**Pre Ex Registration – Hippocampus**

Input files Are in:  
EpilepsyDatabase/<SUBJ>/Processed/PreEx\_Reg/Hp/Init\_images  
A) In one Slicer open (1st) **MRI\_PreExReg\_crop\_res0.4\_inm.nii.gz**   
B) In another Slicer open (2nd) **T1map\_crop\_res0.4.nii.gz**

Fiducial Placement (Markups) -- Minimum 10 fiducials!  
D) In the 1st use the Markups module

1. Create New Markups Fiducials as **Ex**

E) In the 2nd use the Markups module

1. Create New Markups Fiducials as **Pre**
2. You can change their color/size in Advanced options
3. When placing fiducials on the ‘Volume rendering’ Surface make sure they are visible on the T1map\_crop\_res0.4.nii.gz volume and not in outer space!!
4. Right click on fiducial-> JUMP SLICES
5. Make sure fiducials are corresponding on both images!

F) In 1st Save Fiducial list as **Ex.fcsv** in

EpilepsyDatabase/<SUBJ>/Processed/PreEx\_Reg/Hp/Init\_xfms

G) In 2nd Save Fiducial list as **Pre.fcsv** in

EpilepsyDatabase/<SUBJ>/Processed/PreEx\_Reg/Hp/Init\_xfms

Fiducial Registration

H) Load **Ex.fcsv** in 2nd AND **MRI\_PreExReg\_crop\_res0.4\_inm.nii.gz** in 2nd

I) Use Fiducial registration module:

Fixed: Pre fids

Moving: Ex fids

Save tfm: **Sim\_Ex\_T1.tfm**  
Transform Type: Similarity (or Rigid depending on differences in scale)

Image Registration

J) Use Resample Image (Brains) module

1. Image to Warp: **MRI\_PreExReg\_crop\_res0.4\_inm.nii.gz**
2. Reference Image: **T1map\_crop\_res0.4.nii.gz**
3. Output Image Create New Volume / Rename current volume -> **Sim\_Ex\_T1**
4. Warping Parameters --> Transform File: **Sim\_Ex\_T1.tfm**
5. Interpolation mode --> Bspline
6. Apply

K) View registration in Transforms module

1. Active Transform: **Sim\_Ex\_T1**
2. In Apply Transform, move Ex from Transformable to Transformed
3. In the Slice viewers, view **Sim\_Ex\_T1.nii.gz** in the foreground and **T1map\_crop\_res0.4.nii.gz** in the background, change opacity as needed
4. Go to the Data module, find Ex under Sim\_Ex\_T1
5. Right click on Ex and select Harden Transform
6. Save as **Ex\_transformed.fscv** in EpilepsyDatabase/<SUBJ>/Processed/PreEx\_Reg/Hp/Init\_xfms

L) Save transform as: **Sim\_Ex\_T1.tfm** in

EpilepsyDatabase/<SUBJ>/Processed/PreEx\_Reg/Hp/Init\_xfms

M) Save output image: **Sim\_Ex\_T1.nii.gz** in

EpilepsyDatabase/<SUBJ>/Processed/PreEx\_Reg/Hp/Init\_images

**The other way of doing it**

A. In one slider window open: **MRI\_PreExReg\_crop\_res0.4\_inm.nii.gz AND T1map\_crop\_res0.4.nii.gz**

Landmark Registration (minimum 10 fiducials)

B. Select Volumes

Fixed Volume: T1map\_crop\_res0.4.nii.gz

Moving Volume: MRI\_PreExReg\_crop\_res0.4\_inm.nii.gz

DON’T FORGET TO SELECT REGISTRATION TYPE FROM THE BOTTOM 🡪 RIGID OR SIMILAR OR BOTH WE’LL SEE DEPENDS ON SCALING

C. Landmarks > Add to add fiducials

Toggle rock to see how you’re doing

Run 2.0\_concatRigXfms from the UNIX command line

Takes <SUBJ> <structure> >> Concatenates rigid warps for Pre-Ex registration

Run 3.1\_NregWarpNeoToHist from the UNIX command line

Takes <SUBJ> >> Transforms cropped T1 map to Ex-vivo space for full registration

\*\*note: name says wrap neo to hist, but the structure is defined within the body of the function, and that was changed to Hp

Create and Apply Binary Mask

N) Create overlay binary mask for **MRI\_PreExReg.nii.gz** in

EpilepsyDatabase/<SUBJ>/Ex/9.4T/Hp

1. Open **MRI\_PreExReg.nii.gz** for intensity reference and shape reference. Keep this open until mask creation is finished.

2. Get an idea for the starting point of your threshold via finding the lower 15 percentile of the image using:

fslstats <input> -P 15

input = **MRI\_PreExReg.nii.gz**

outputs a number, that is your lower threshold

3. Generate masks using:

fslmaths <input> -thr ### -bin <output>

input = **MRI\_PreExReg.nii.gz**

output = **mask.nii.gz**

4. View **mask.nii.gz** in fslview

5. Brute force threshold using fslmaths and different threshold numbers

If image is all black 🡪 threshold is too low

Increasing threshold decrease the noise

If threshold is too high, the mask may cut off bits of the original image

6. Stop when you get a good match

O) Apply mask using

fslmaths <input> -mas <mask> <output>

input = **MRI\_PreExReg.nii.gz**

mask = **mask.nii.gz**

output = **MRI\_PreExReg.masked.nii.gz**

Plastimatch Transform(Do in Windows)

P) Non-rigid registration

1. In Slicer load the data:

**Sim\_Ex\_T1.nii.gz**

**T1map\_crop\_res0.4.nii.gz**

**Ex\_transformed.fcsv**

**Pre.fcsv**

1. Go to the LANDWARP Landmark deformable registration module

Fixed Volume: **T1map\_crop\_res0.4.nii.gz**

Moving Volume: **Sim\_Ex\_T1.nii.gz**

Fixed Fiducials: **Pre.fcsv**

Moving Fiducials: **Ex\_transformed.fcsv**

Output Vector Field (MRML): Create new as **Plasti\_Ex\_T1**

Output file for vector field [full path]:

/home/ROBARTS/xwan9/EpilepsyDatabase/<SUBJ>/Processed/PreEx\_Reg/Hp/Init\_xfms/Plasti\_Ex\_T1.nii.gz/

Basis Function: Gauss

RBF Radius: 50.0

Stiffness: 0.1

1. Save **Plasti\_Ex\_T1** as a NifTi file --> **Plasti\_Ex\_T1.nii.gz**

Run 5\_warpExToPreNonRigid from the UNIX command line

Takes <structure> <SUBJ>

Non-rigid registration of Ex to Pre

Run 6\_checkRegExToPre from UNIX command line

Takes <structure> <SUBJ>

Checks the quality of the registrations