ECoG Electrode Localization

User Instructions

**Step 1:**

Use SPM to register CT (pre-op and post-op) to pre-op MRI

**Step 2:**

Use freesurfer to create cortical surface from pre-op (convert surfaces to nifti for cortical hull creation in step 5):

mri\_convert -i ${SUBJECTS\_DIR}/${SUBJECT\_ID}\_FS/mri/lh.ribbon.mgz -o ${SUBJECTS\_DIR}/${SUBJECT\_ID}\_FS/mri/gray\_left.nii -it mgz -ot nii

mri\_convert -i ${SUBJECTS\_DIR}/${SUBJECT\_ID}\_FS/mri/rh.ribbon.mgz -o ${SUBJECTS\_DIR}/${SUBJECT\_ID}\_FS/mri/gray\_right.nii -it mgz -ot nii

mri\_convert -i ${SUBJECTS\_DIR}/${SUBJECT\_ID}\_FS/mri/ribbon.mgz -o ${SUBJECTS\_DIR}/${SUBJECT\_ID}\_FS/mri/t1\_class.nii -it mgz -ot nii

**Step 3:**

Use Osirix to 3D render Skin and stereotactic frame from Pre-op CT and store as a wavefront object

Load co-registered CT into **Osirix** to create surface

**Plugins>Database>Nifti to DICOM,** select **pre-op CT**

Double click on image in series to bring up larger viewer

**3D Viewer>3D Surface Rendering**

Generally, move **Resolution** past halfway and set **Pixel Value** to **1400**

Adjust **Pixel Value** until just the skull is visible

Once complete, click **Export 3D-SR** on the top-right and select **Export as Wavefront (.obj)**

**Step 4:**

Use Osirix to render 3D skull and DBS leads from post-op CT and save them as wavefront object

Similar to step 3.

**Step 5:**

prepare surfaces for matlab use, use Prepare\_Surfaces\_for\_Localization.m, outputs include Skull-frame (from pre-op CT), Skull-DBS (from post-op CT), cortex (from pre-op MRI) and cortical hull (from pre-op MRI)

**Step 6:** Mark the DBS electrode paths

Run **MRI\_Fid\_Localizer.m**

Click **Open Image**

Navigate to the Subjects directory and for the desired subject, locate **Post-op CT (Nifti)**

Locate the DBS electrode paths and mark the tract every 2 slices on both sides

Once complete, select **Save Electrodes** and navigate to your folder in **Electrode\_Locations** within that subject’s directory and save as **depthelectrodes.mat**

**Step 7:** Mark CT Pin Locations

Run **MRI\_Fid\_Localizer.m** or click **Open Image** again if interface is already open from marking the DBS electrodes

Click **Open Image**

Navigate to the Subjects directory and for the desired subject, locate co-registered Pre-op CT (nifti format)

Locate the locations where the stereotactic frame pins intersect with the skull (4 pins)

Once complete, select **Save** and navigate to your folder in **Electrode\_Locations** within that subject’s directory and save as **PinTips.mat**

**Step 8:** Localize Electrode Strips

Run **DBS\_Elec\_Localizer.m**

To load all surfaces/ landmarks, click **File>Load>Load All**

To load individual surfaces/ landmarks:

**File>Load>Cortical Reconstruction** and select **cortex.mat** in the subject’s directory

**File>Load>Skull Reconstruction** and select **skull.mat** in the **CT\_reg** directory of the subject’s directory

**File>Load>Cortical Hull** and load your **hull.mat** in the subject’s directory

**File>Load>Skull Fiducials** and load **PinTips.mat** in the **Electrode\_Locations** folder of the subject’s directory

**File>Load>Electrode Locations** and select **depthelectrodes.mat** in the **Electrode\_Locations** folder of the subject’s directory

**File>Load>Fluoro Image** located in the **fluoro** folder in the subject’s directory

**Image>Flip Fluoro Horizontally** – Performed for all images to apply appropriate parallax effect (emitter on the left; detector on the right)

Align Skull/MRI with Fluoro

Optimize the following parameters:

CT skull to skull visible on the fluoroscopic image

Pin tip locations to stereotactic frame in fluoro

If pin tips are not visible on fluoroscopic image, ensure that they the CT locations are also not on the fluoro image

Depth DBS electrodes to fluoro depth electrodes/ guide tube

Adjust the degree of parallax effect (default: head placed in the middle of the C-arm)

Surface/ landmark visibility can be adjusted under **Transparency**

Once position is finalized:

Select the side of the ECoG electrodes under **Electrode Side** (i.e. Left or Right)

Click **Mark Electrodes**

Using standard cursor mode (IMPORTANT), click on each strip electrode visible on fluoro

Marking should appear after calculation

**Step 9:** Save electrode coordinates

**File>Export>Electrode Coordinates**

Navigate to your **Electrode\_Locations**

Electrode locations will be saved in a .mat file

Step10: Check cortical parcellation with freeview:

freeview -f cortical\_reconstruct/surf/rh.pial:annot=aparc.annot:name=pial\_aparc:visible=0 \

cortical\_reconstruct/surf/rh.inflated:overlay=rh.thickness:overlay\_threshold=0.1,3::name=inflated\_thickness:visible=0 \

cortical\_reconstruct /surf/rh.inflated:visible=0 \

cortical\_reconstruct /surf/rh.white:visible=0 \

cortical\_reconstruct /surf/rh.pial \

--viewport 3d