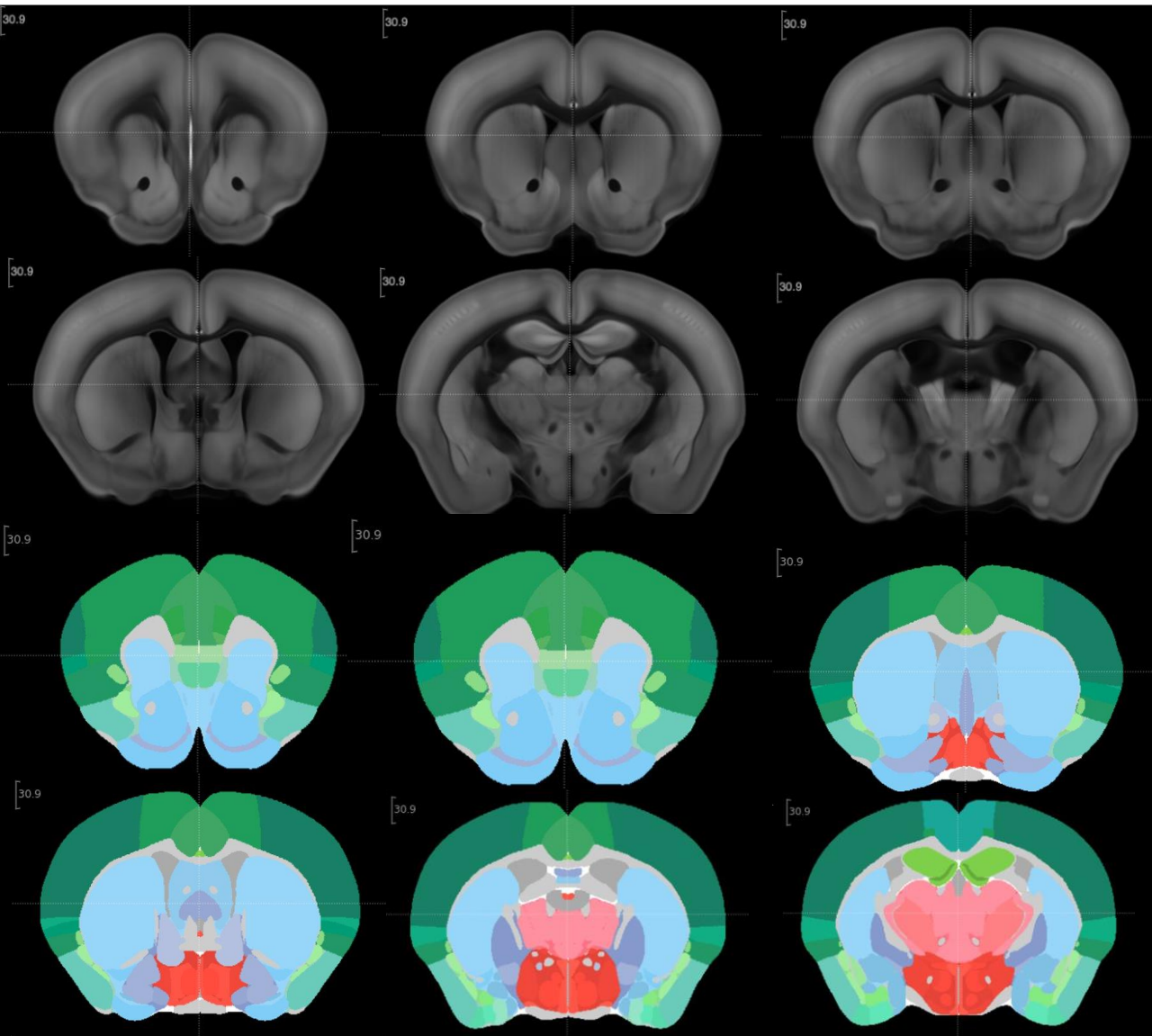


A structured patch



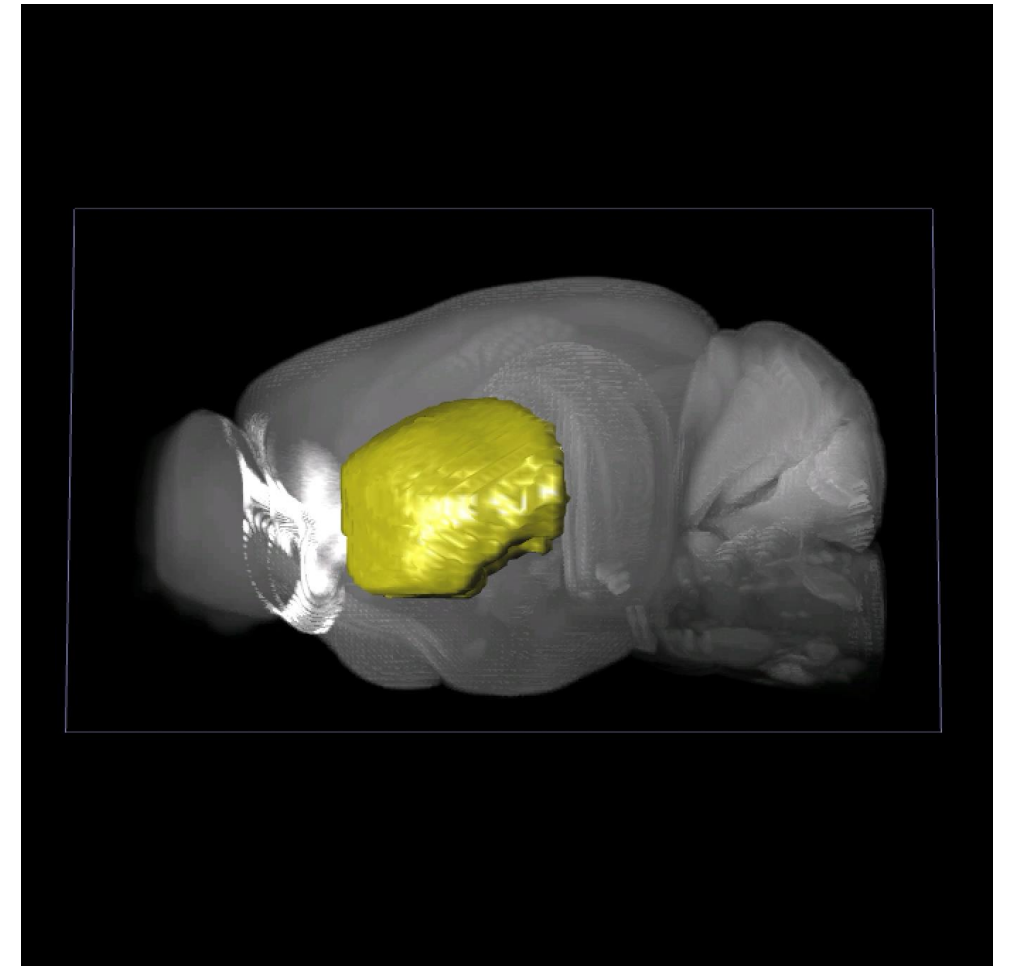
(Haghiasthani et al., 2019)

2D visualization & models



Along the axis of CP (caudate putamen) , step size: 500 μm

A 3D model of CP

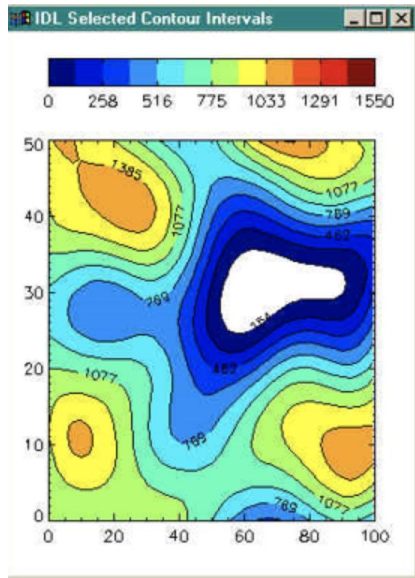


Yellow surface object :CP

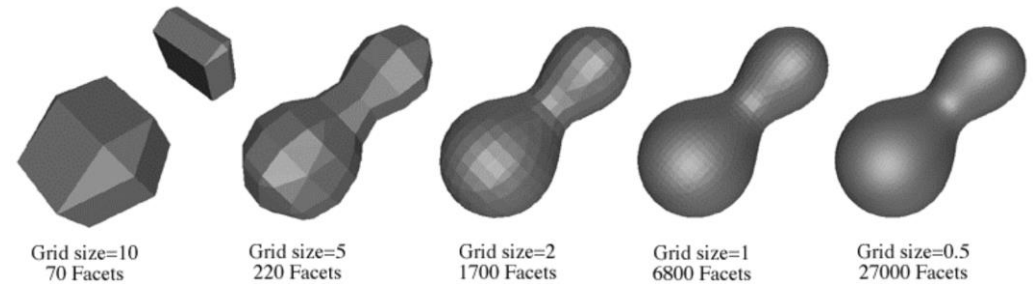
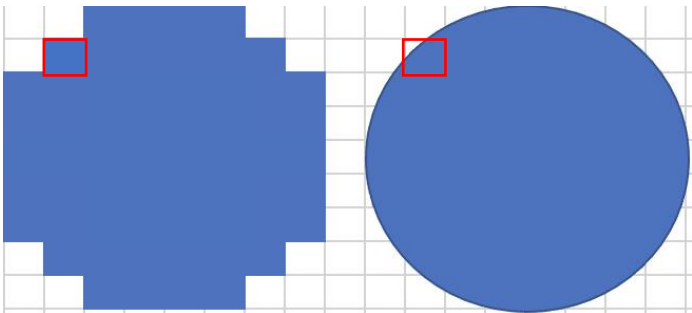
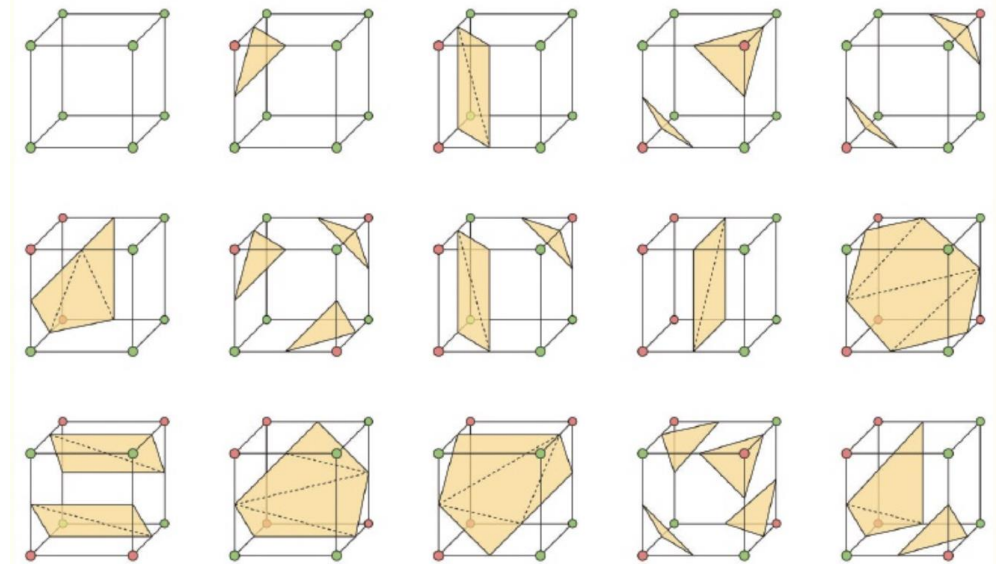
Brain image: CCF average template

Concepts behind a surface mesh

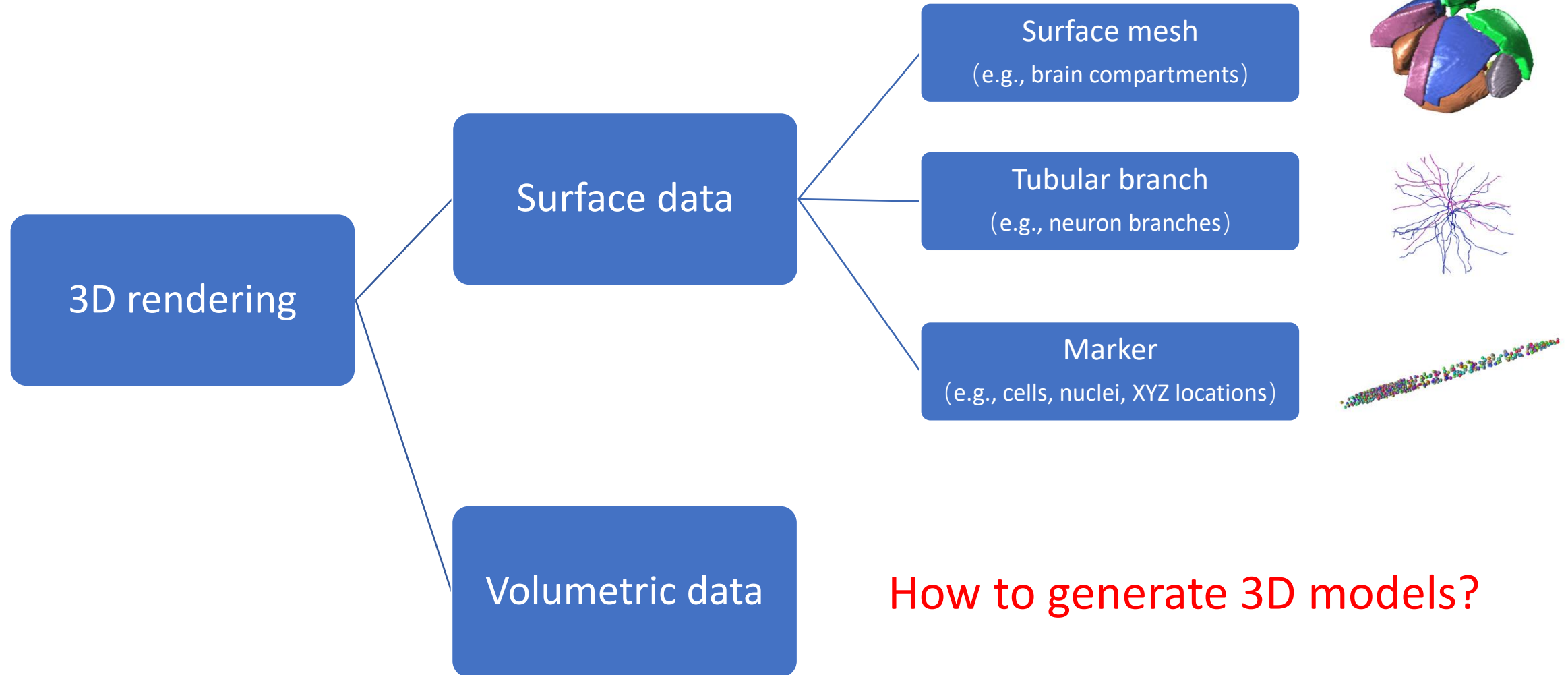
Isoline and isosurface



The marching cubes algorithm



The Vaa3D rendering system

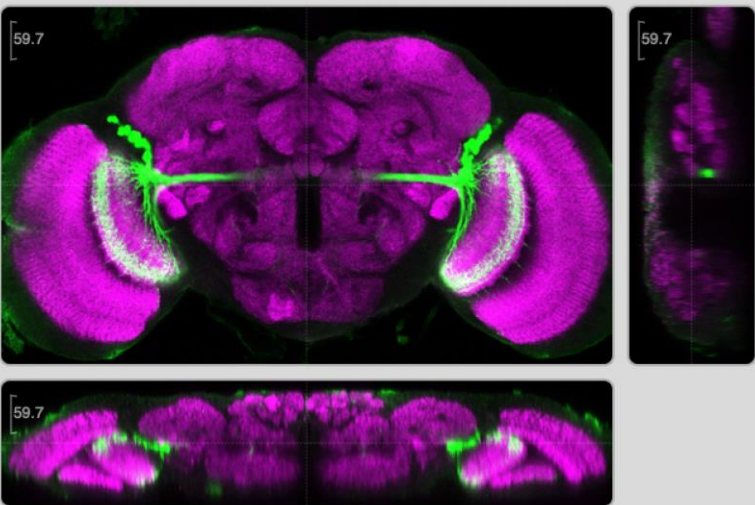


Generating surface object from annotation

Image data

Annotation data

Image data
Views [XY: upper-left] [ZY: upper-right] [XZ: lower-left]



Information of your selections

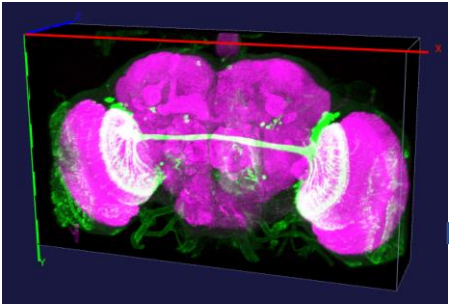
Voxel type: UINT8; Tri-view zoom: 0.502453
Focus: (509, 300, 108) RGB = (14, 6, 14)
Channel min/max: C1 [min=0, max=255]; C2 [min=0, max=255]; C3 [min=0, max=255];
Defined marker location:

Image data
Views [XY: upper-left] [ZY: upper-right] [XZ: lower-left]

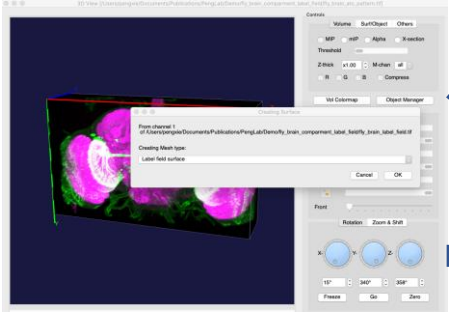


Information of your selections

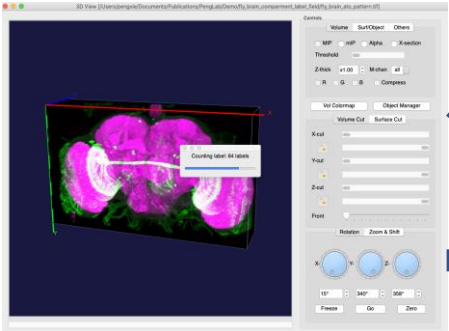
Voxel type: UINT8; Tri-view zoom: 0.502453
Focus: (509, 300, 108) RGB = (0, 0, 0)
Channel min/max: C1 [min=0, max=64];
Defined marker location:



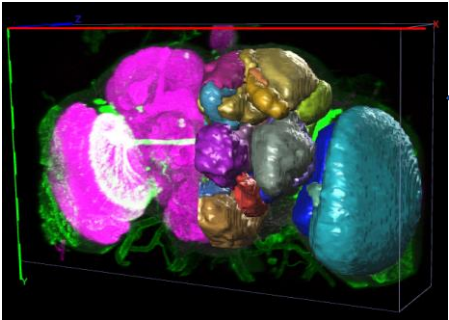
Drag and drop 'annotation'



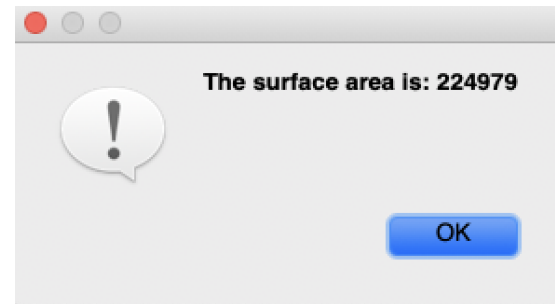
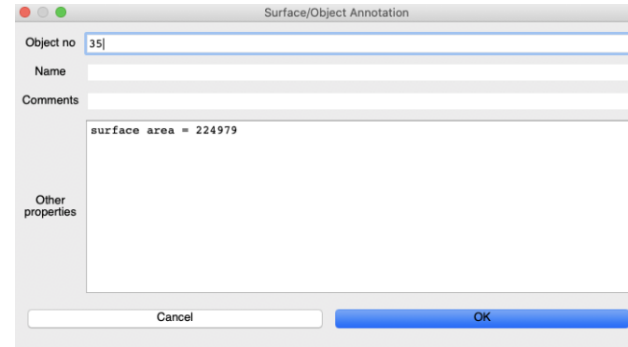
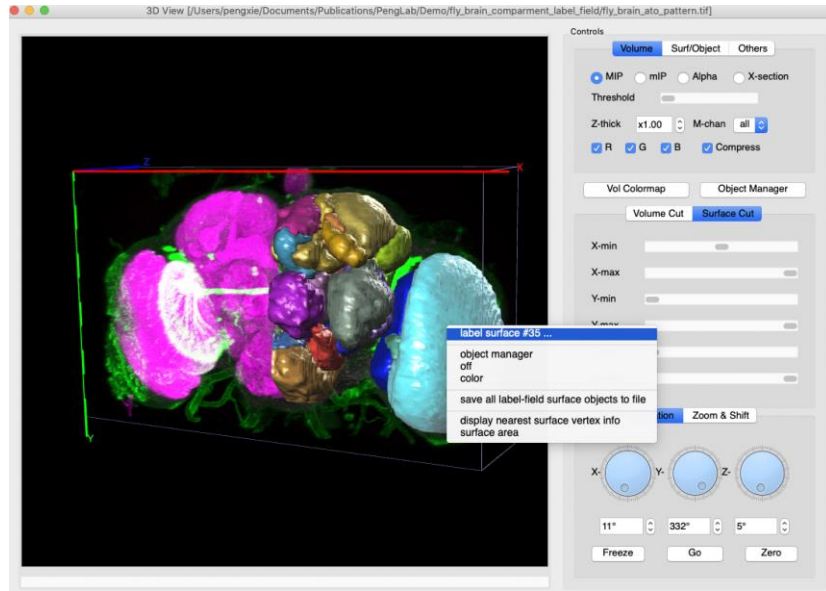
Select 'Label field surface' and parameters



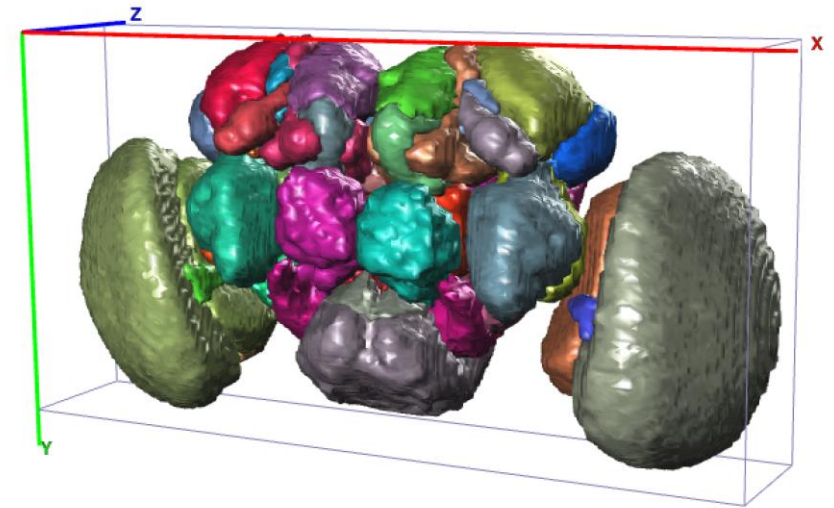
Results are surface meshes



Surface information and file format

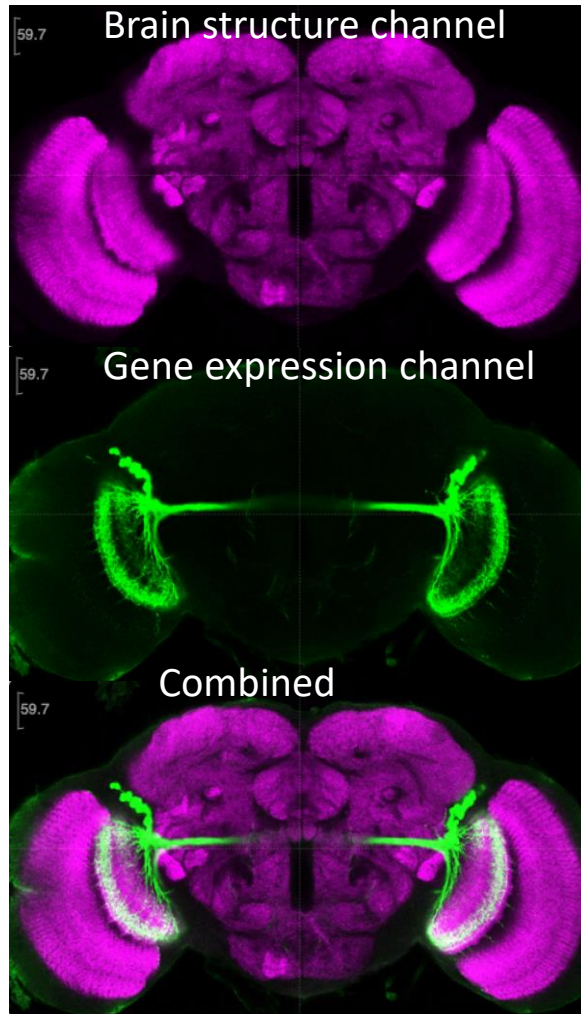


Saved .vaa3ds data

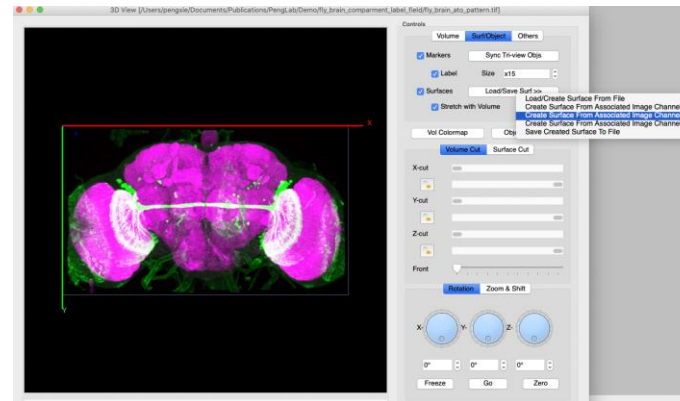


Generating surface object from image

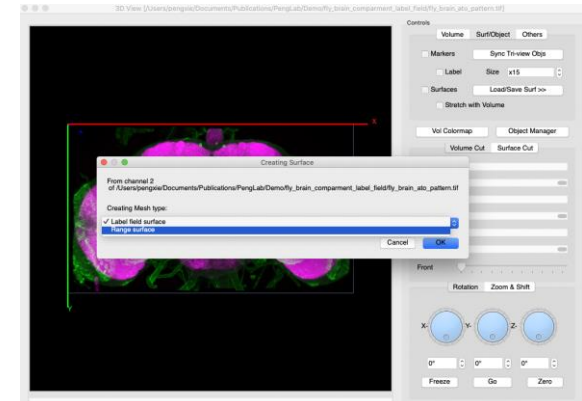
‘Gene expression’ to ‘3D neuron population model’



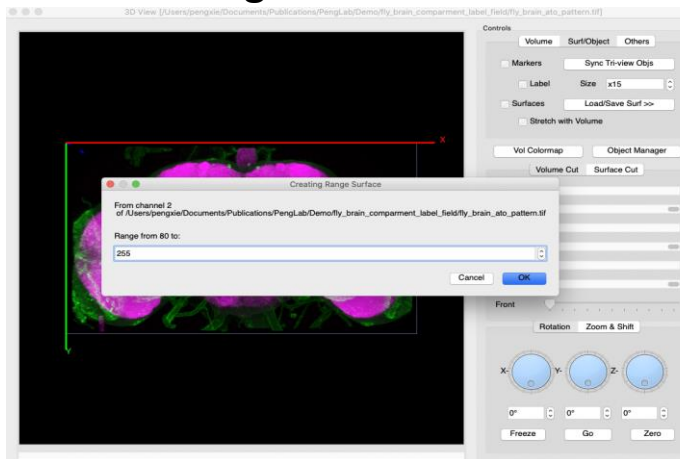
1. Select color channel



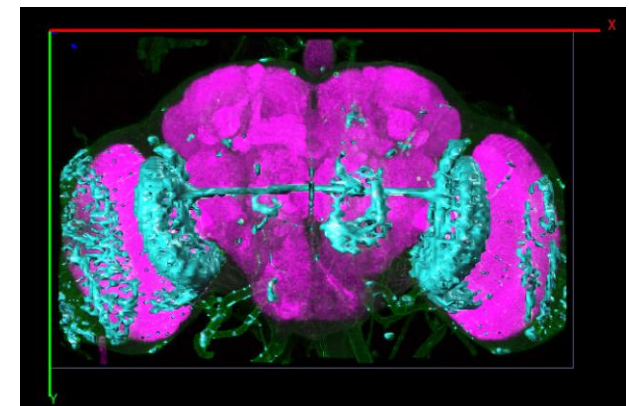
2. Select ‘range surface’ algorithm



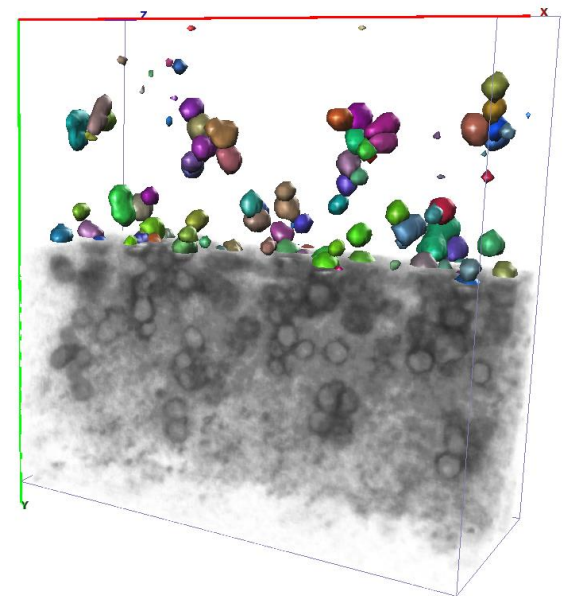
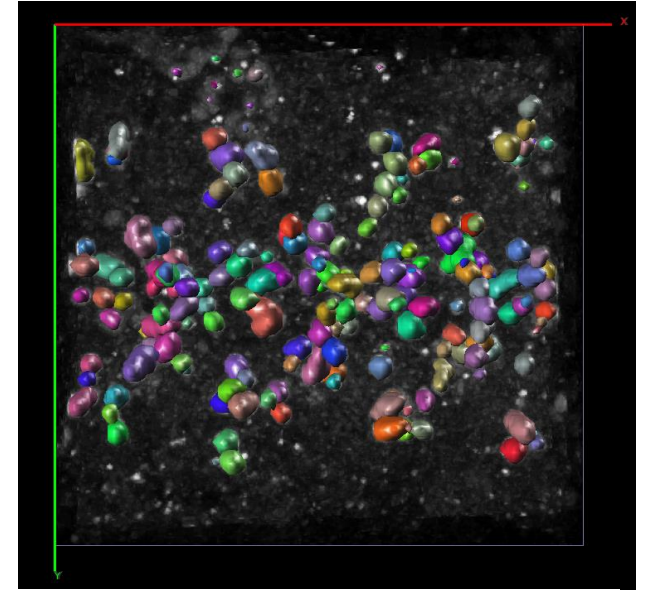
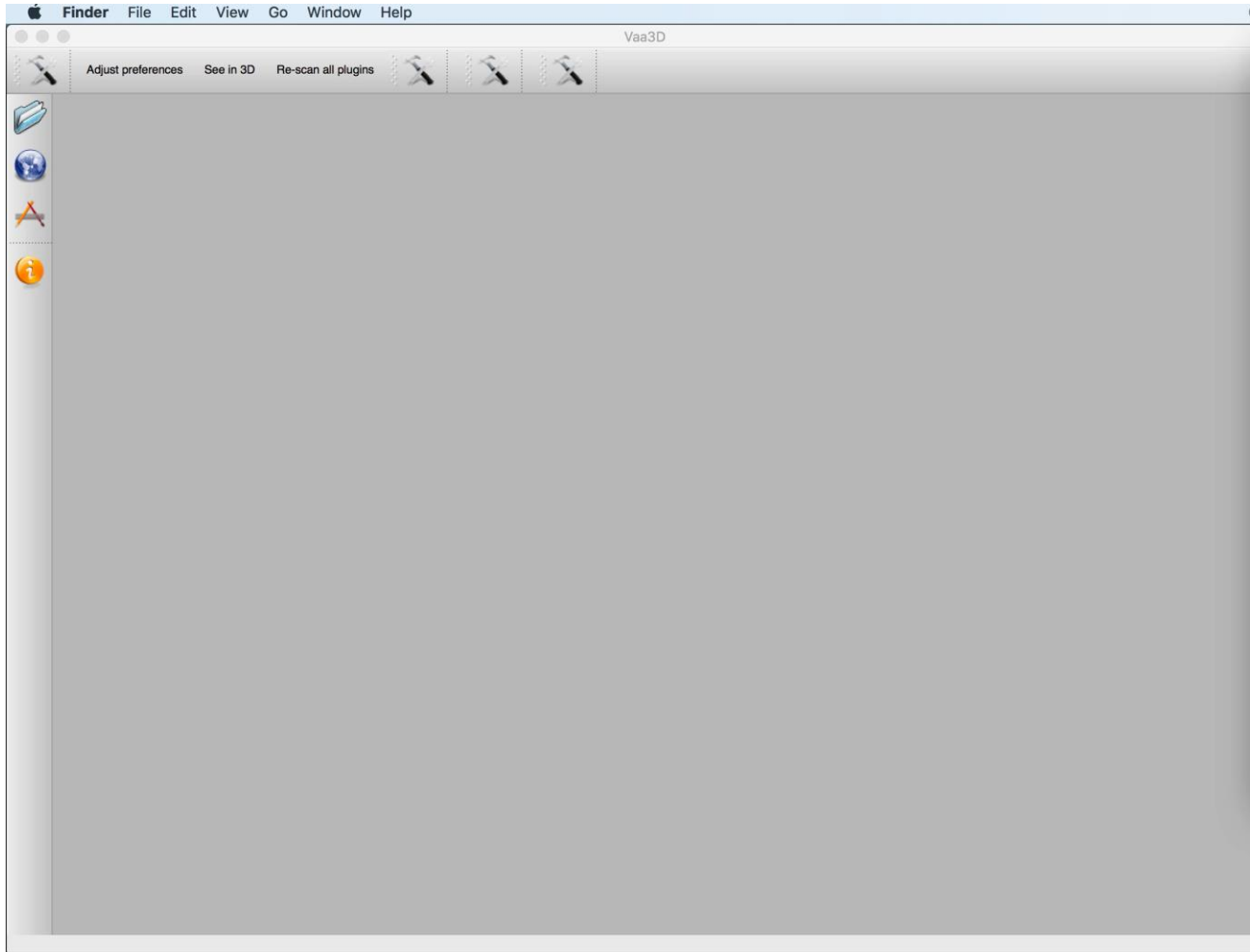
3. Set a range



4. Generated 3D model



Cell profiling by image segmentation and mesh generation



The Vaa3D rendering system: integrated visualization



Video courtesy of Lulu Yin

Display modes of surface meshes

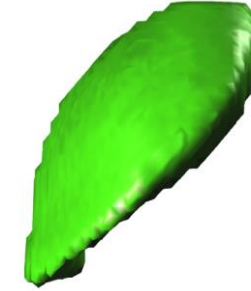
Special debugging keys

T short-cut to trace a path between two landmarks (if landmarks defined).

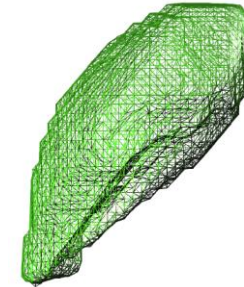
For 3D view window short keys

Ctrl-W (Windows, Linux) or Cmd-W (Mac)	close current 3D viewer Window.
Ctrl-A (Windows, Linux) or Cmd-A (Mac)	toggle Animating the rotation of objects.
Ctrl-M (Windows, Linux) or Cmd-M (Mac)	generate Movie.
Ctrl-B (Windows, Linux) or Cmd-B (Mac)	change Brightness of whole view.
Ctrl-R (Windows, Linux) or Cmd-R (Mac)	Reload data set (return to the initial data set, but user-controlled parameters isn't changed).
Ctrl-U (Windows, Linux) or Cmd-U (Mac)	Update landmarks and traced curves from associated tri-view.
Ctrl-P (Windows, Linux) or Cmd-P (Mac)	toggle the Polygon-fill/line/point/transparent display mode of surface object.
Alt-P	change Polygon display options of surface object.
Ctrl-L (Windows, Linux) or Cmd-L (Mac)	toggle skeLeton-view and tube-view of SWC objects (e.g. a neuron).
Alt-L	change skeLeton-view options of SWC objects (e.g. a neuron).
Ctrl-Z (Windows, Linux) or Cmd-Z (Mac)	Undo last tracing/editing operation of SWC objects (e.g. a neuron).
Ctrl-X (Windows, Linux) or Cmd-X (Mac)	Redo last tracing/editing operation of SWC objects (e.g. a neuron).
Ctrl-N (Windows, Linux) or Cmd-N (Mac)	toggle Name of APO object (e.g. point cloud).
Shift-N	toggle Names of markers objects (not their labels!).
Ctrl-V (Windows, Linux) or Cmd-V (Mac)	update Volume image from tri-view.
Alt-V	change Volume rendering advance options.
Ctrl-F (Windows, Linux) or Cmd-F (Mac)	toggle volume texture Filter.
Mouse-drag	Rotation around x/y-axis of view space, like track ball.
Shift-Mouse-wheel, [and]	Rotation around z-axis of view space.
Alt-Mouse, Alt-arrows	Rotation around axes of objects itself.
\	Reset rotation.
Ctrl-\ (Windows, Linux) or Cmd-\ (Mac)	toggle Parallel projection (Scale bar).
Shift-Mouse, Shift-arrows	Shift the objects around.
Left, Right, Up, Down arrows	Shift the view window around.
Mouse-wheel, - and =	Zoom-out and zoom-in.
Backspace	Reset zoom and shift.
, and .	Move the volume front/f-slice plane.

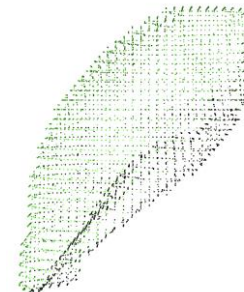
solid surface



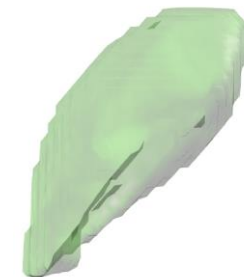
wiring frame



point cloud



semi-transparent surface



Display modes of tubular structures

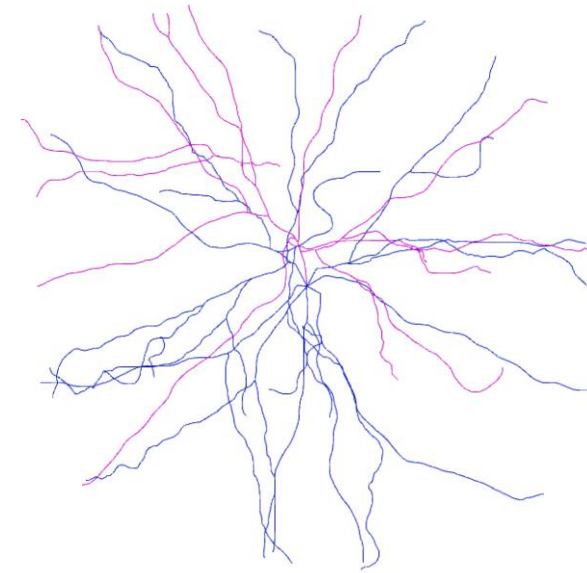
Special debugging keys

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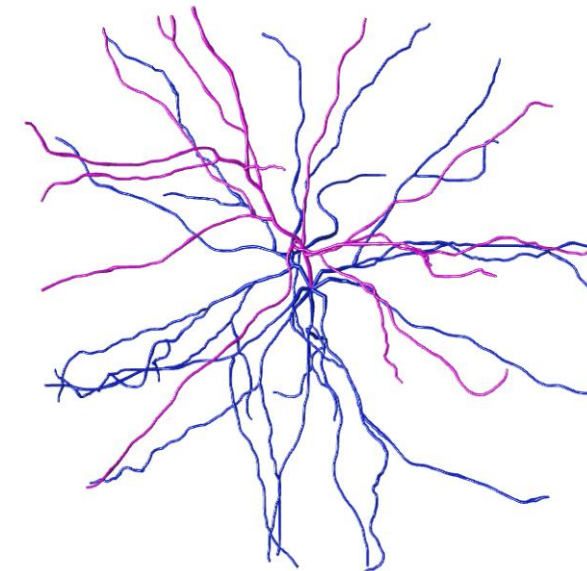
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Ctrl-M (Windows, Linux) or Cmd-M (Mac)	generate Movie.
Ctrl-B (Windows, Linux) or Cmd-B (Mac)	change Brightness of whole view.
Ctrl-R (Windows, Linux) or Cmd-R (Mac)	Reload data set (return to the initial data set, but user-controlled parameters isn't changed).
Ctrl-U (Windows, Linux) or Cmd-U (Mac)	Update landmarks and traced curves from associated tri-view.
Ctrl-P (Windows, Linux) or Cmd-P (Mac)	toggle the Polygon-fill/line/point/transparent display mode of surface object.
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, and .	Move the volume front/f-slice plane.

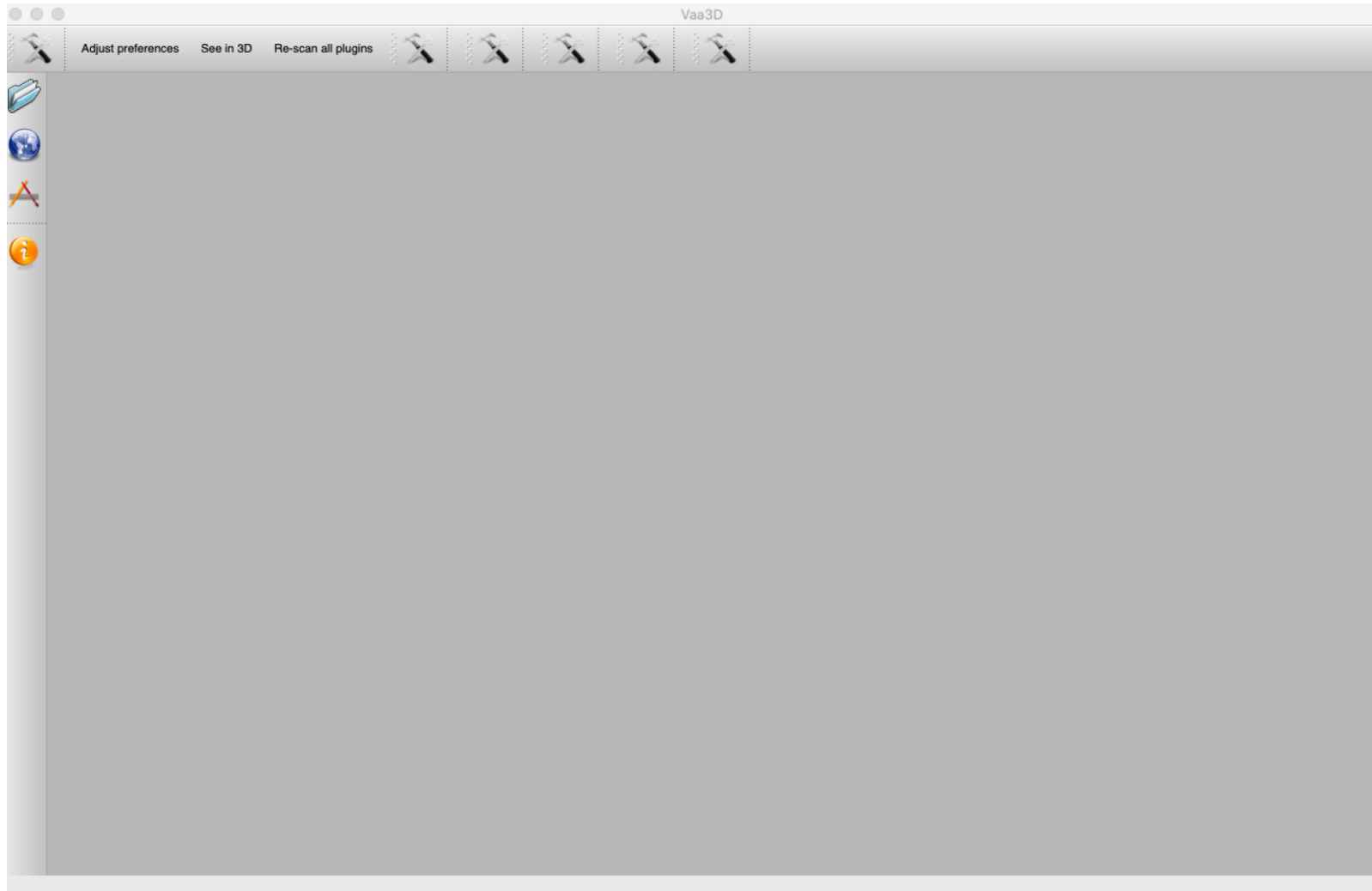
Skeleton view



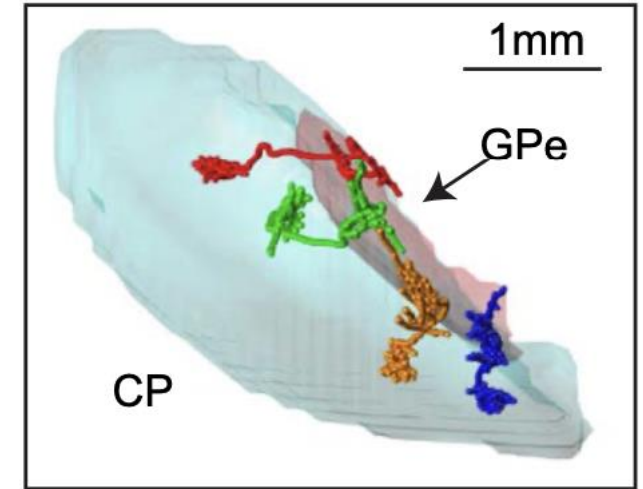
Tube view



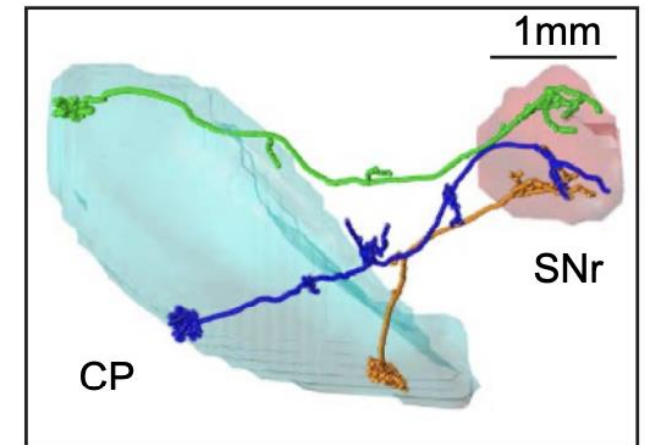
Usage 1: Integrated object visualization for topography analysis



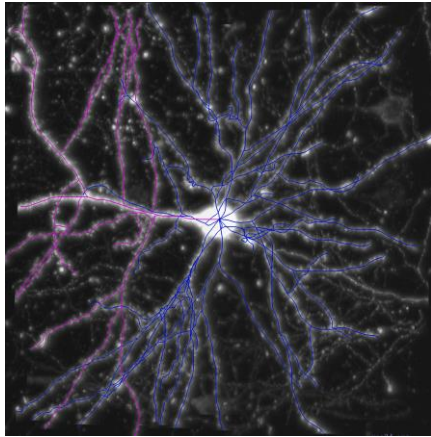
Horizontal view



Horizontal view



Usage 2: Dendrite/soma radius estimation



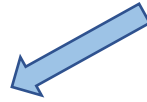
Dendrite reconstruction



Vaa3D
File Image/Data Visualize Advanced Plug-In Window Work-Mode Help

neuron_utilities
neuron_radius

vaa3d_msvc
Terafly image path
In folder path
Threshold 40
Out folder path (optional)
 Is 2D radius
Ok Cancel



Dendrite cropped image
Dendrite radius checking