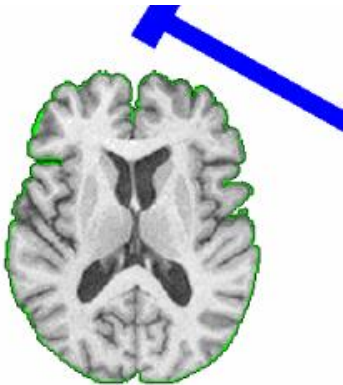




HAMMER: Hierarchical Attribute Matching Mechanism for Elastic Registration



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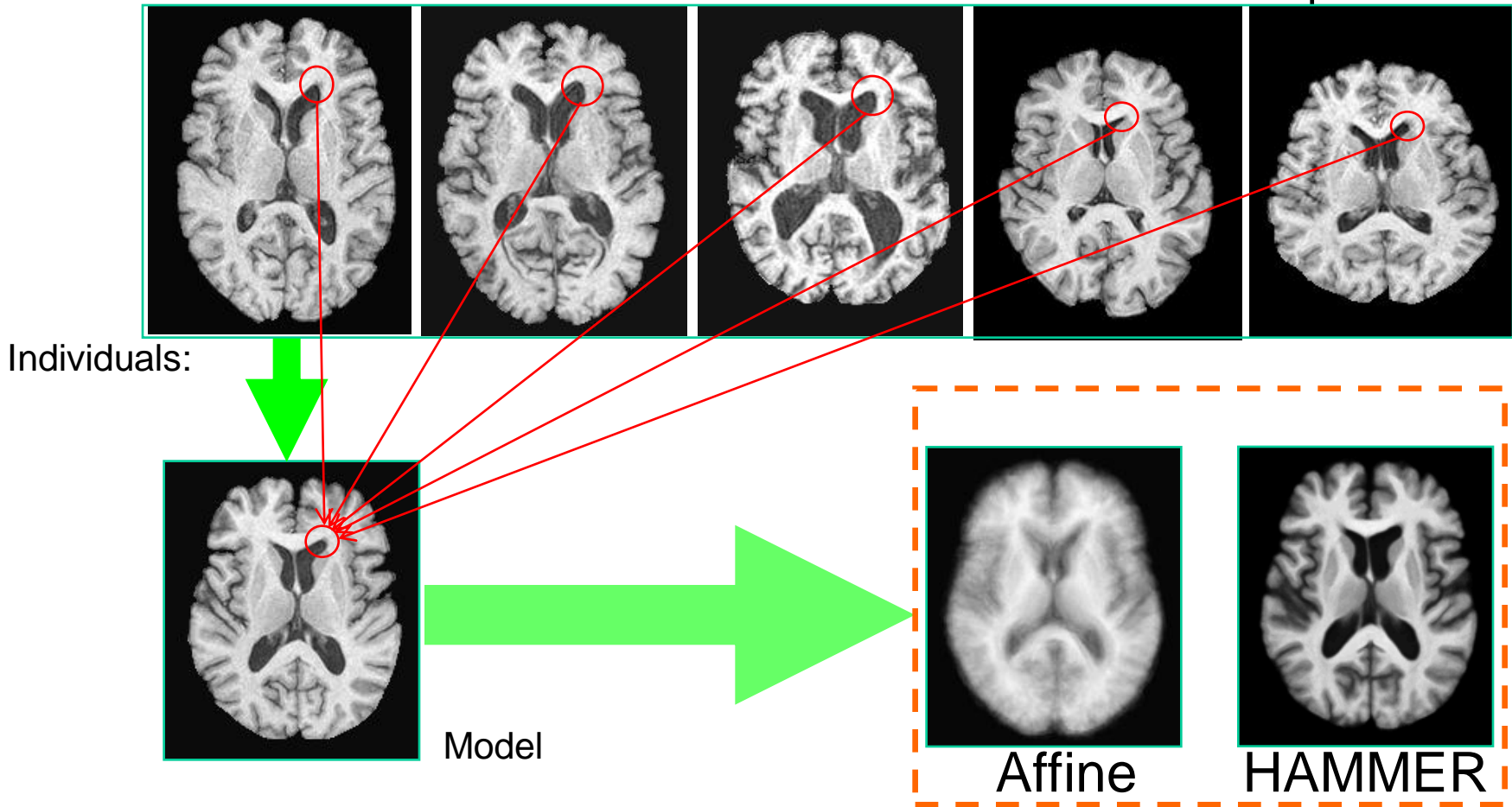
**Department of Radiology and BRIC, University of North Carolina at Chapel Hill, U.S.A.*

+Visualization and Computer Vision Laboratory, GE Research, U.S.A.

HAMMER: Background



- The goal of deformable registration of brain images
 --- Establish the anatomical correspondence

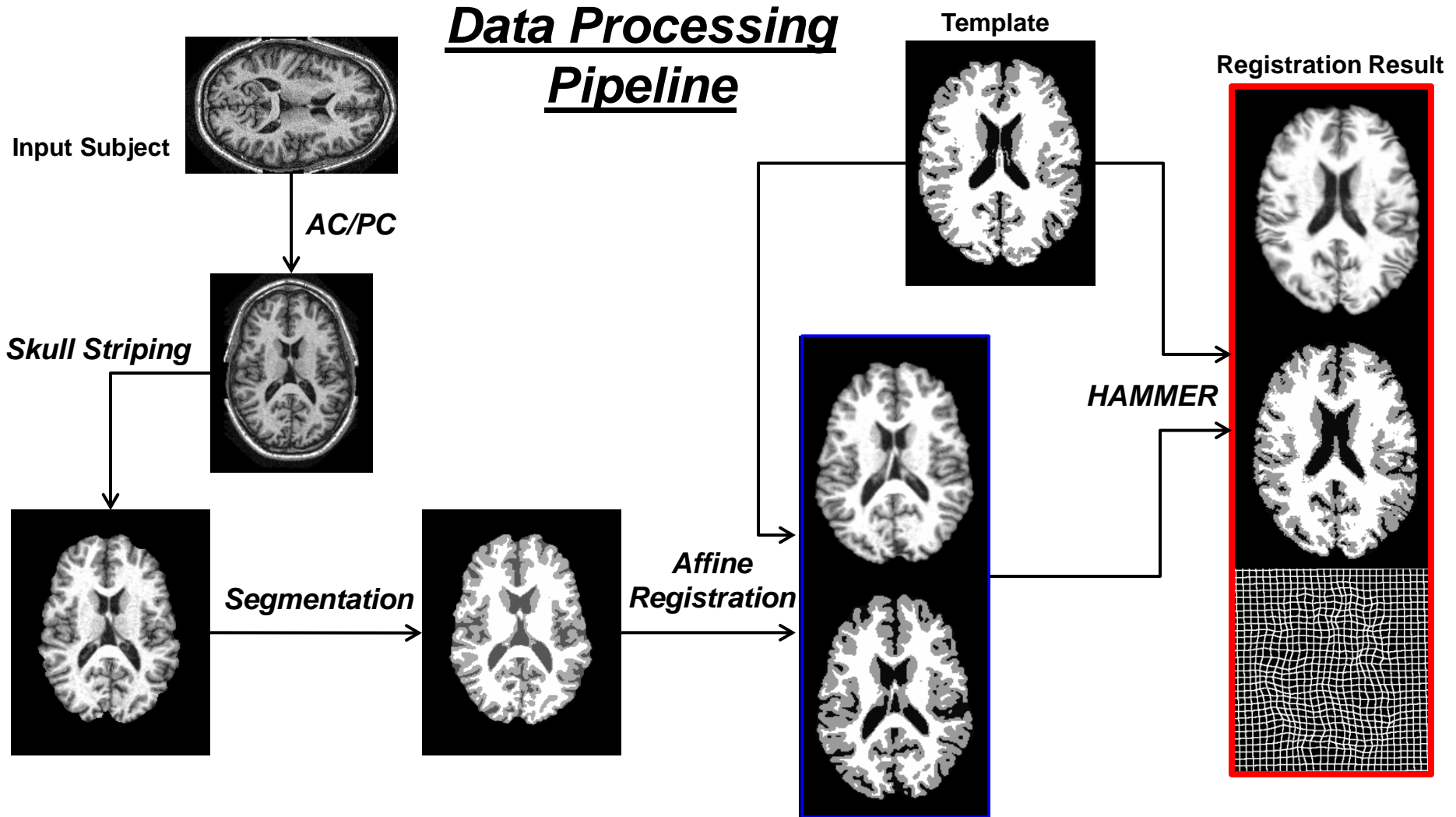




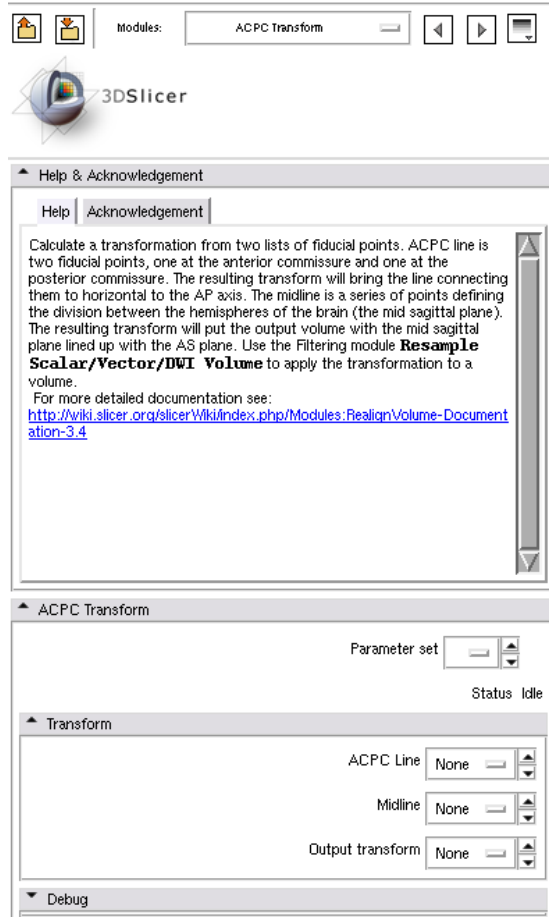
- Clinical applications:

- † Spatial normalization of functional images, *for group analysis.*
- † Measurement of structure, *by deforming a model to individual.*
- † Image data mining *in lesion-deficit studies.*

- HAMMER has been used to align over 8,000 brains image since 2002.
- HAMMER paper has received the 2006 Best Paper Award for IEEE Signal Process Society.



Step 1: AC/PC Correction



Modules: ACPC Transform

3DSlicer

Help & Acknowledgement

Help | Acknowledgement

Calculate a transformation from two lists of fiducial points. ACPC line is two fiducial points, one at the anterior commissure and one at the posterior commissure. The resulting transform will bring the line connecting them to horizontal to the AP axis. The midline is a series of points defining the division between the hemispheres of the brain (the mid sagittal plane). The resulting transform will put the output volume with the mid sagittal plane lined up with the AS plane. Use the Filtering module **Resample Scalar/Vector/DWI Volume** to apply the transformation to a volume.
 For more detailed documentation see: <http://wiki.slicer.org/slicerWiki/index.php/Modules:RealignVolume-Documentation-3.4>

ACPC Transform

Parameter set: [None]

Status: Idle

Transform

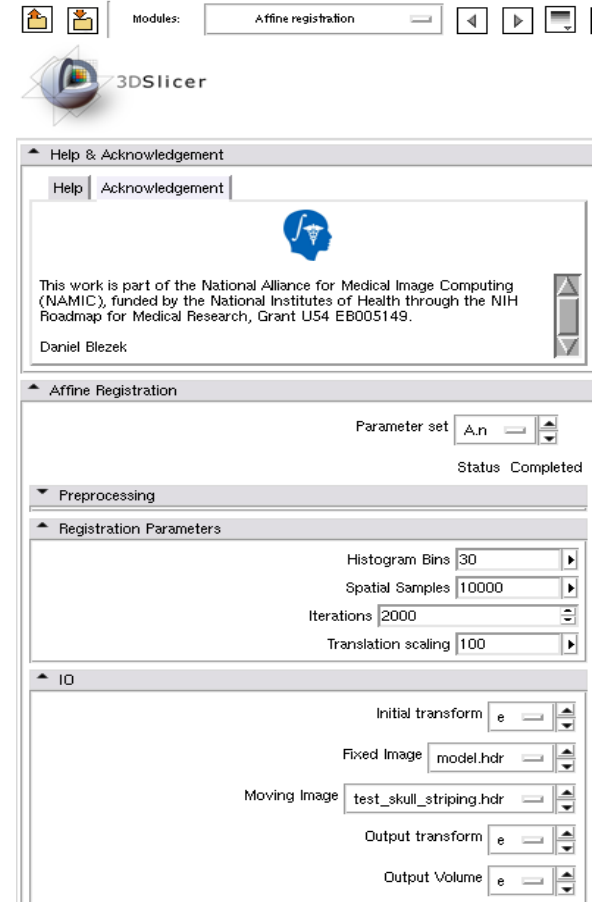
ACPC Line: [None]

Midline: [None]

Output transform: [None]

Debug

or



Modules: Affine registration

3DSlicer

Help & Acknowledgement

Help | Acknowledgement

This work is part of the National Alliance for Medical Image Computing (NAMIC), funded by the National Institutes of Health through the NIH Roadmap for Medical Research, Grant U54 EB005149.
 Daniel Blezek

Affine Registration

Parameter set: A.n

Status: Completed

Preprocessing

Registration Parameters

Histogram Bins: 30

Spatial Samples: 10000

Iterations: 2000

Translation scaling: 100

IO

Initial transform: [e]

Fixed Image: model.hdr

Moving Image: test_skull_stripping.hdr

Output transform: [e]

Output Volume: [e]

Step 2: Skull Stripping

Help & Acknowledgement

Help Acknowledgement

This work is part of the National Alliance for Medical Image Computing (NAMIC), funded by the National Institutes of Health through the NIH Roadmap for Medical Research, Grant U54 EB005149.

Xiaodong Tao, taox@research.unc.edu

Skull Stripper For Structural MR

Parameter set: R ←

Status: Completed

IO

Input Volume: t.r ←

Output brain surface: S...J ←

Brain Mask: e ←

Skull Stripping Parameters

Iterations: 100 ←

Subdivisions: 20 ←

Dilation Radius after deformation: 3 ←

Optional Output

Default Cancel Apply

Default parameter set

Input file name

Output brain surface file name

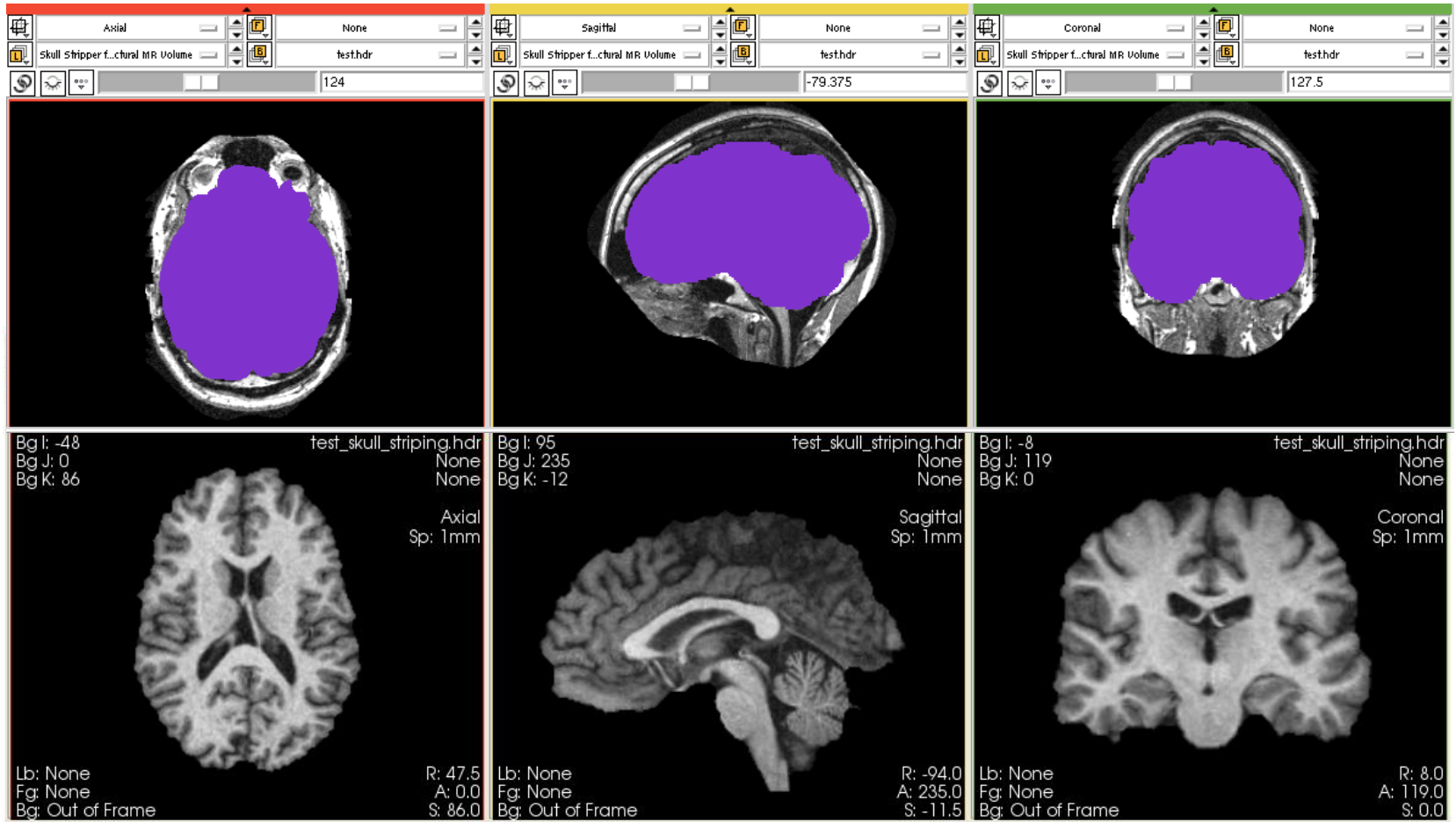
Brain mask file

Iterations used in skull stripping

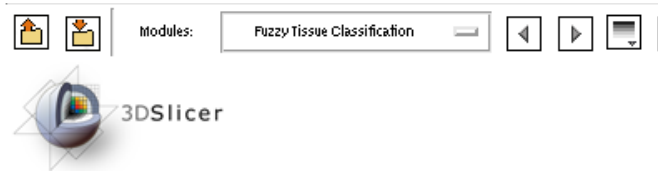
The number of sub-divisions

The dilation radius after deformation

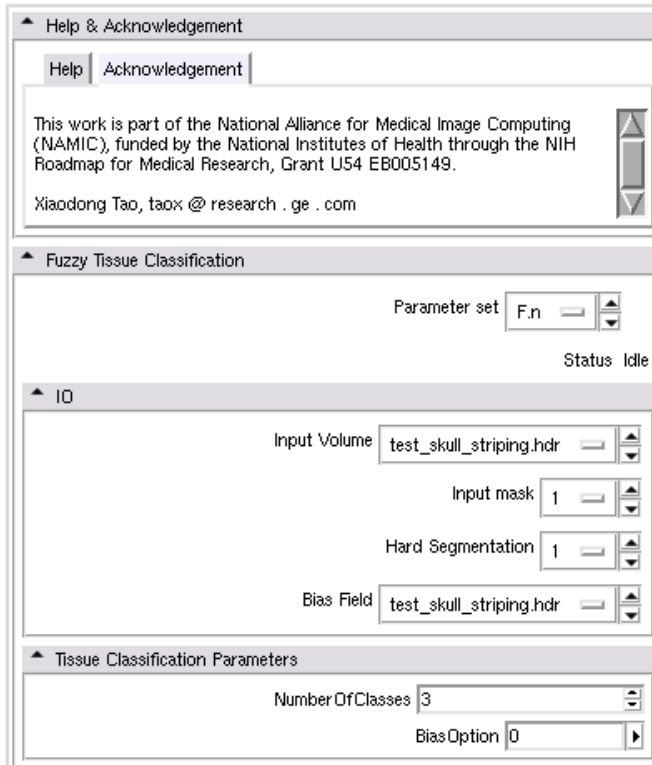
Skull Striping Result



Step 3: Tissue Segmentation

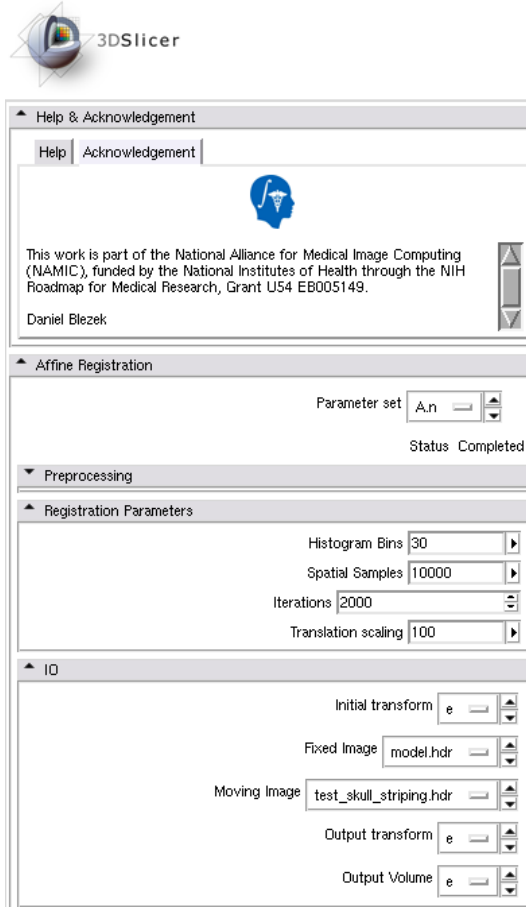


Segmentation and bias correction with 'Fuzzy Tissue Classification' in Slicer3



- ← *Input file name*
- ← *Input Mask file name*
- ← *Output hard segmentation result*
- ← *Output bias field result*
- ← *The number of tissue types*
- ← *The option for bias correction*

Step 4: Affine Registration



The number of histogram bins

The number of iterations

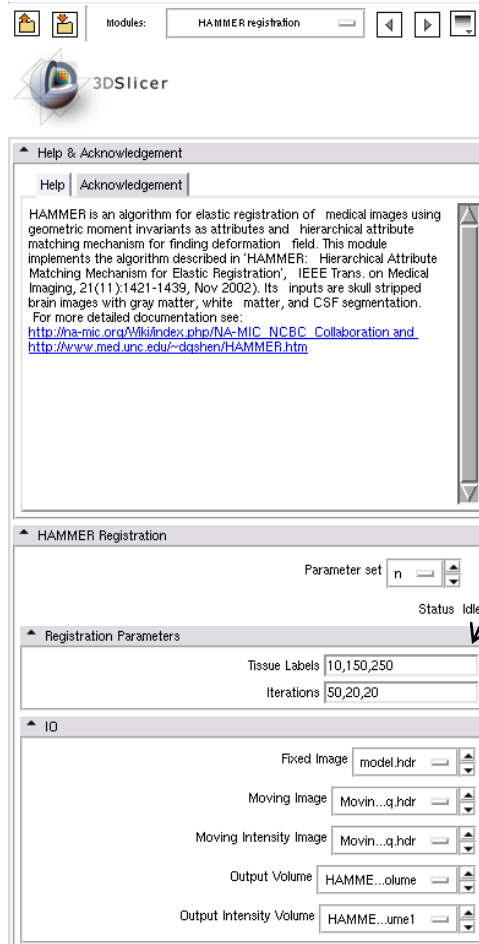
Fixed Image

Moving Image

Output transformation

Output affine registration result

Step 5: HAMMER Registration



The labeling of WM, GM, and CSF in HAMMER

The number of iterations in each resolution

Fixed image

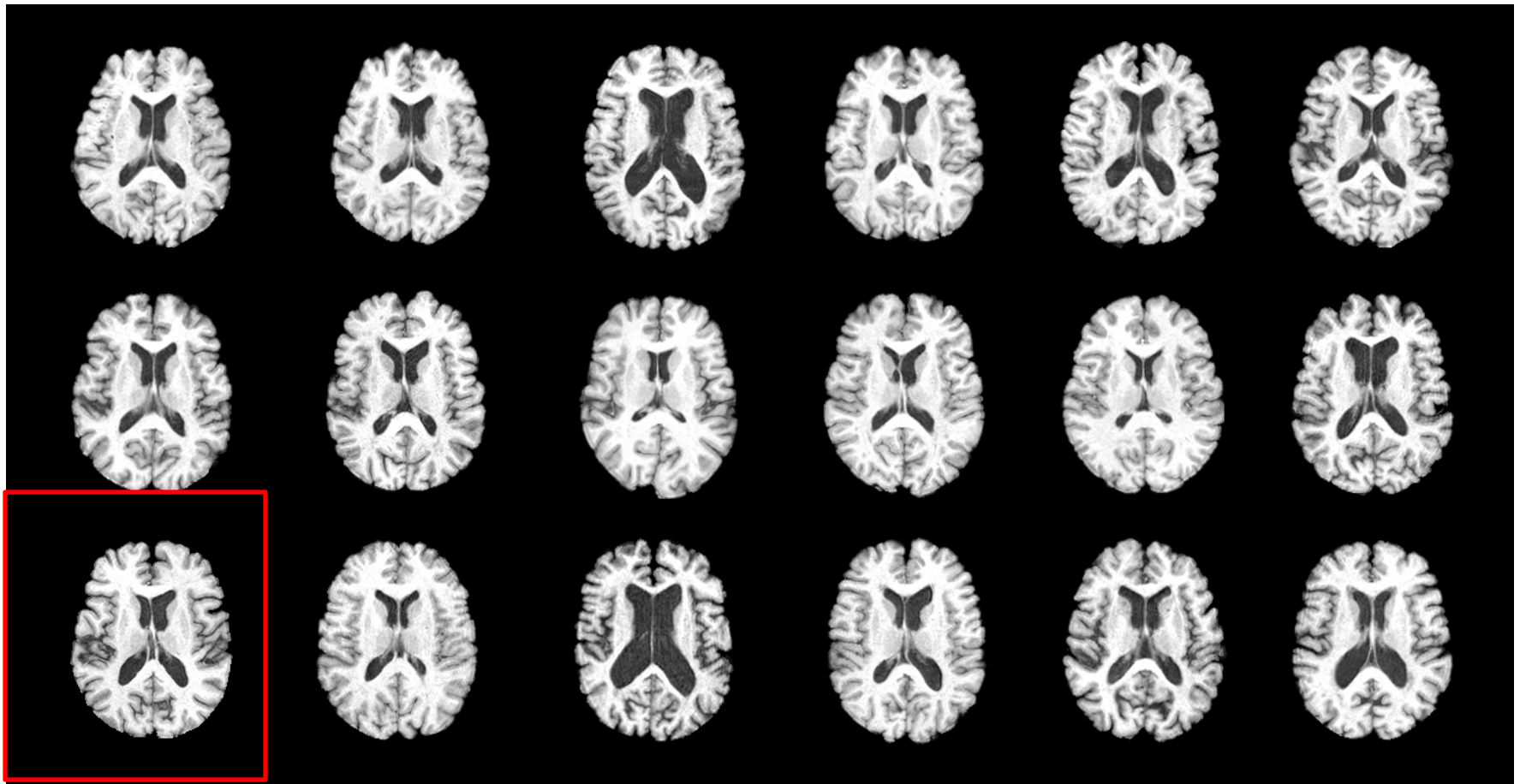
Moving segmented image

Moving intensity image

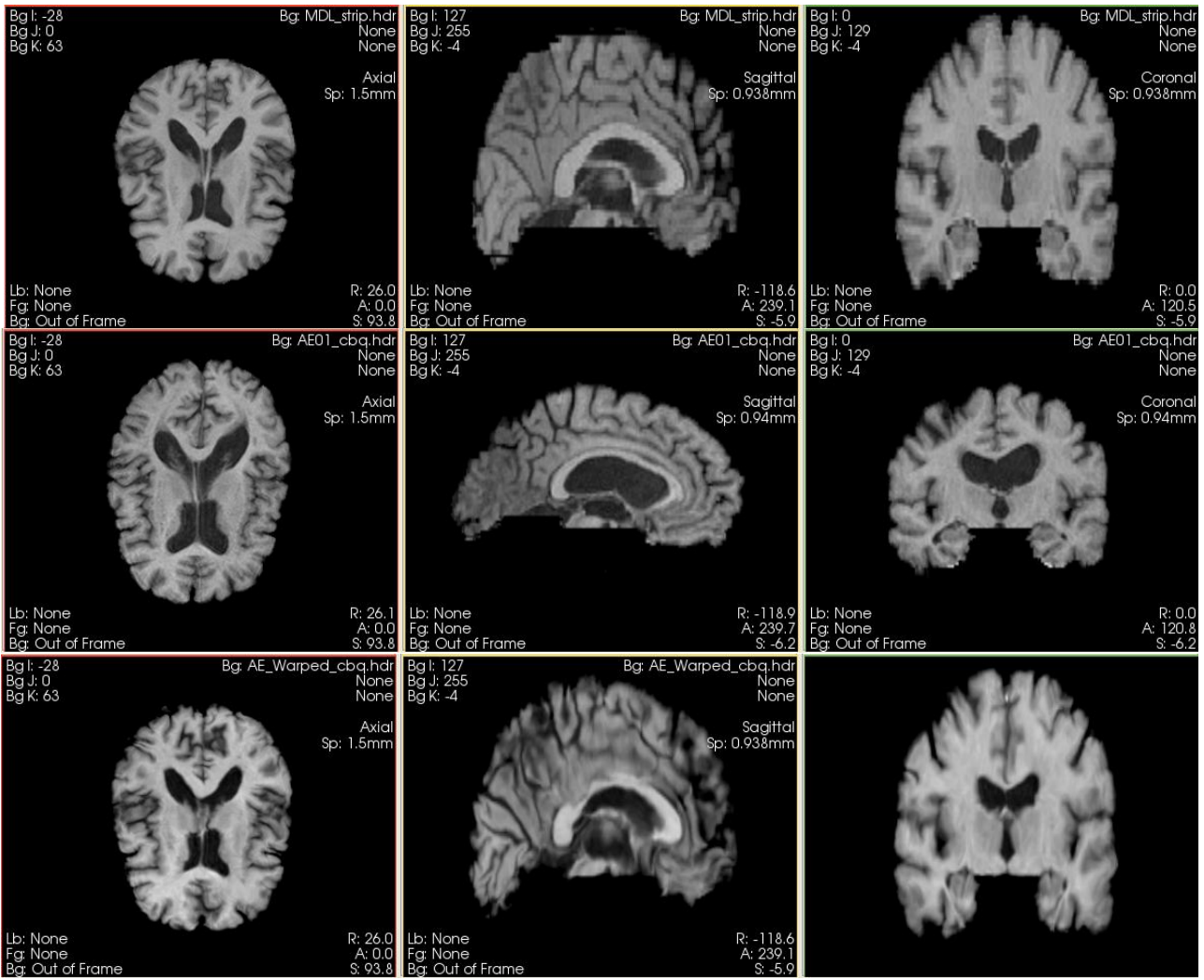
Output segmented image

Output intensity image

Experiment 1: 18 Elder Brains From BLSA Dataset



HAMMER: Results

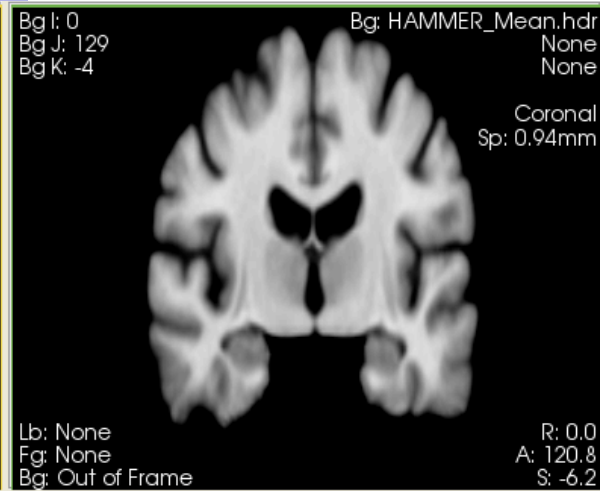
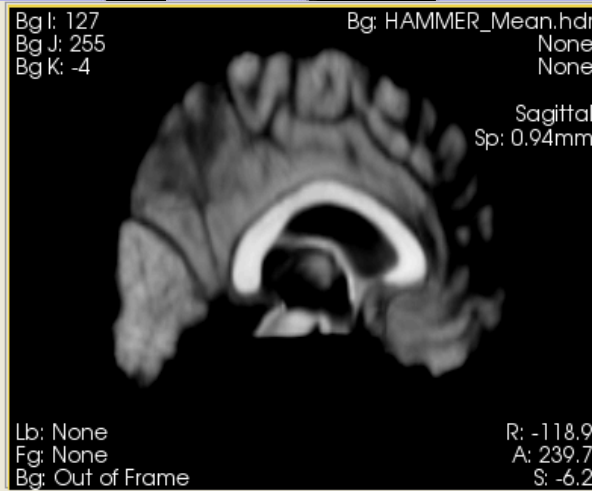
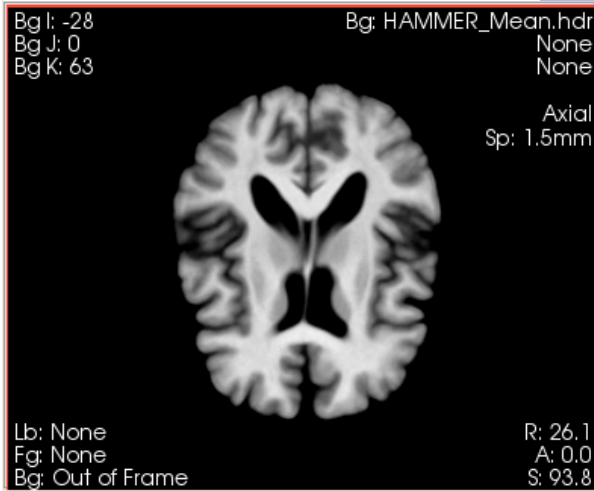
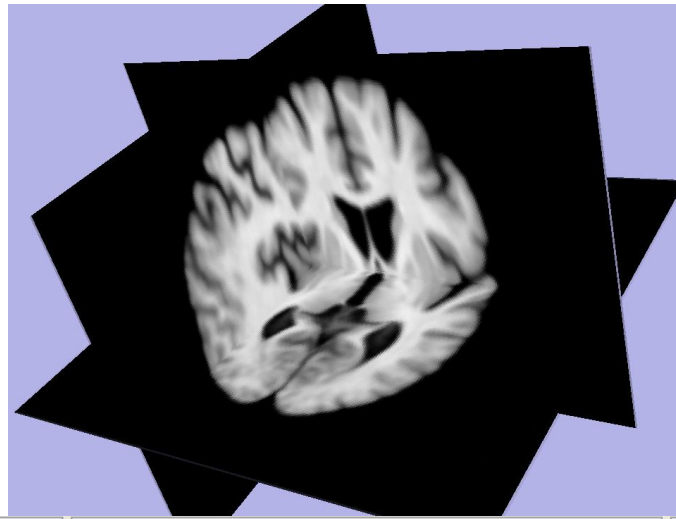


Template

Subject

Registration
result by
HAMMER

Average Image





HAMMER: Results



40 LONI Dataset with 54 manually labeled RIOs

Laboratory of Neuro Imaging

Enter search keyword

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LONI >

LONI Atlases

An atlas of the brain allows us to define its spatial characteristics. Where is a given structure; relative to what other features; what are its shape and characteristics and how do we refer to it? Where is this region of functional activation? How different is this brain compared with a normal database? An atlas allows us to answer these and related questions quantitatively.

Brain atlases are built from one or more representations of brain. They describe one or more aspects of brain structure and/or function and their relationships after applying appropriate registration and warping strategies, indexing schemes and nomenclature systems. Atlases made from multiple modalities and individuals provide the capability to describe image data with statistical and visual power.

An atlas can take on many forms, from descriptions of structure or function of the whole brain to maps of groups or populations. Individual systems of the brain can be mapped as can changes over time, as in development or degeneration. An atlas enables comparison across individuals, modalities or states. Differences between species can be catalogued. But in most cases, the value added by brain atlases is the unique and critical ability to integrate information from multiple sources. The utility of an atlas is dependent upon appropriate coordinate systems, registration and deformation methods along with useful visualization strategies. Accurate and representative atlases of brain hold the most promise for helping to create a comprehensive understanding of brain in health and disease.

IN THIS SECTION:

Available Atlases

[Alzheimer's Disease Template](#)

[Human Atlas](#)

[ICBM 452 T1 Atlas](#)

[ICBM DTI-81 Atlas](#)

[ICBM Probabilistic Atlases](#)

[ICBM T2 Atlas](#)

[ICBM Template](#)

[LPBA40](#)

[Monkey Atlas](#)

[Mouse Atlas](#)

[Mouse Minimum](#)

[Deformation Atlas \(MDA\)](#)

[Neonatal \(P0\) Mouse Nissl Brain Atlas](#)

[Neonatal \(P0\) MRI Mouse](#)

[Brain Atlas](#)

[Rat Atlas](#)

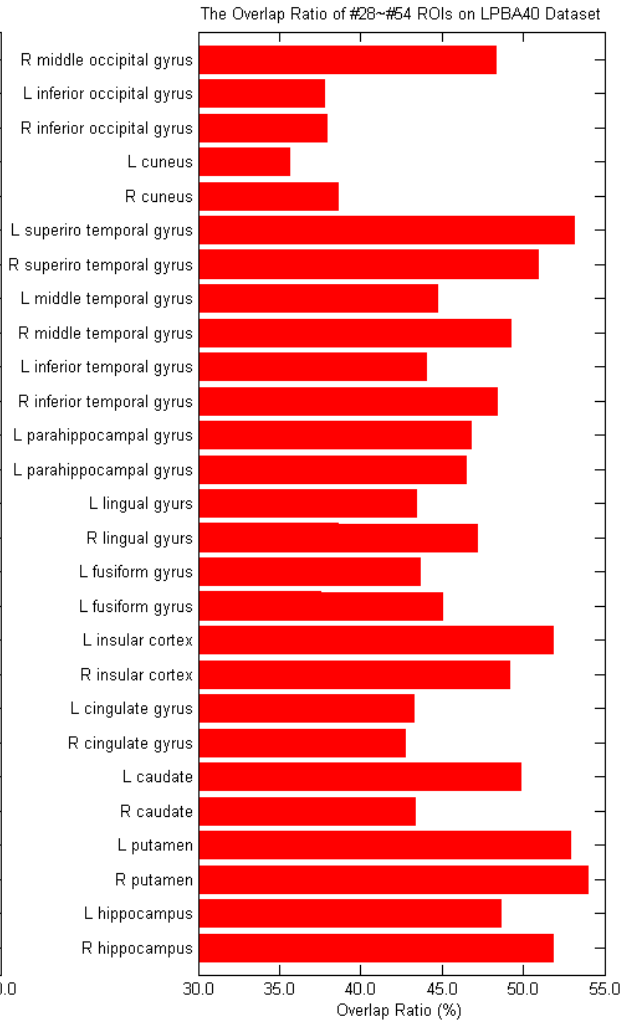
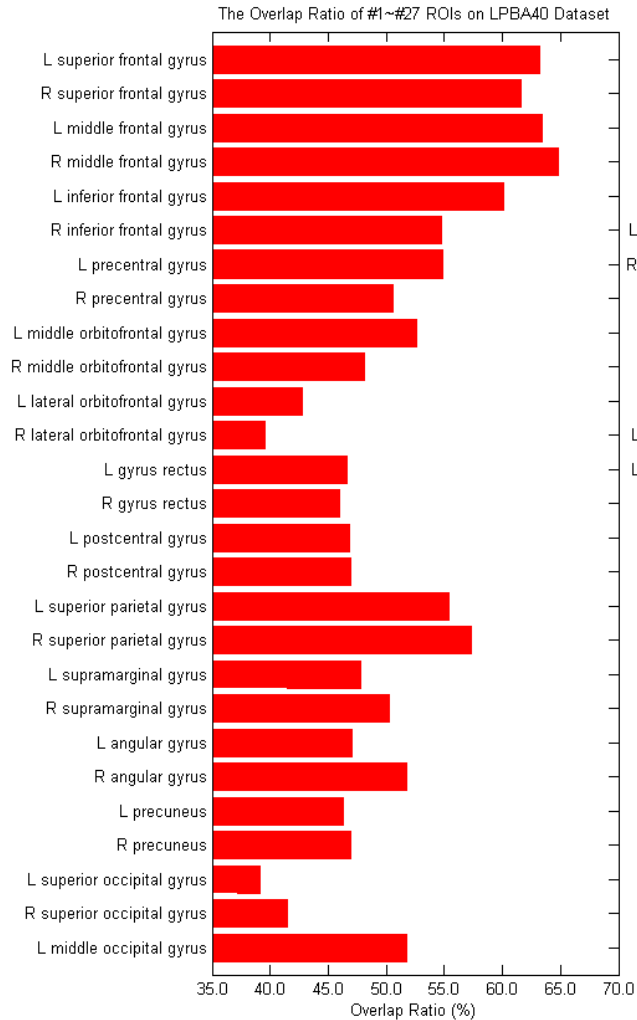


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THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL





Thanks!

Modules: Transforms

3DSlicer

Help & Acknowledgement

Load

Load Transforms

Display And Edit

Transform Editor

Transform Node: Linear Transform

1.000000	0.000000	0.000000	0.000000
0.000000	1.000000	0.000000	0.000000
0.000000	0.000000	1.000000	0.000000
0.000000	0.000000	0.000000	1.000000

Translation

LR

PA

IS

Min Translation Limit

Max Translation Limit

Rotation

LR

PA