3D Multimodal Co-Registration of the Macaque Brain

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DUKE UNIVERSITY: SOMMER LAB

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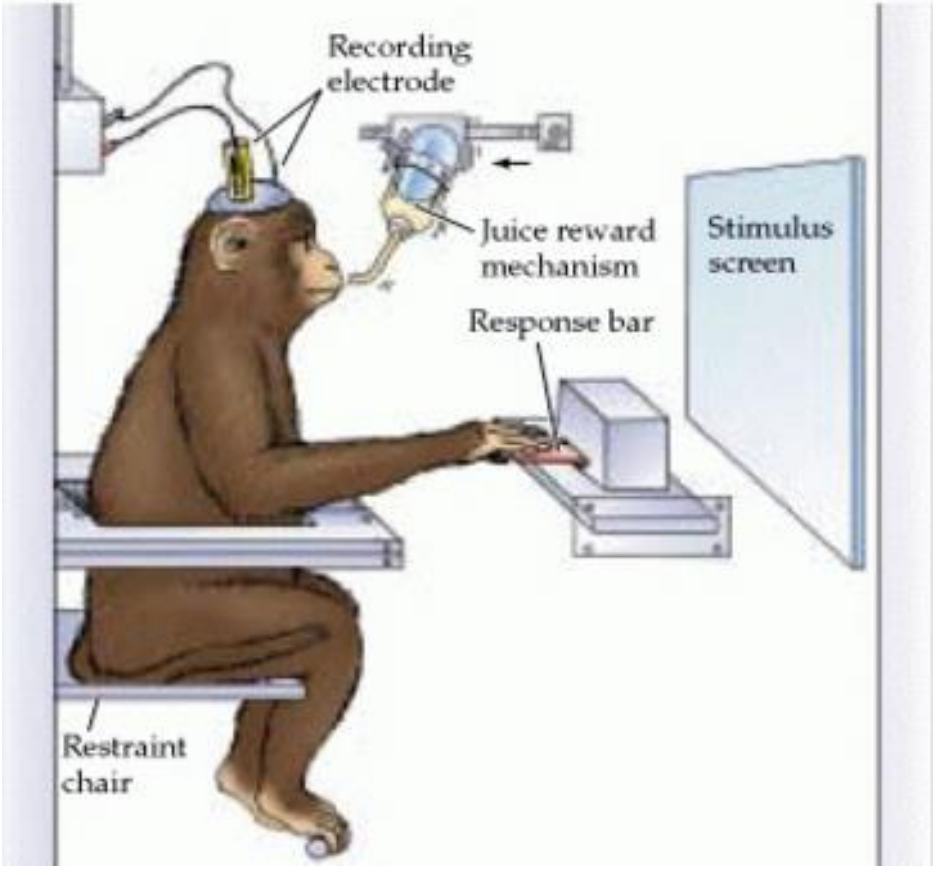
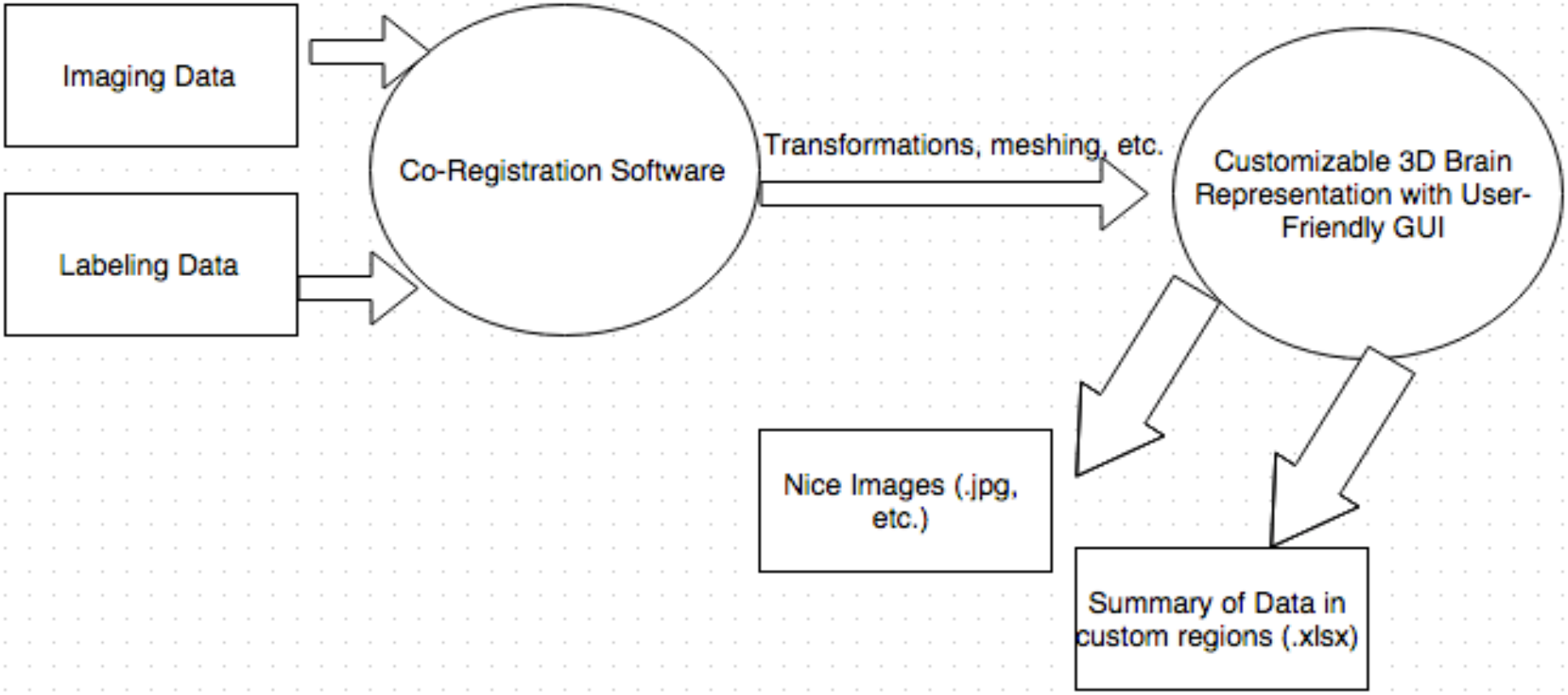
Sommer Lab: Electrophysiological Recordings in the Cerebellum

- Goal is to understand neuronal circuits of the brain
  - Learn how individual areas process signals
  - Learn how multiple areas interact to cause cognition
- Record at the single neuron level



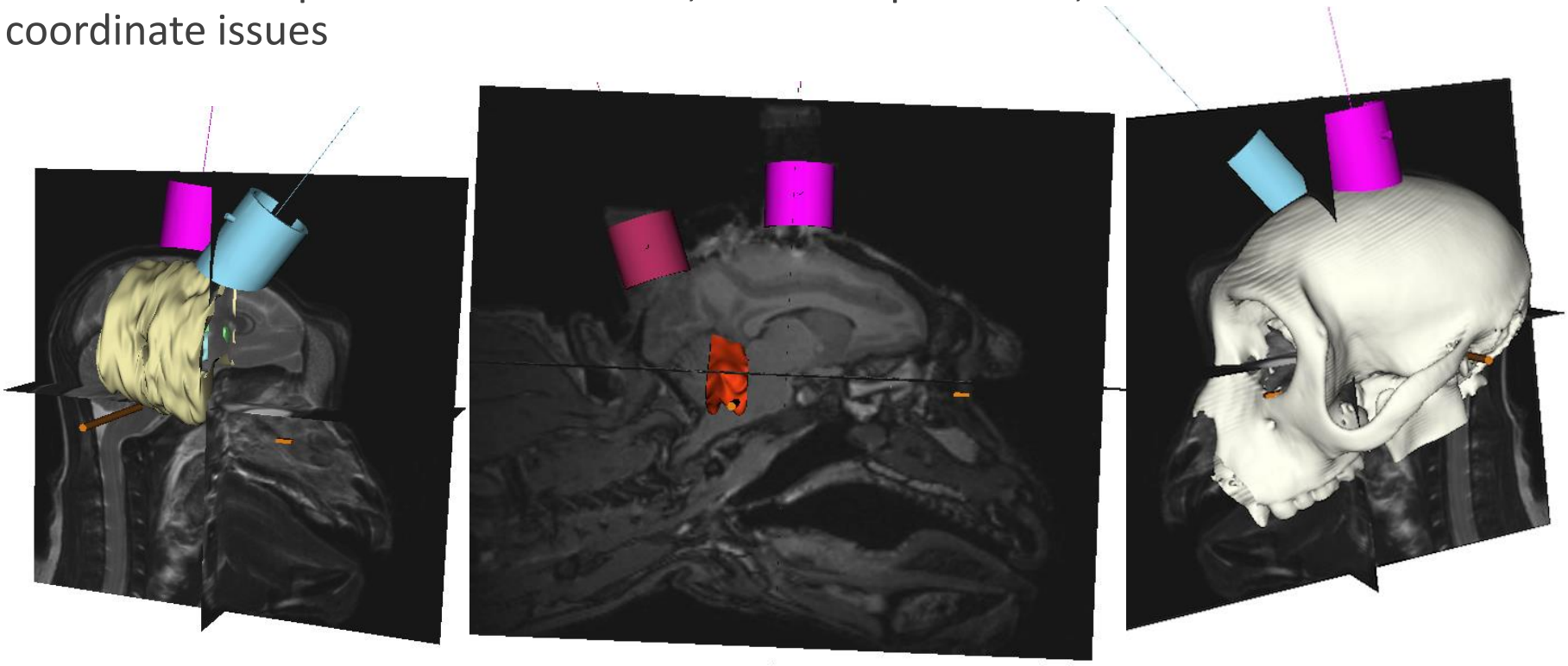
Project Goal:

Create a procedure for the lab to use to visualize recording sites

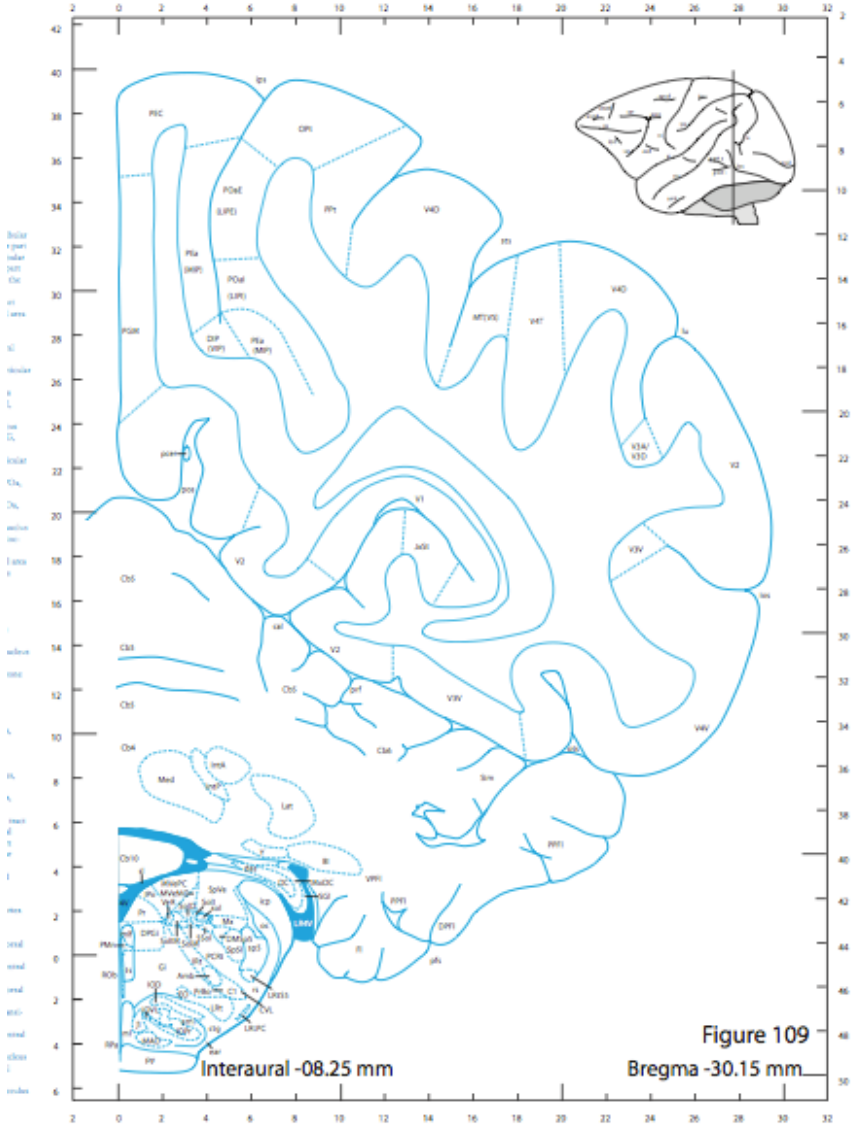


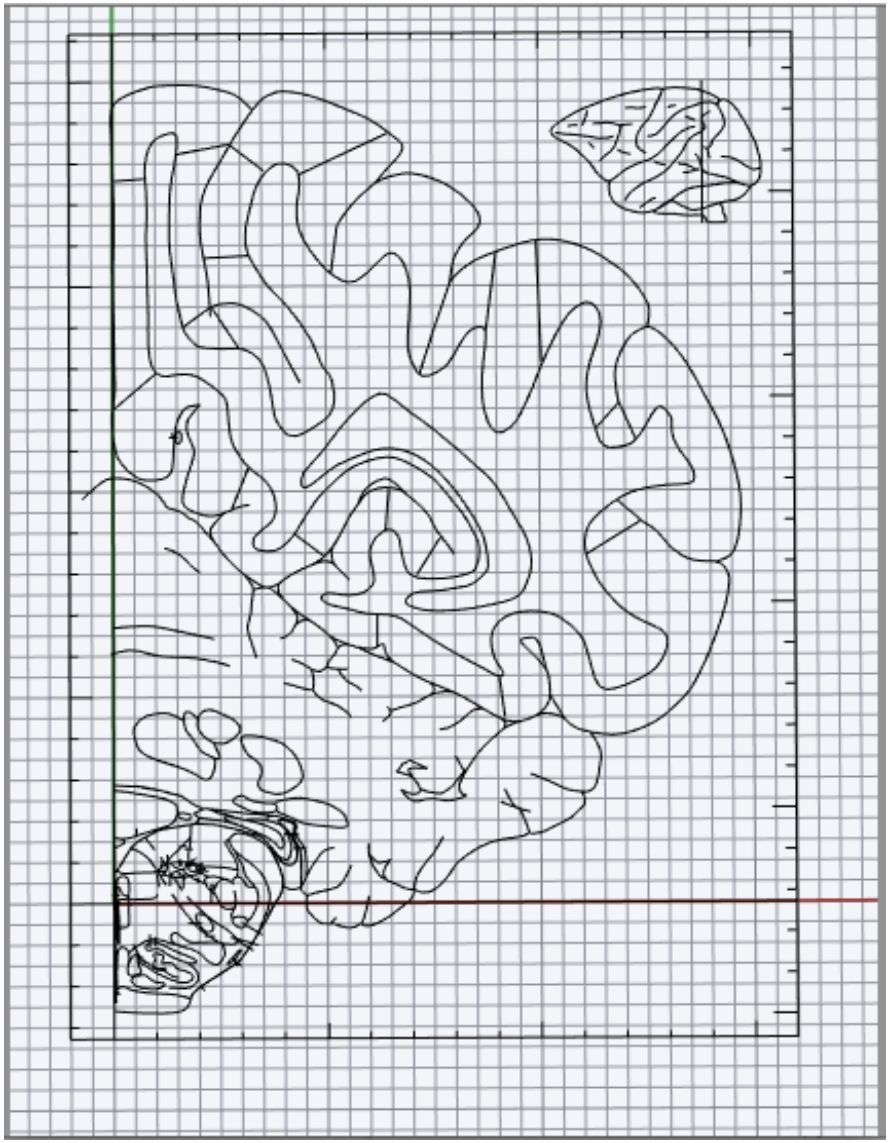
MonkeyCicerone Software

- Developed by University of Minnesota
- Co-registers MRI, CT, 3D atlas, MER data, chamber location, and DBS electrodes with VTA predictions
- Limitations: no posterior cerebellum, DICOM input issues, and chamber rotation coordinate issues

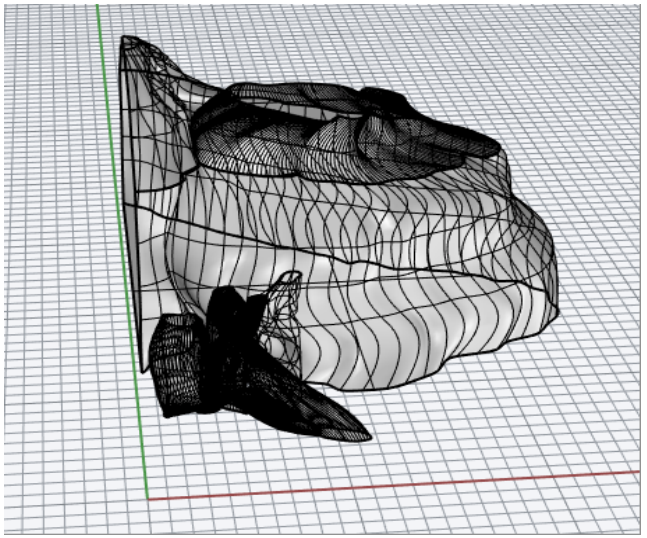


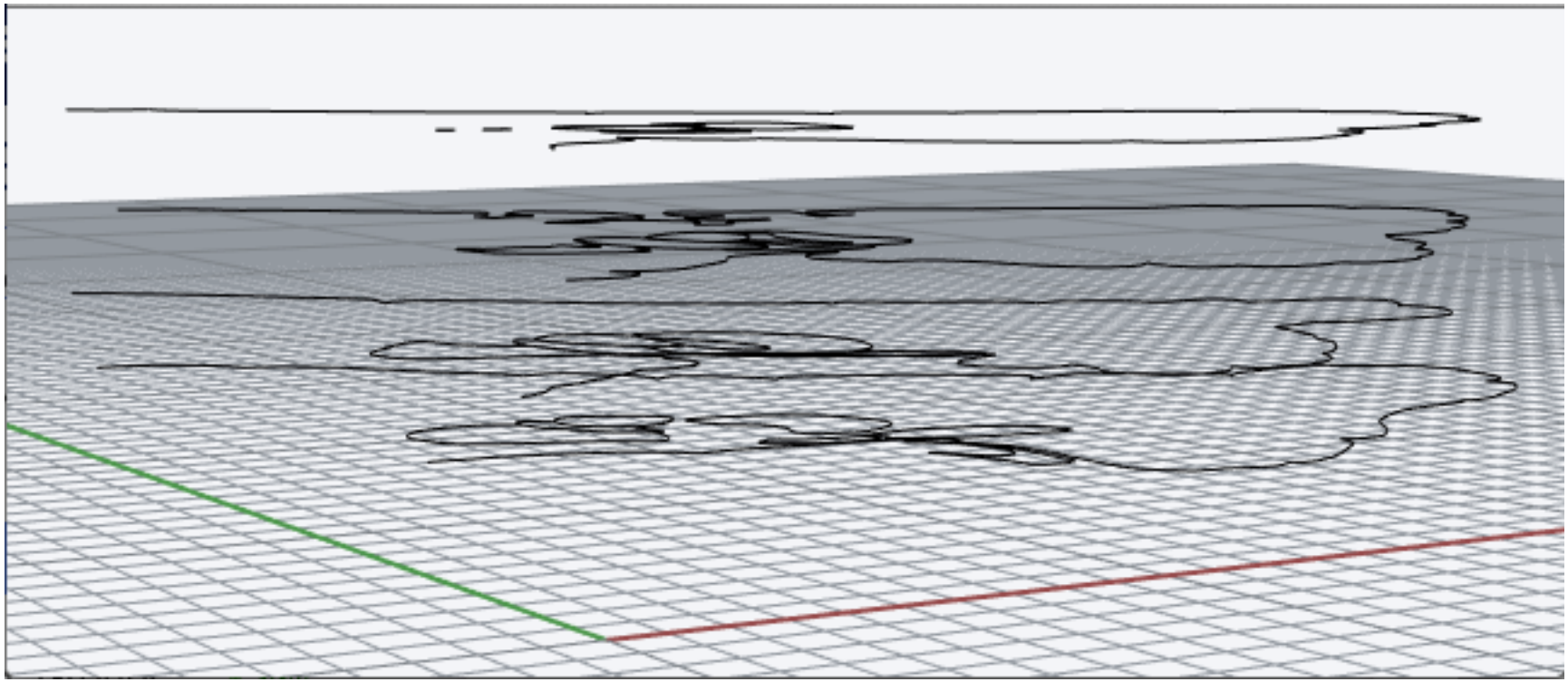
3D Posterior Cerebellum Creation





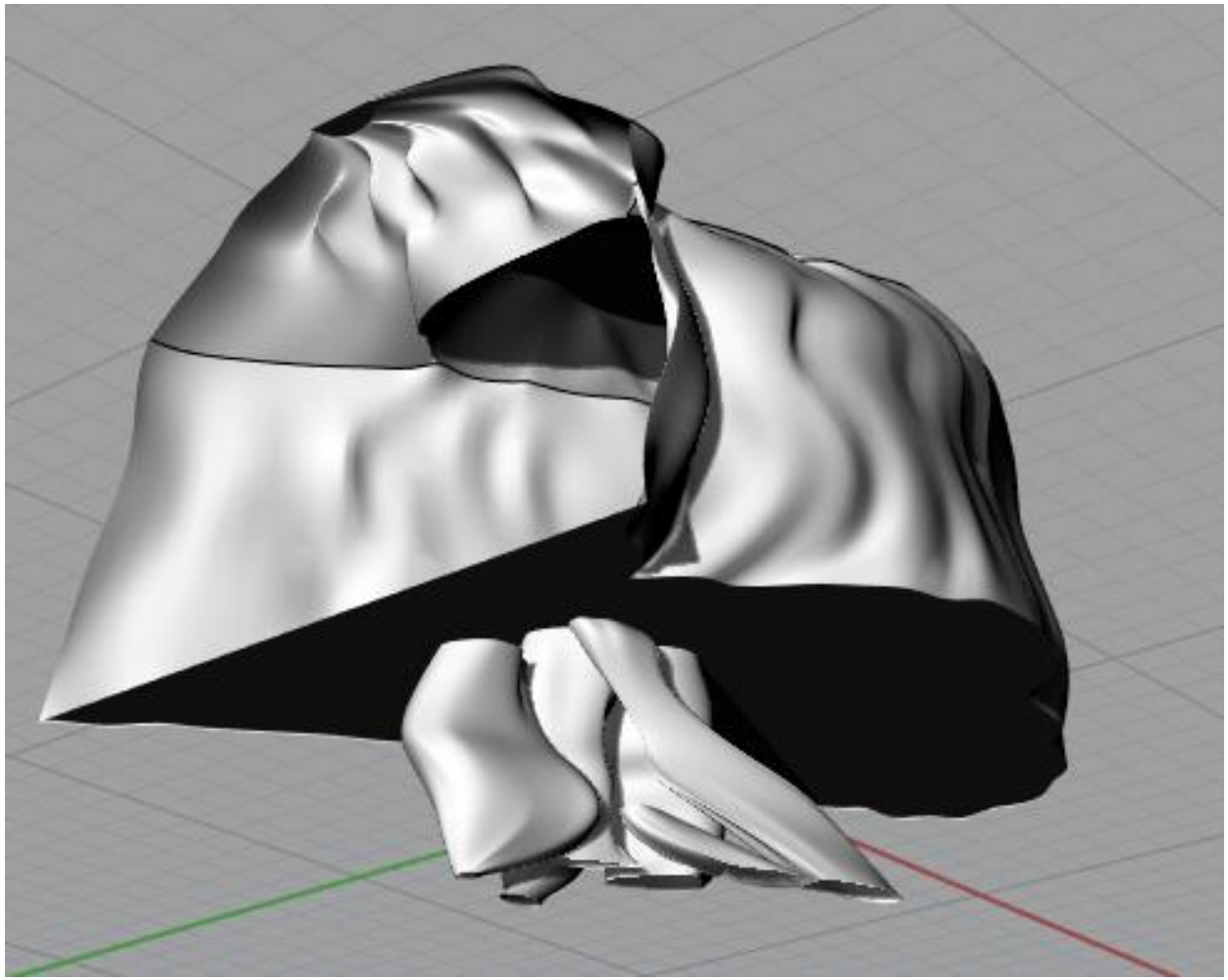
- Successive cross-sections of the posterior cerebellum were traced in Rhino3D
- The sections were taken from a Rhesus macaque 2D brain atlas
- Once all cross-sections were positioned, the structure was lofted and smoothed





3D Posterior Cerebellum

- To personalize the Cicerone software for the Sommer Lab, a 3D posterior cerebellum was added using 2D MRI, CT and MER data.



Fixing the Chamber Rotation Coordinates Issue

	A	B	C	D	E	F	G	H
1	Filename	Chamber Rotation	Monkey	Chamber Location	M-L	A-P	Theta	Hypotenuse
2	R83L4A0_19100	20	Rigel	L4A0	4	0	-20	4
3	R83L4A0_19400		Rigel	L4A0	4	0	0	4
4	R140L6A1_20160		Rigel	L6A1	6	1	9.4623222	6.08276253
5	R132M8A3_20100		Rigel	M8A3	-8	3	-20.55605	8.544003745
6	R81M3P5_15100		Rigel	M3P5	-3	-5	59.036243	5.830951895
7	R832M4P4_13000		Rigel	M4P4	-4	-4	45	5.656854249
8	R232L4A2_10000		Rigel	L4A2	4	2	26.565051	4.472135955

I	J	K	L
ML Coordinate	AP Coordinate	Calibration (mm)	Depth (mm)
3.758770483	-1.368080573		19.1
4	0		19.4
6	1		20.16
8	-3		20.1
3	5		15.1
4	4		13
4	2		10

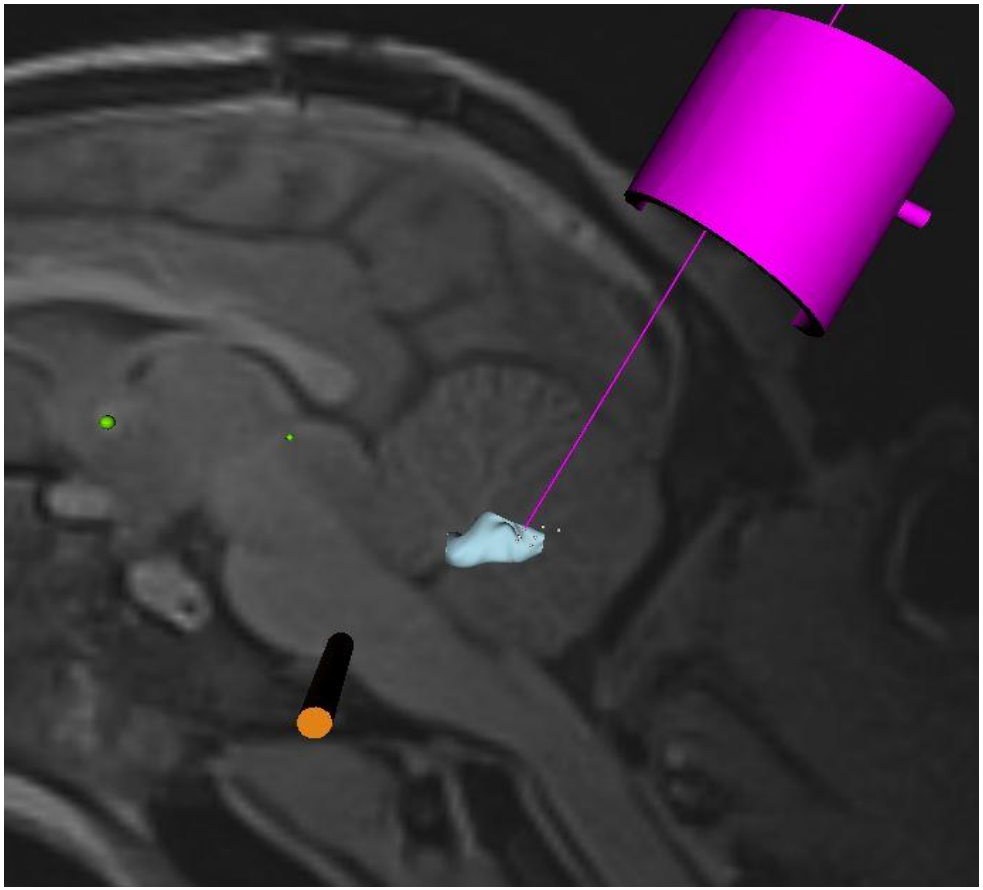
Cicerone does not account for chamber rotations used in the Sommer Lab, so an easy-to-use Excel input file was developed to automatically translate the brain coordinates into Cicerone coordinates.

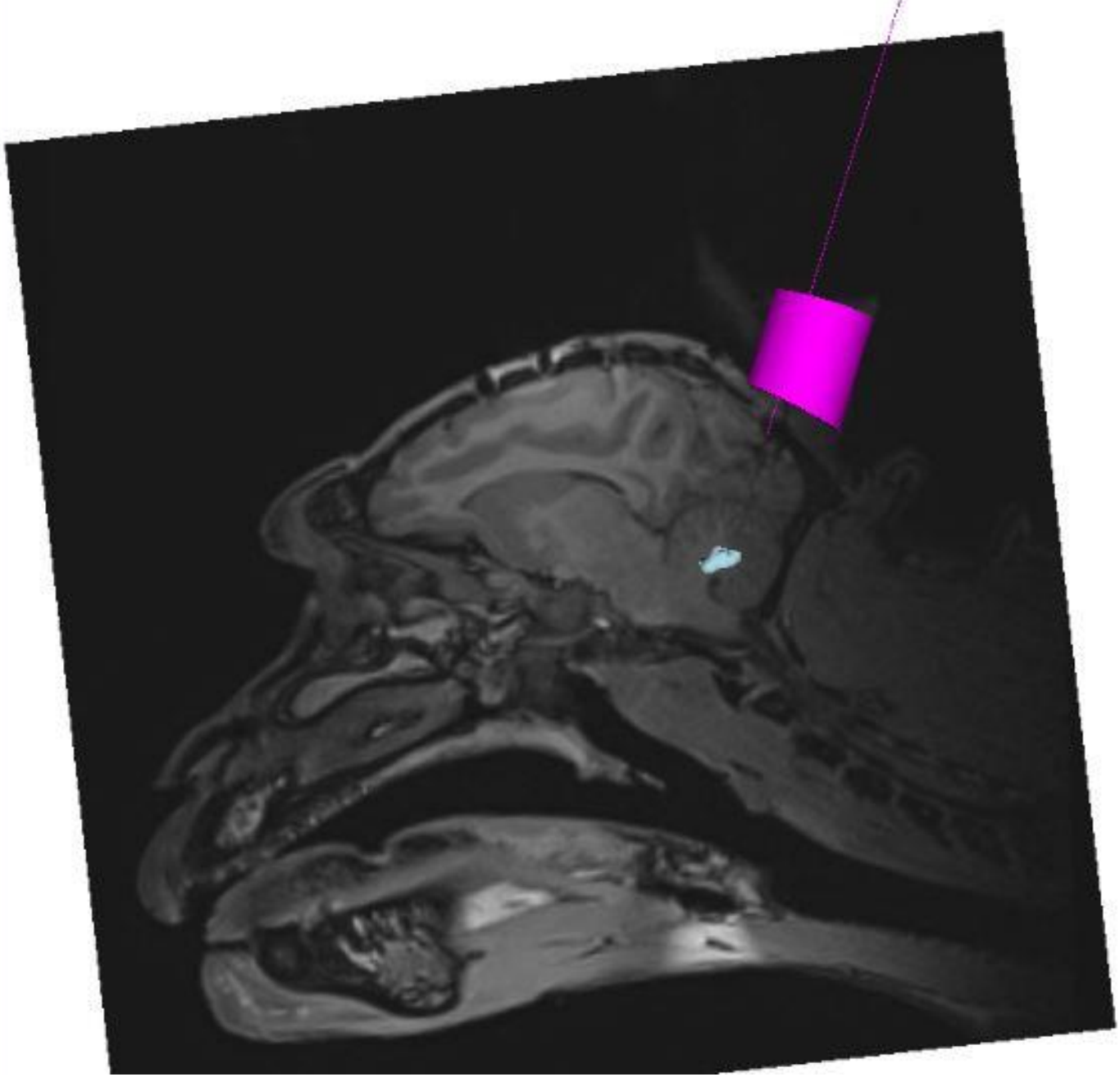
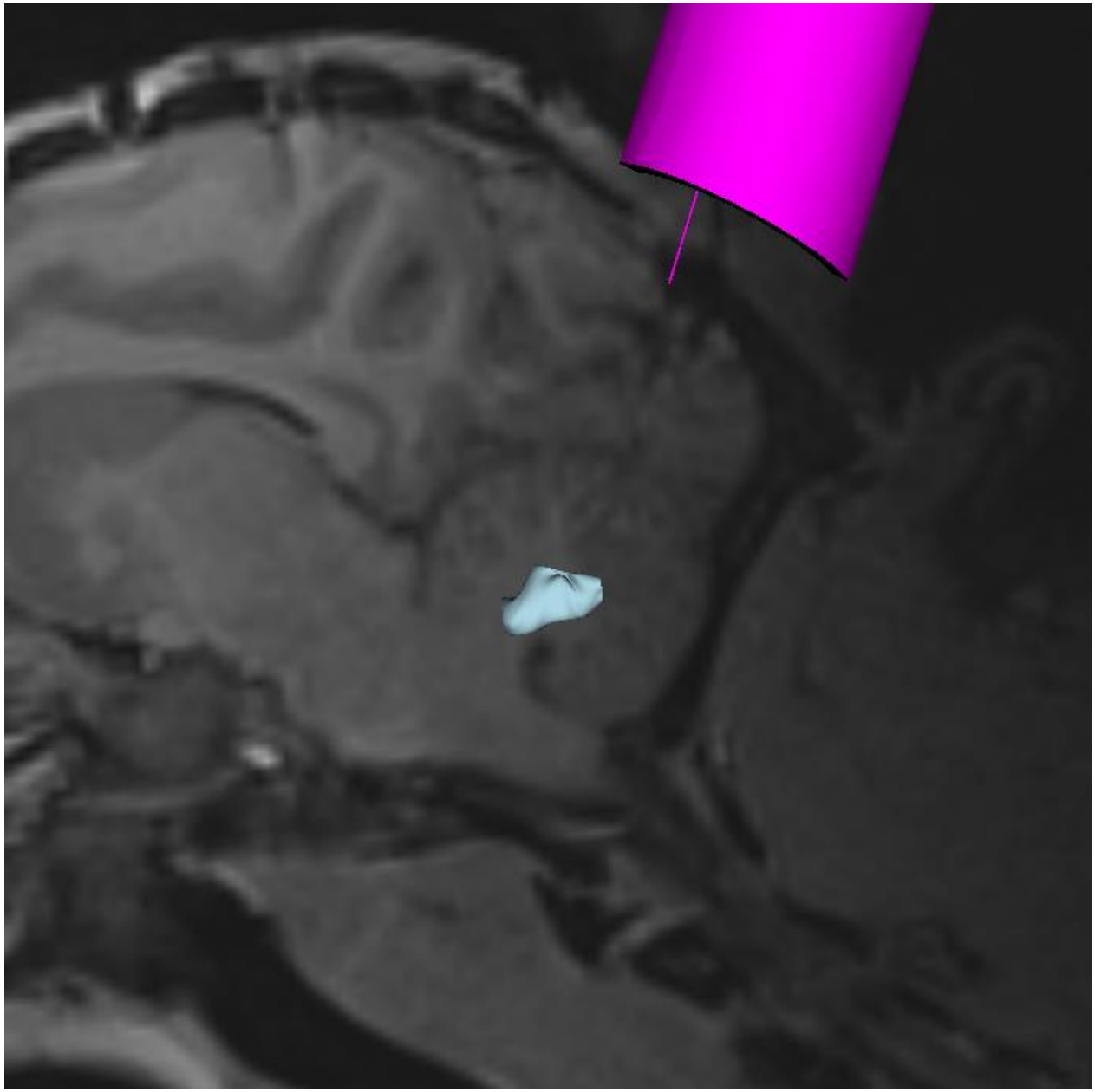
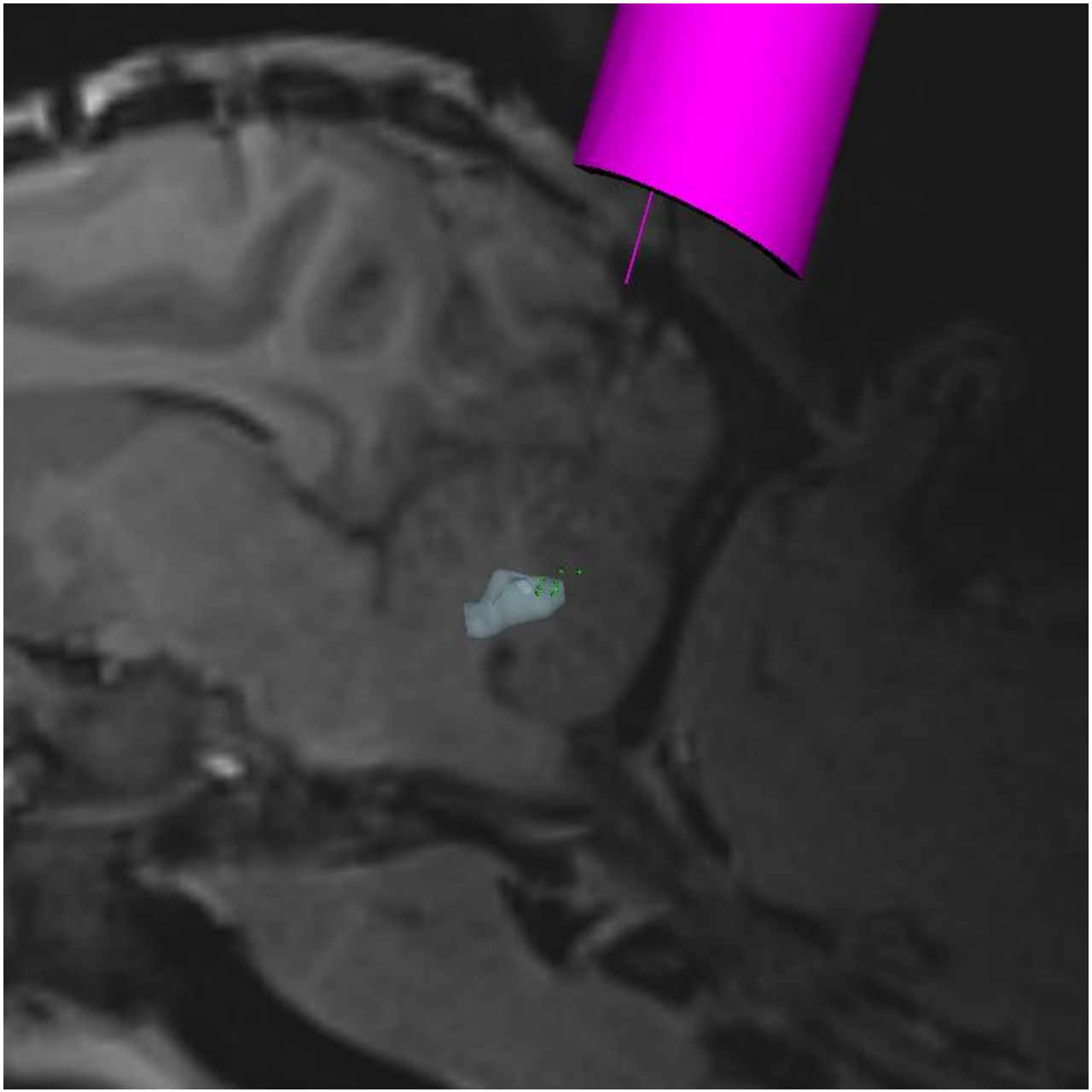
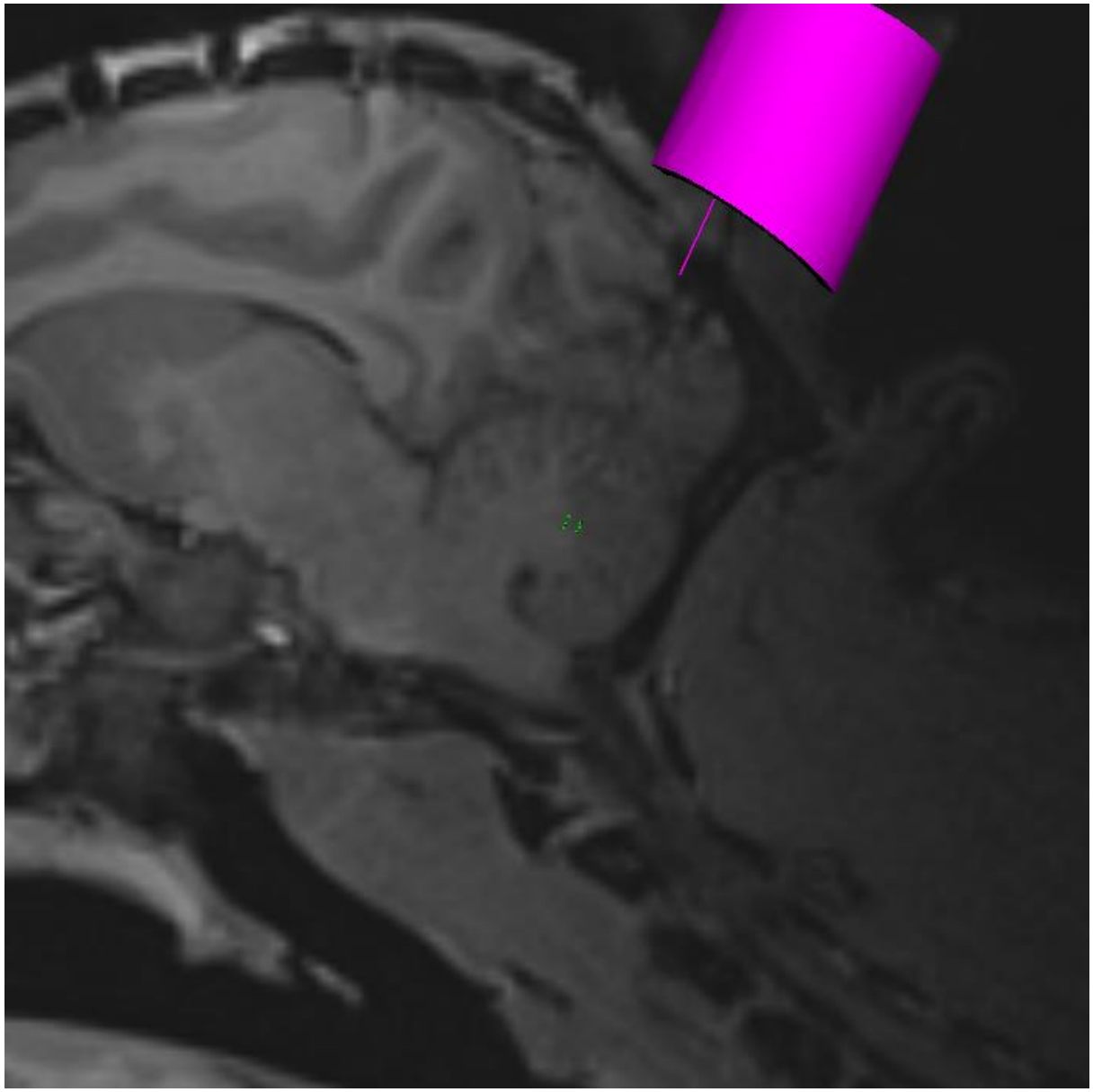
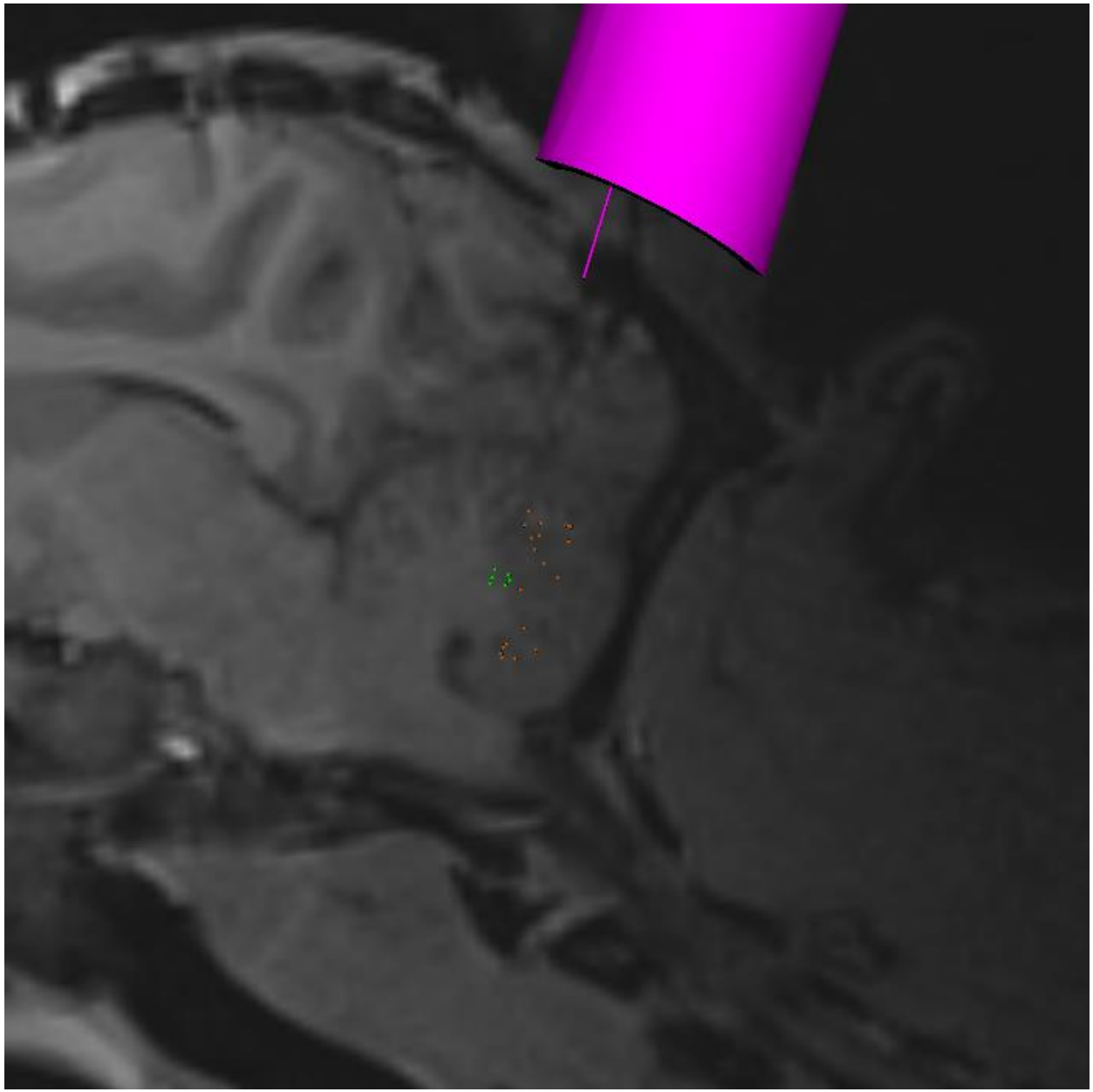
Fixing the DICOM Input Issue

```
function sort_asf29_cd(realtopdir,dest_folder_str)
%Summary of this function goes here
%   Detailed explanation goes here

now=cd;
cd(realtopdir)
nfwrit=0;
topdir=dir;
destdrive=strcat(dest_folder_str);

for tdn=4:4
    cdname = strcat(realtopdir, topdir(tdn).name);
    padir  = dir(cdname);

        for pdn=3:length(padir)
            pnname = strcat(cdname,'\',padir(pdn).name);
            stdir  = dir(pnname);

            for stn=3:length(stdir)
                sename = strcat(pnname,'\',stdir(stn).name);
                sedir  = dir(sename);

                for sen=3:length(sedir)
                    selsen = strcat(sename,'\',sedir(sen).name);
                    iis    = dicominfo(selsen);
                    destfile = strcat(destdrive,'\',iis.SeriesDescription,num2str(iis.SeriesNumber));

                    if ~exist(destfile)
                        mkdir(destfile);
                    end
                    copyfile(selsen,destfile)
                    nfwrit=nfwrit+1;
                end

            end

        end
end
cd(now)
end
```

Cicerone accepts only a certain DICOM file type, so a MATLAB script was developed to automatically sort the DICOM files into Cicerone-readable folders.

Results



Summary:

- Successfully built a brain visualization process in Cicerone
- University of Minnesota has communicated that it intends to adopt the cerebellum visualization into its next Cicerone software update
- Future improvements will include adding more features (histology, etc.)