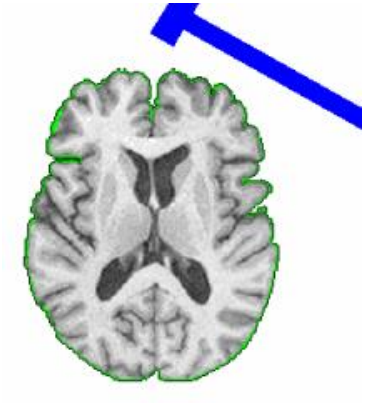
Using HAMMER in 3D Slicer



Guorong Wu*, Xiaodong Tao+, Jim Miller+, and Dinggang Shen*

*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.

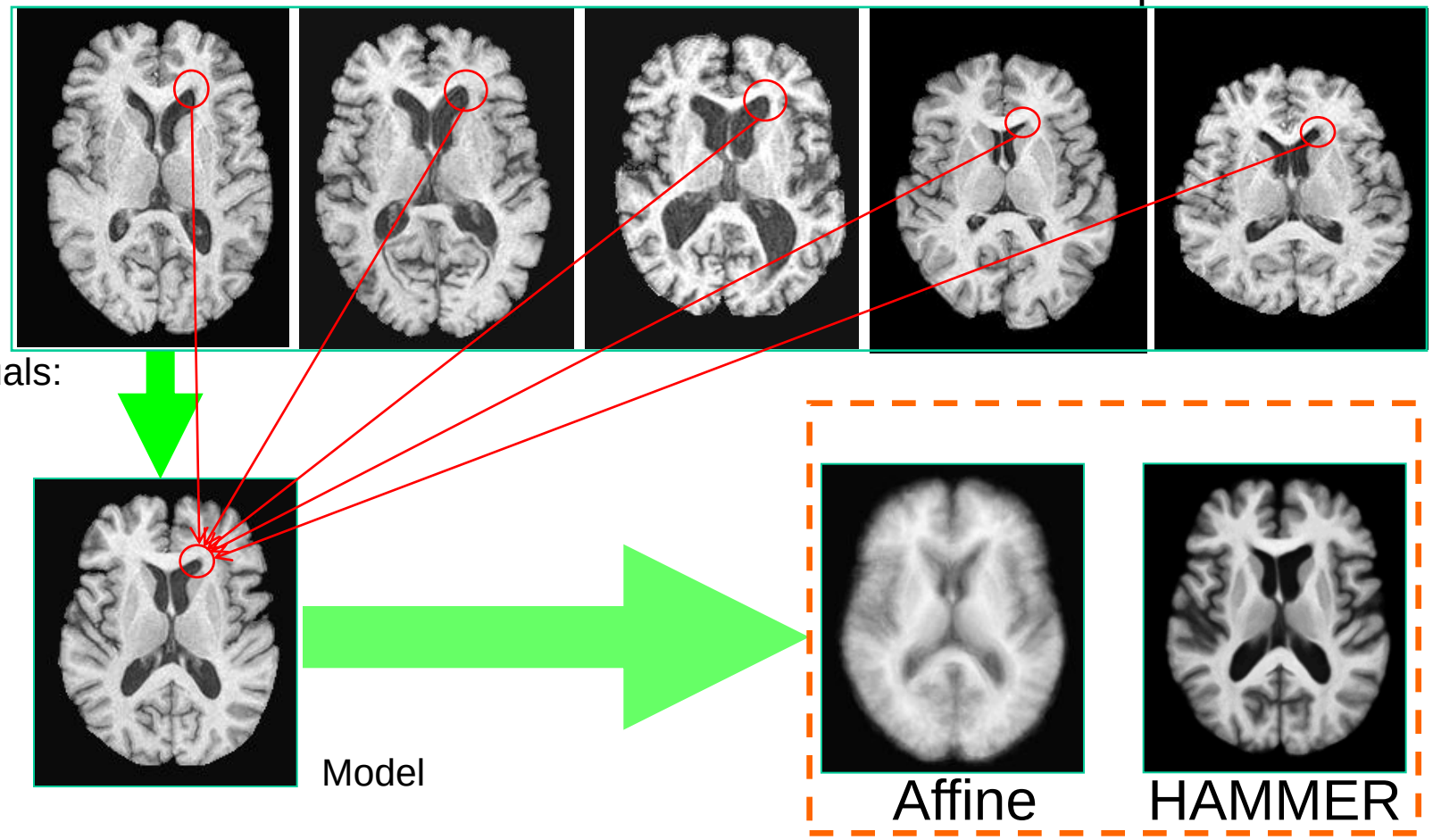
Using HAMMER in 3D Slicer

Contents

- Introduction
- Data processing pipeline
- Registration using HAMMER
- Step-by-step tutorial

Introduction

- The goal of deformable registration of brain images
  --- Establish anatomical correspondences

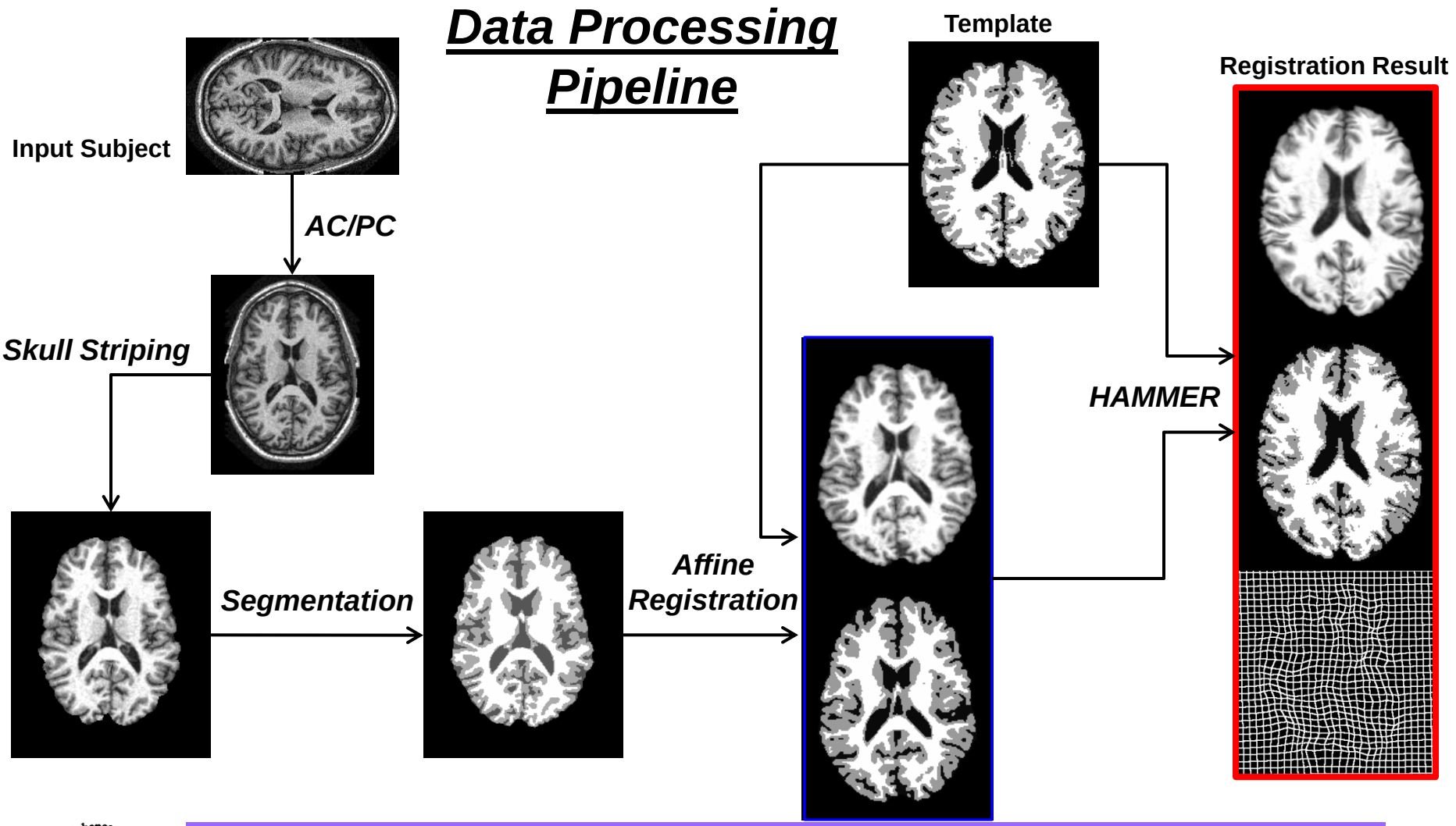


Introduction

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

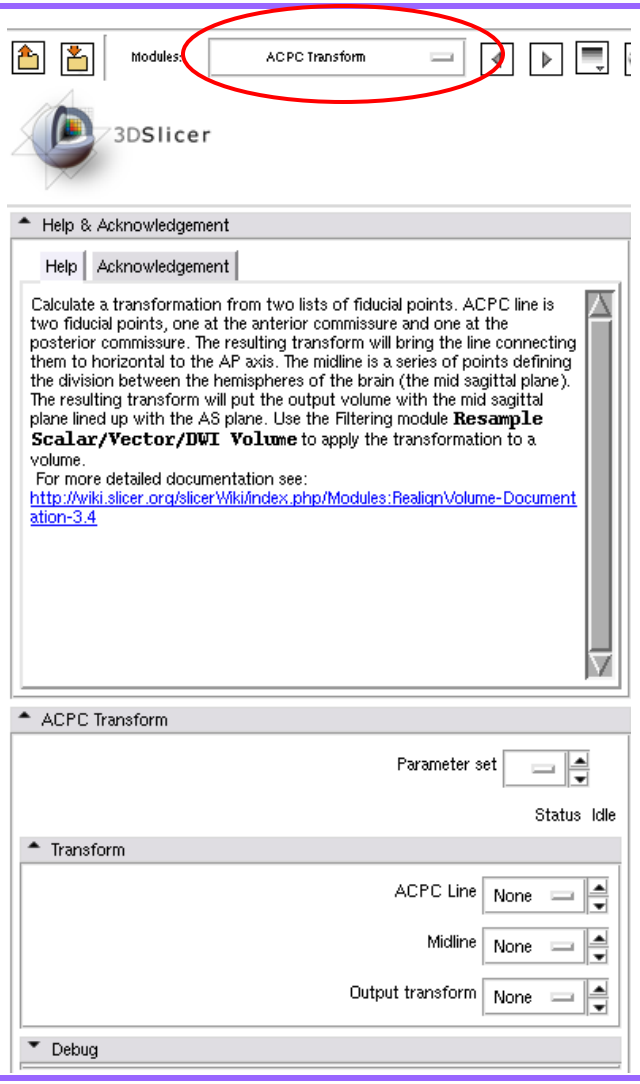
- HAMMER has been used to align over 8,000 brains image since 2002.
- The TMI paper describing HAMMER received the 2006 Best Paper Award from the IEEE Signal Process Society.

HAMMER in 3D Slicer3



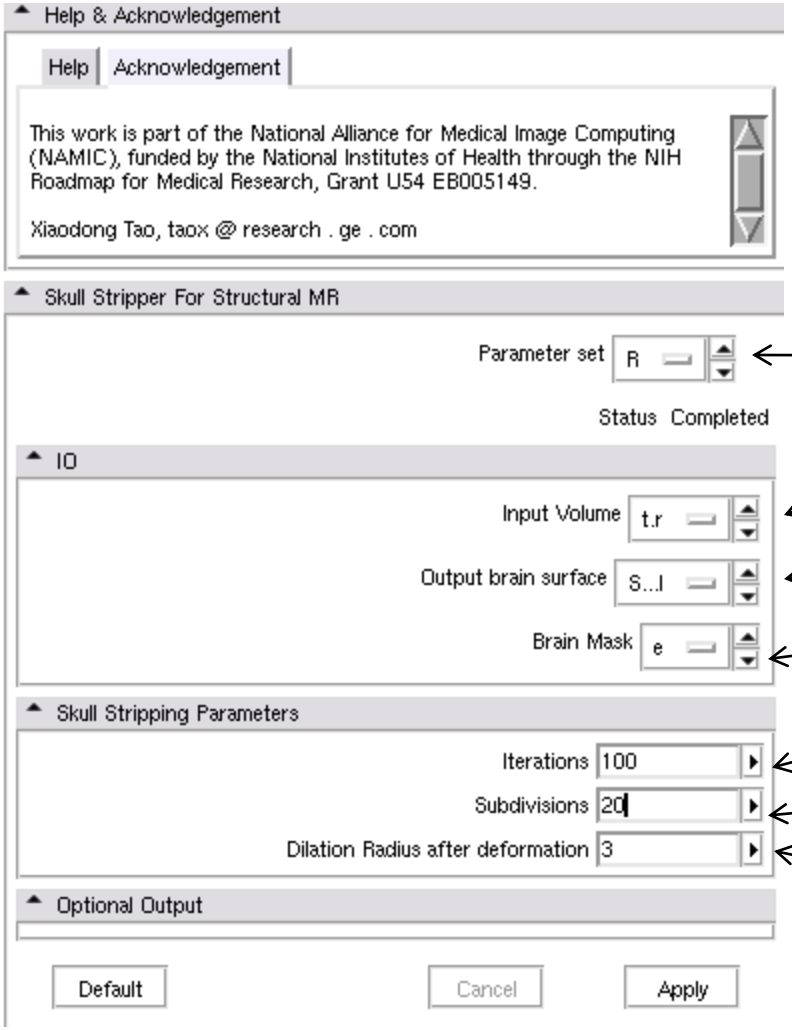
HAMMER in 3D Slicer3

AC/PC alignment



HAMMER in 3D Slicer

Skull striping



Default parameter set

Input file name

Output brain surface file name

Brain mask file

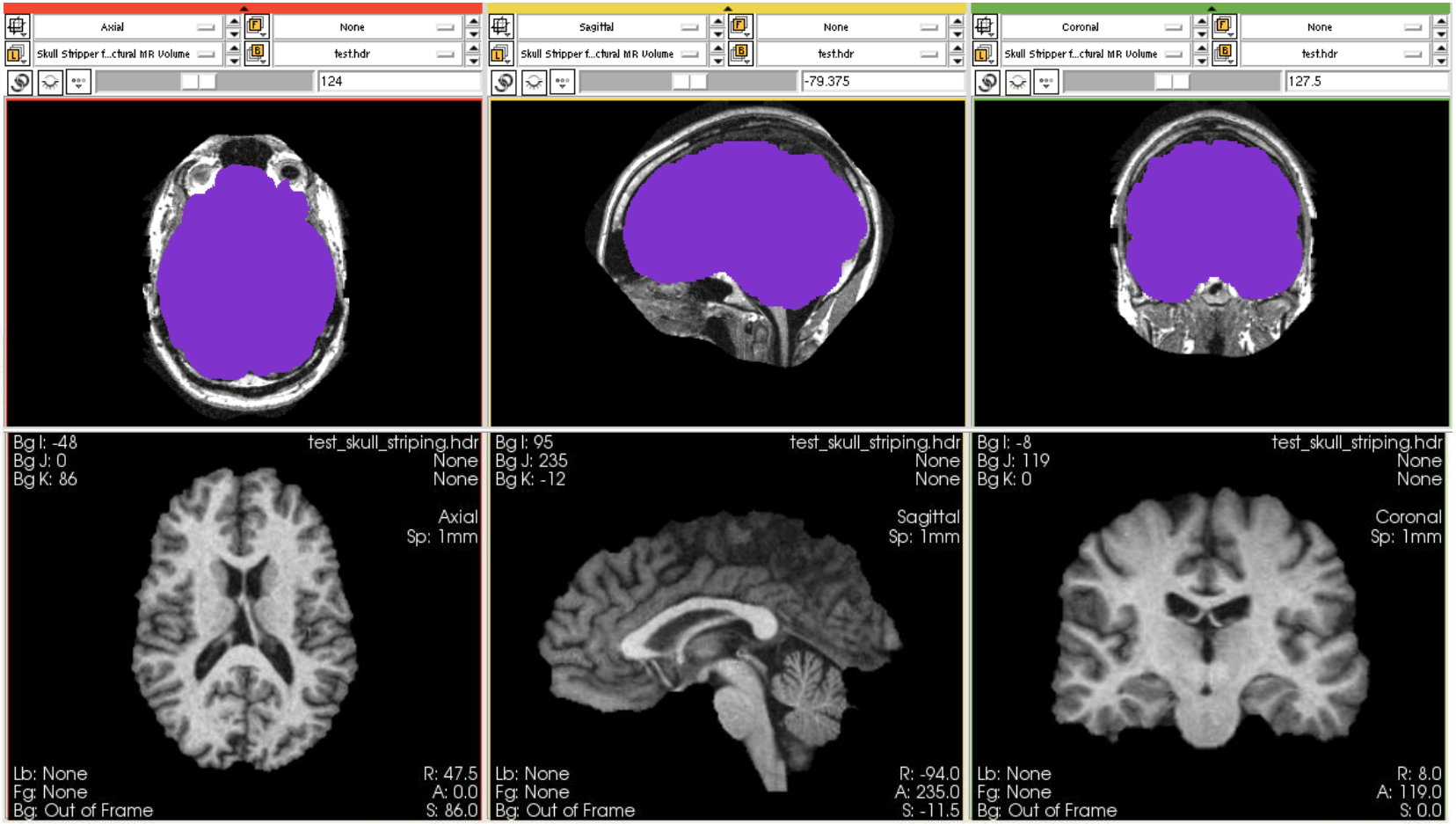
Iterations used in skull stripping

The number of sub-divisions

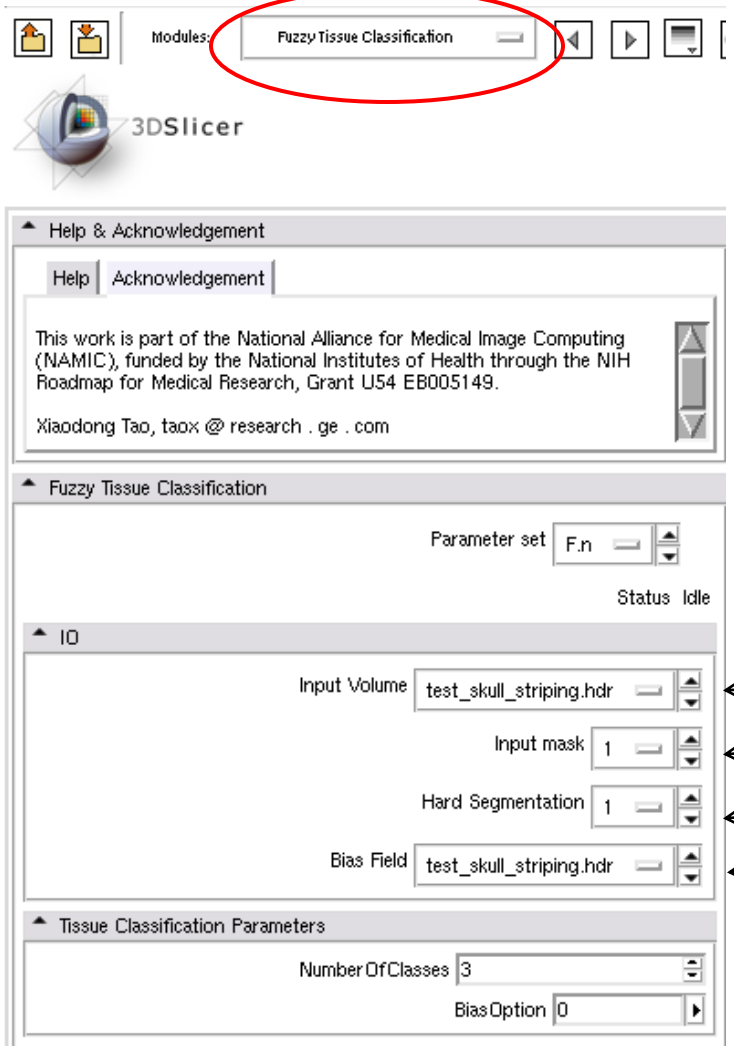
The dilation radius after deformation

HAMMER in 3D Slicer

Skull Striping



HAMMER in 3D Slicer



Segmentation and bias correction with 'Fuzzy Tissue Classification' in 3D Slicer

Input file name

Input mask file name

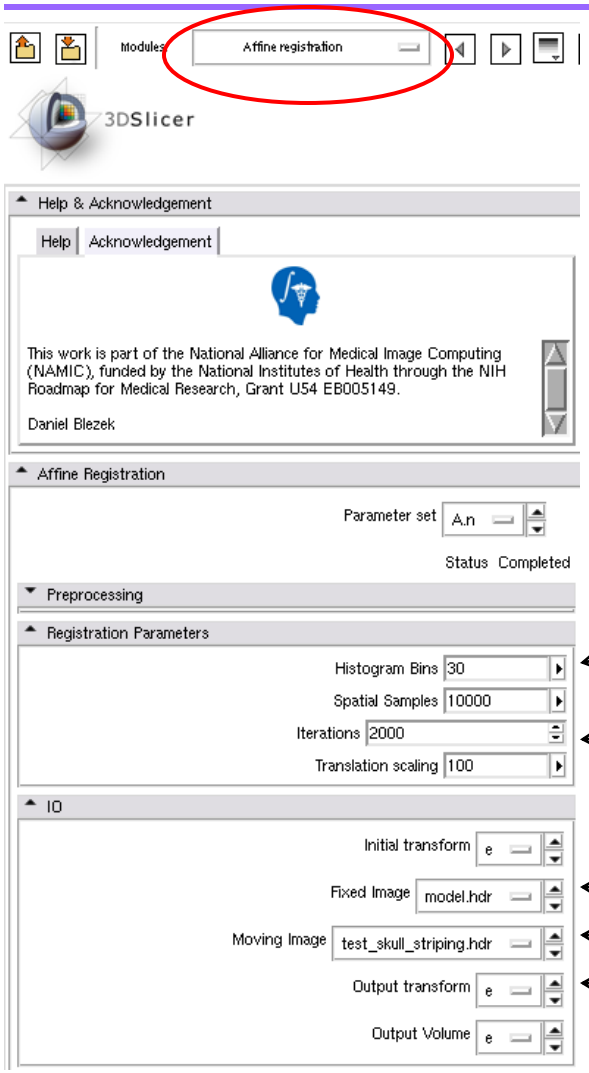
Output hard segmentation result

Output bias field result

The number of tissue types

The option for bias correction

HAMMER in 3D Slicer



Affine Registration in Slicer3

The number of histogram bins

The number of iterations

Fixed image

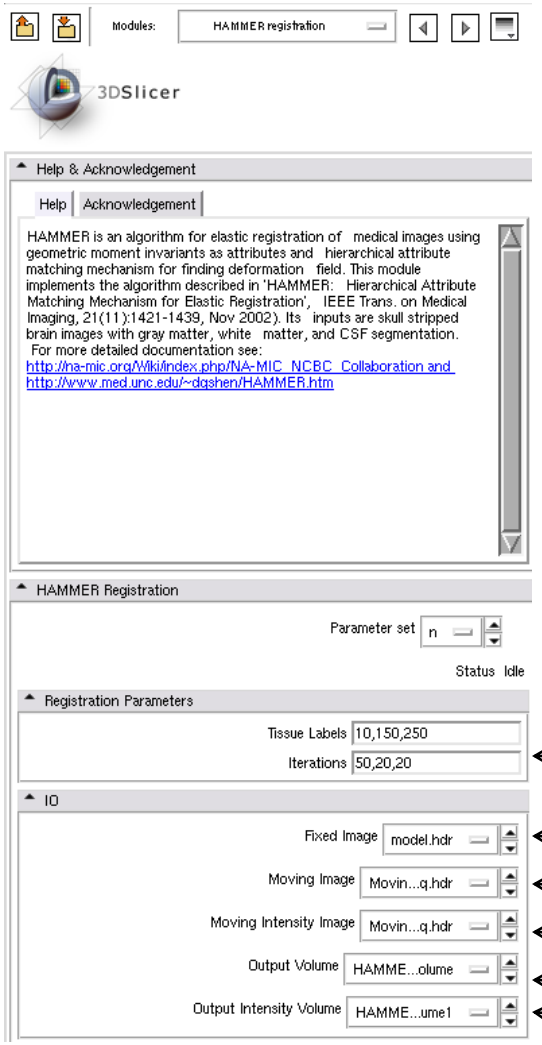
Moving image

Output transformation

Output affine registration result

HAMMER in 3D Slicer

HAMMER Registration in Slicer3



The number of iterations in each resolution

Fixed image

Moving segmented image

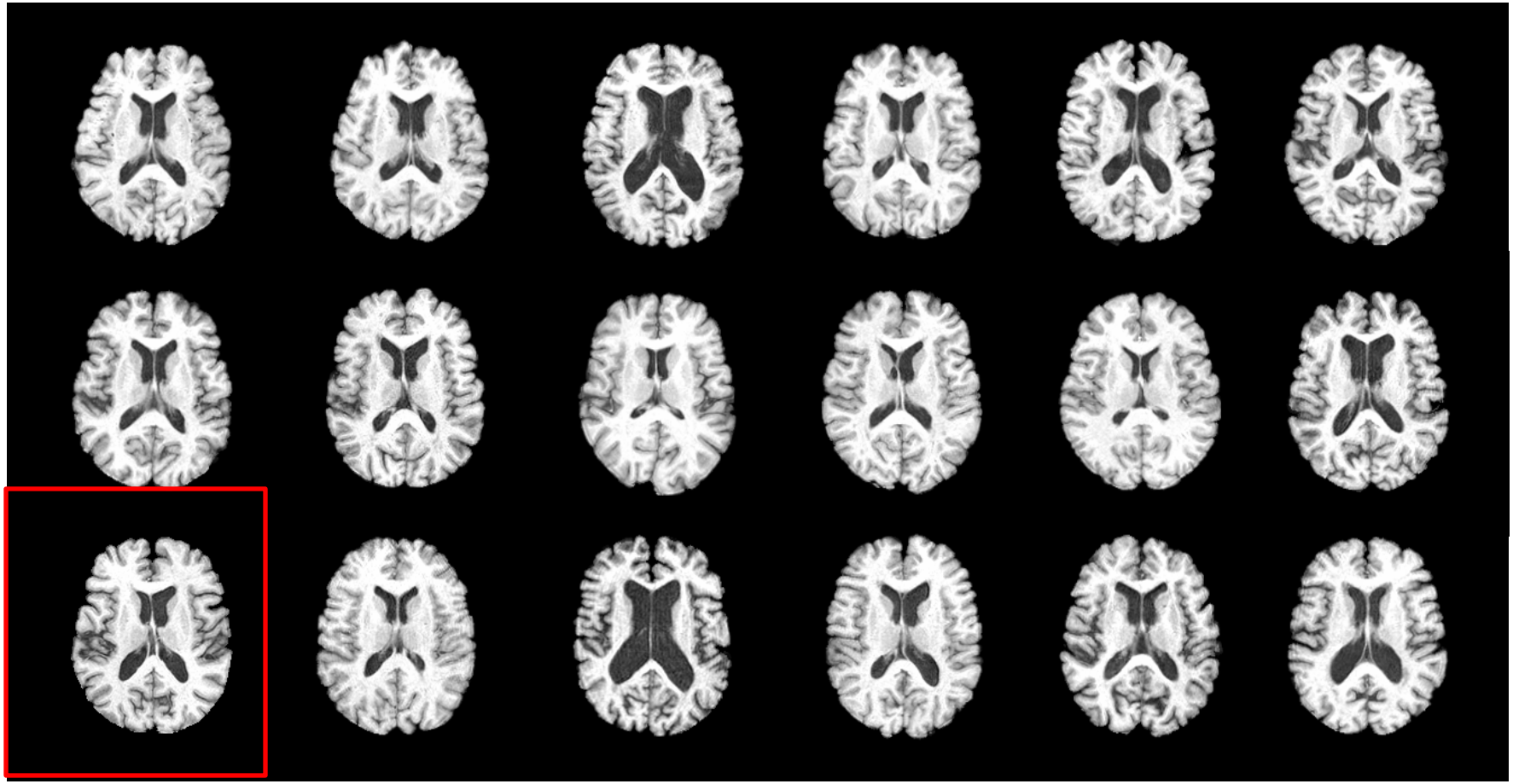
Moving intensity image

Output segmented image

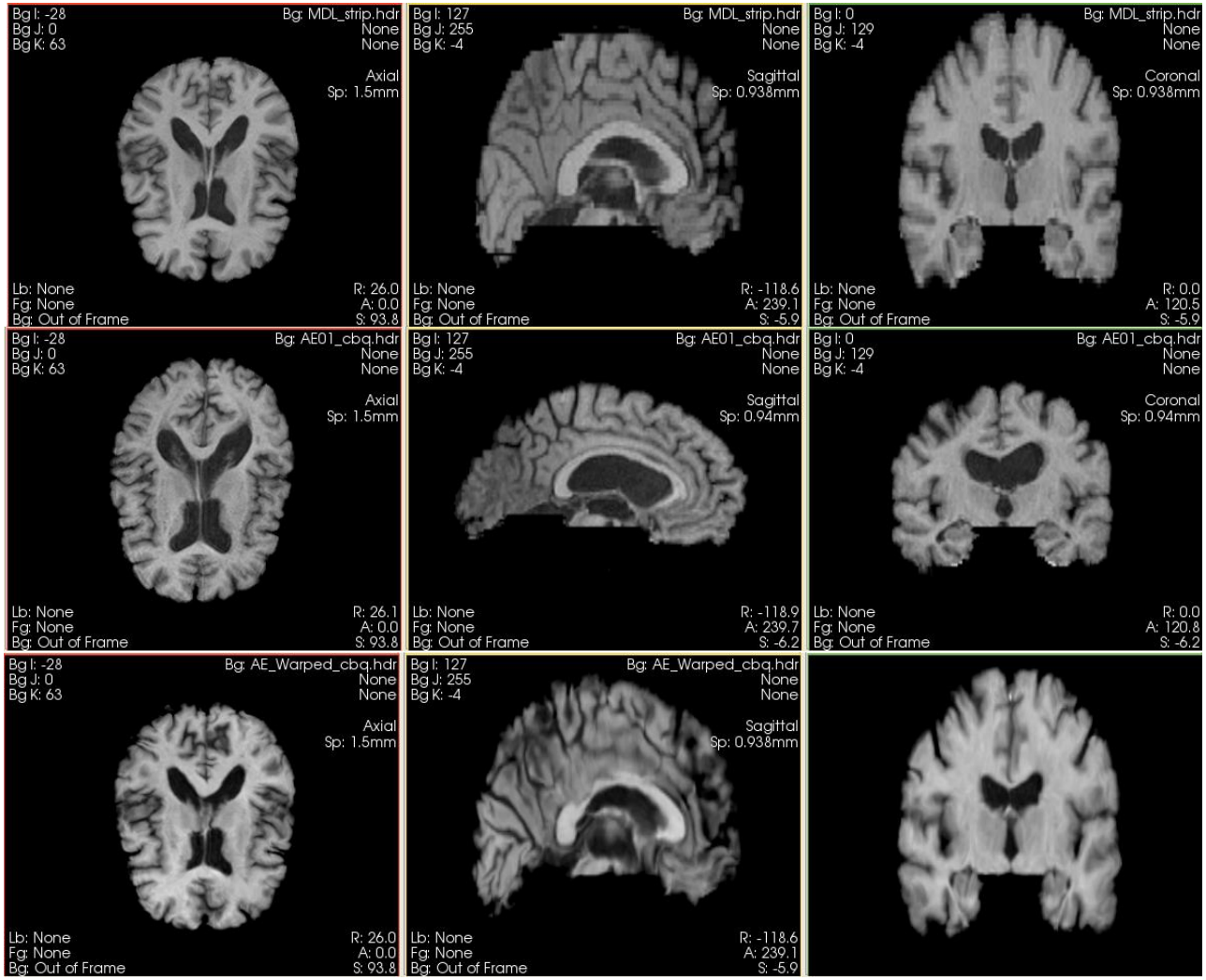
Output intensity image

HAMMER: Results

Experiment 1: 18 Elderly Brains From BLSA Dataset



HAMMER: Results



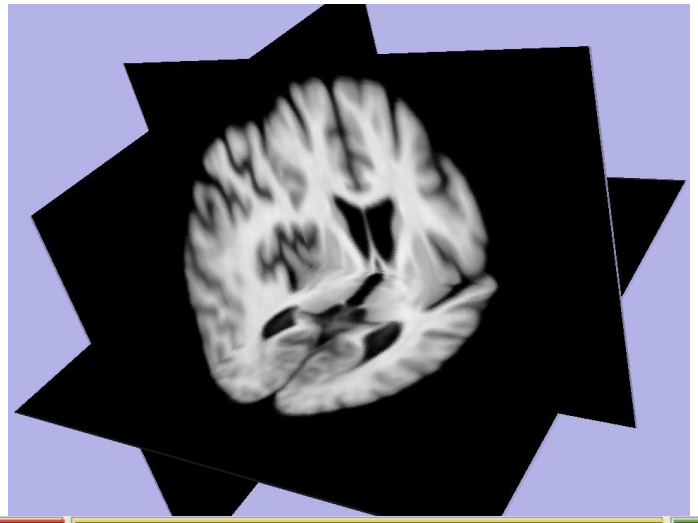
Template

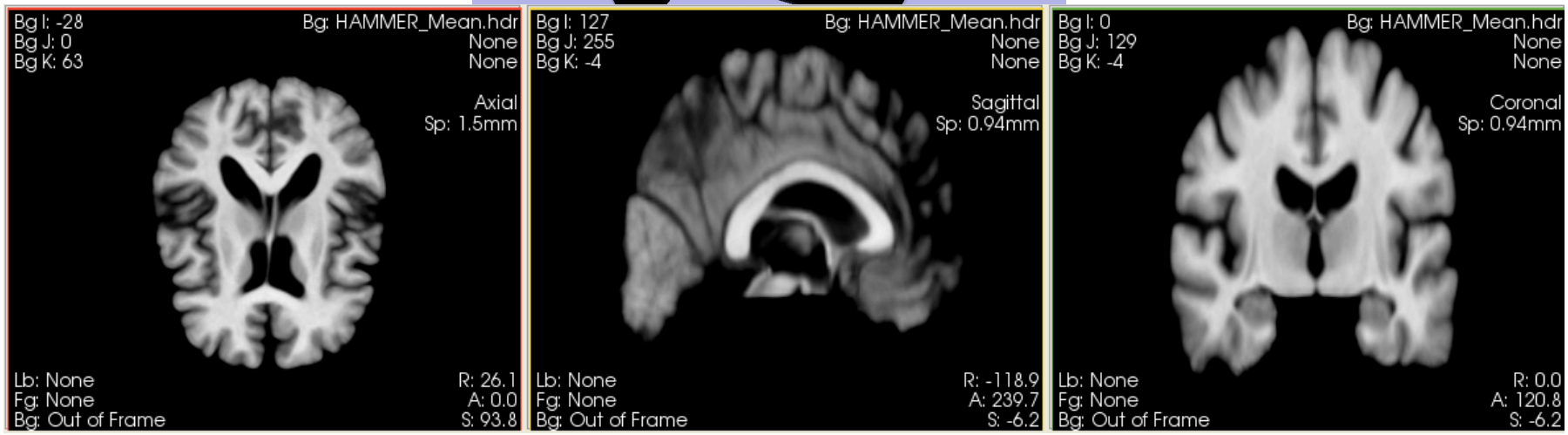
Subject

Registration by HAMMER

HAMMER: Results

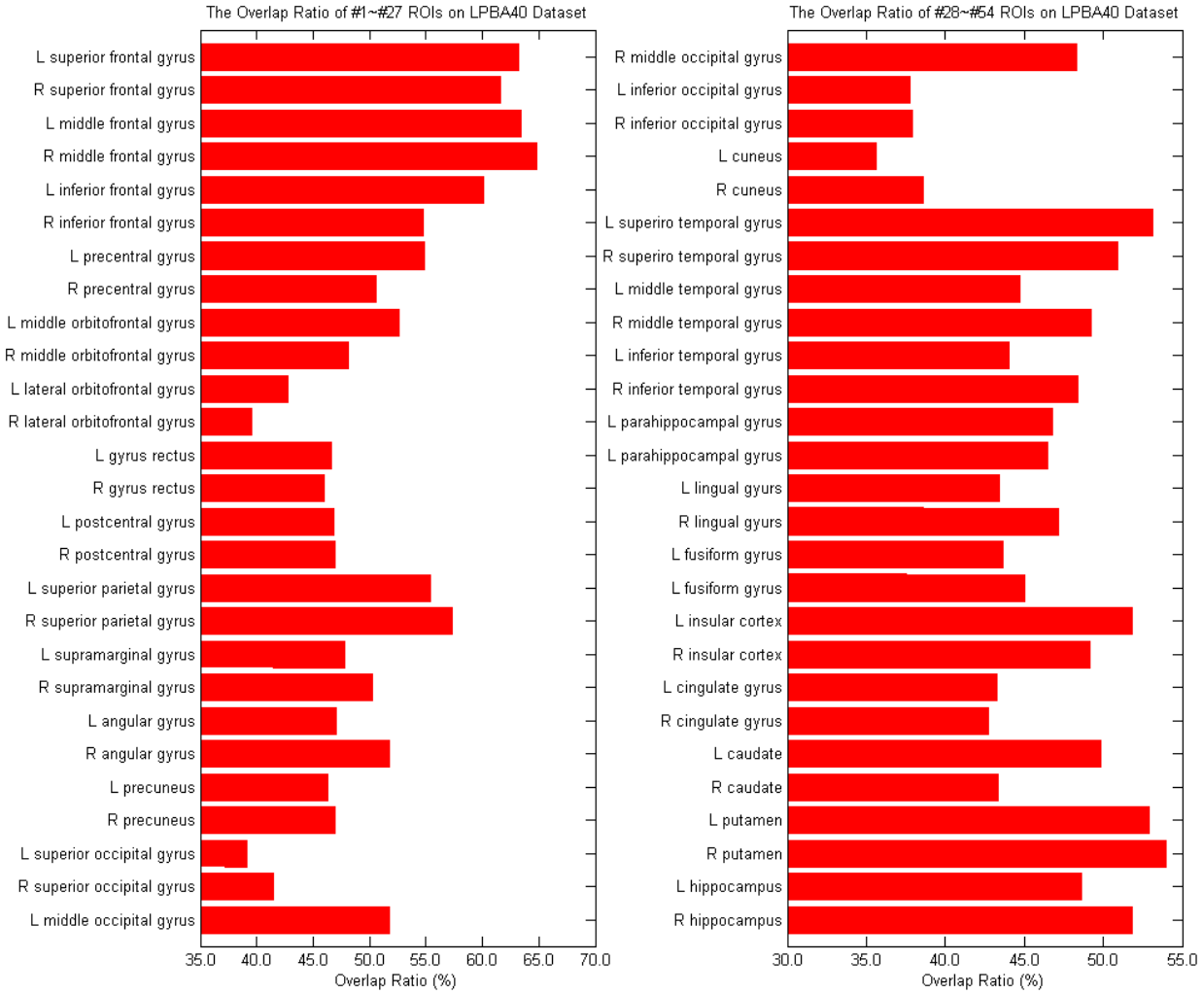
Average Image

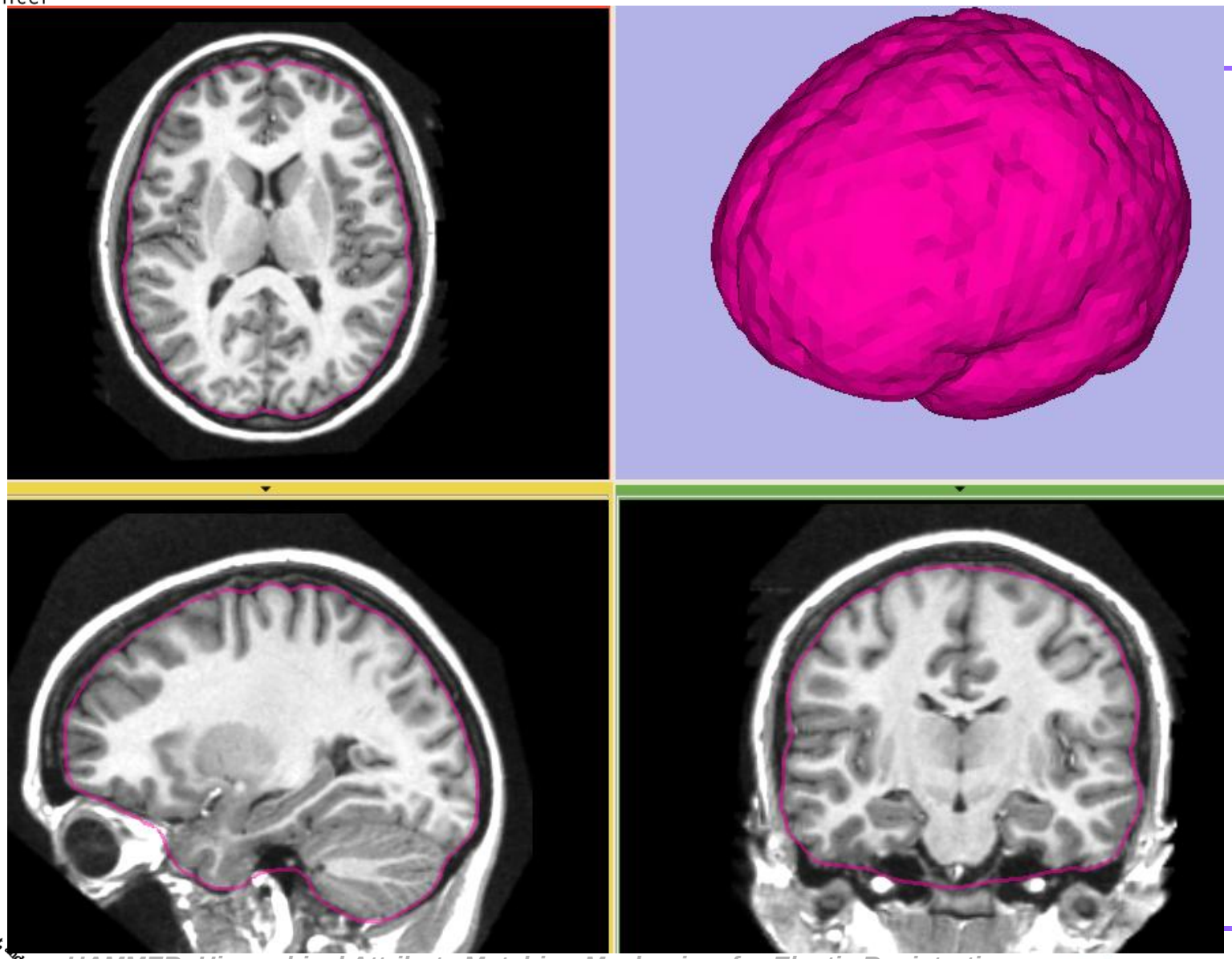




40 LONI Dataset with 54 manually labeled RIOs

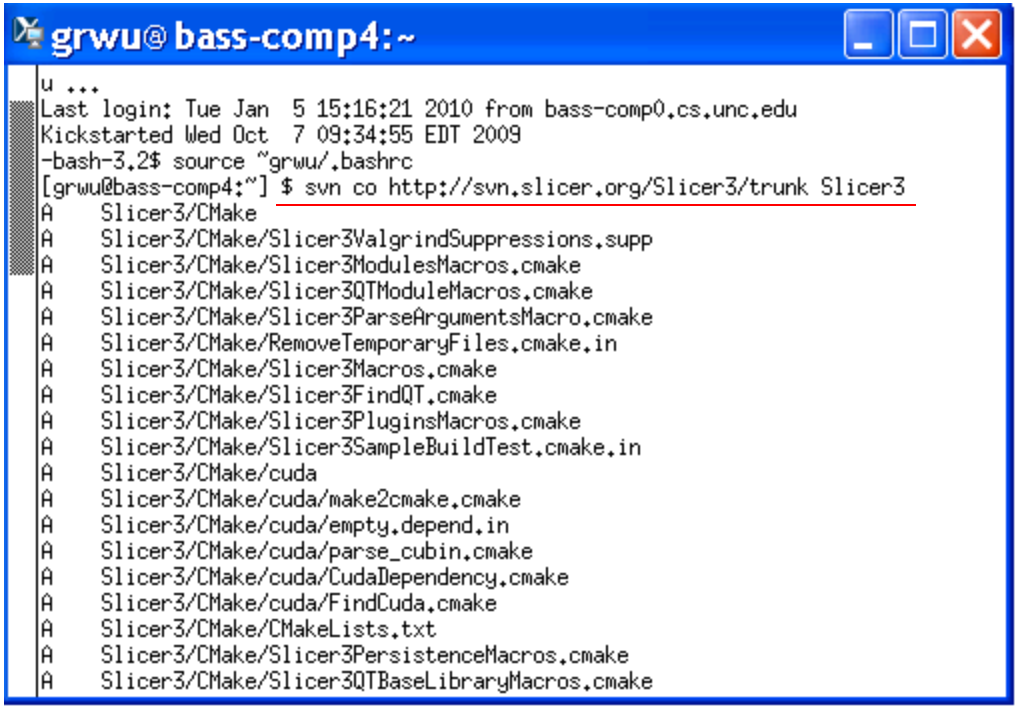
HAMMER: Results



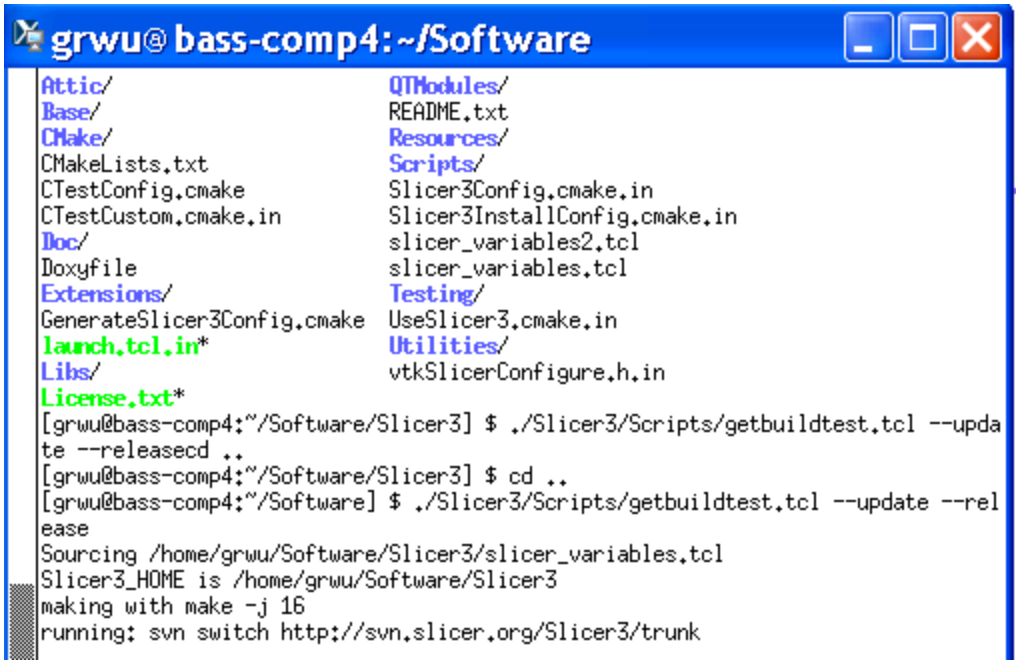

3DSlicer

Step-by-step tutorial

HAMMER - 3D Slicer Setup



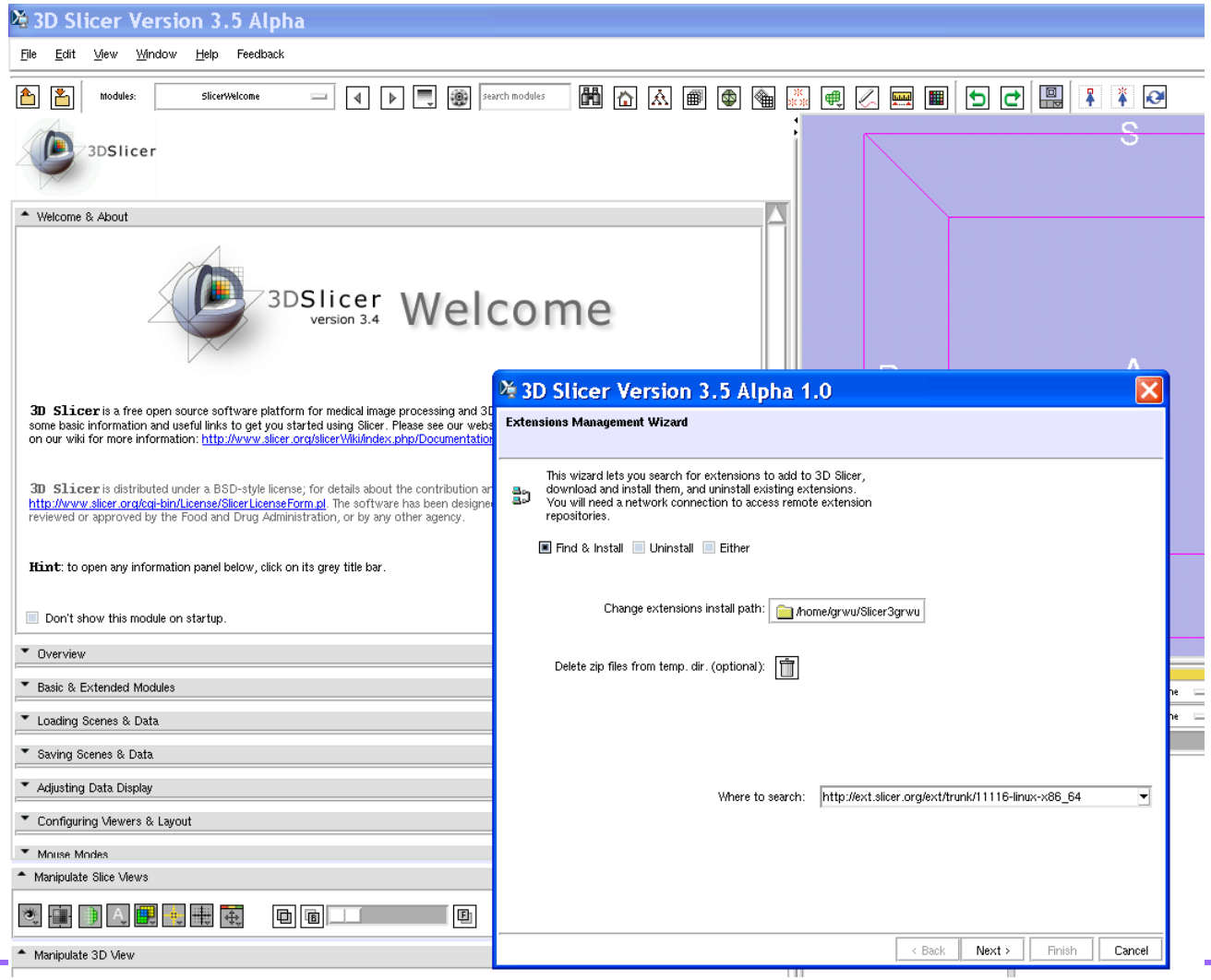
HAMMER – 3D Slicer Setup



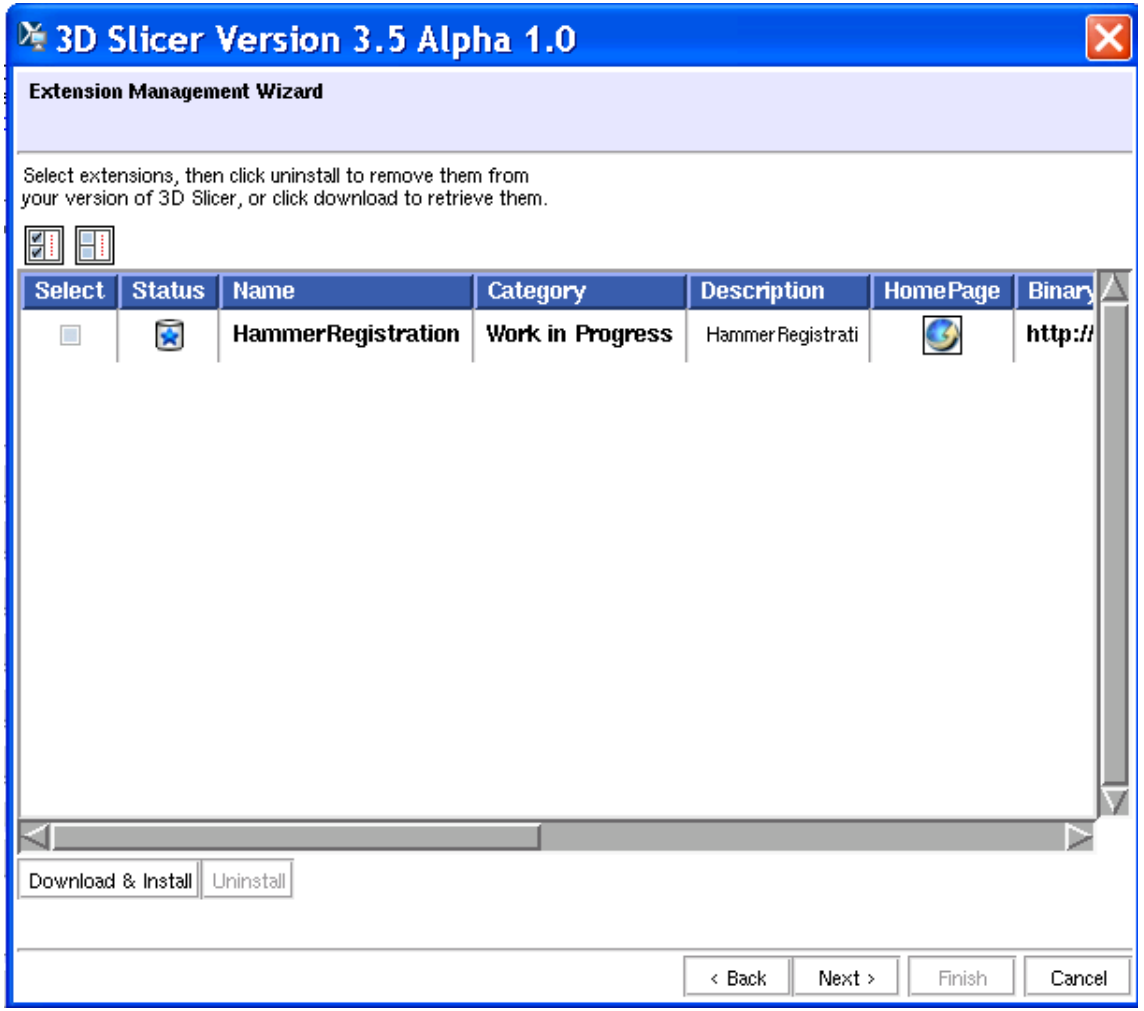
HAMMER – 3D Slicer Setup

```
home/grwu/Software/Slicer3-ext/HammerRegistration-build/CMakeFiles  1 2
[100%] Built target HammerRegistration
make[1]: Leaving directory `/home/grwu/Software/Slicer3-ext/HammerRegistration-b
uild'
/home/grwu/Software/Slicer3-lib/CMake-build/bin/cmake -E cmake_progress_start /h
ome/grwu/Software/Slicer3-ext/HammerRegistration-build/CMakeFiles 0
make -f CMakeFiles/Makefile2 preinstall
make[1]: Entering directory `/home/grwu/Software/Slicer3-ext/HammerRegistration-
build'
make[1]: Nothing to be done for `preinstall'.
make[1]: Leaving directory `/home/grwu/Software/Slicer3-ext/HammerRegistration-b
uild'
Install the project...
/home/grwu/Software/Slicer3-lib/CMake-build/bin/cmake -P cmake_install.cmake
-- Install configuration: "Debug"
-- Installing: /home/grwu/Software/Slicer3/../Slicer3-ext/HammerRegistration-ins
tall/lib/Slicer3/Plugins/HammerRegistration
-- Removed runtime path from "/home/grwu/Software/Slicer3/../Slicer3-ext/HammerR
egistration-install/lib/Slicer3/Plugins/HammerRegistration"

running: zip -r9 /home/grwu/Software/Slicer3/../Slicer3-ext/HammerRegistration-i
nstall/lib/Slicer3/Plugins/HammerRegistration-svn153-2010-01-05-linux-x86_64.zip
  adding: HammerRegistration (deflated 79%)

Uploading /home/grwu/Software/Slicer3/../Slicer3-ext/HammerRegistration-install/
lib/Slicer3/Plugins/HammerRegistration-svn153-2010-01-05-linux-x86_64.zip to ext
.slicer.org port 8845...
uploaded /home/grwu/Software/Slicer3/../Slicer3-ext/HammerRegistration-install/l
ib/Slicer3/Plugins/HammerRegistration-svn153-2010-01-05-linux-x86_64.zip (964240
 bytes)
Uploading /home/grwu/Software/Slicer3/../Slicer3-ext/Extensions/HammerRegistrati
on.s3ext to ext.slicer.org port 8845...
uploaded /home/grwu/Software/Slicer3/../Slicer3-ext/Extensions/HammerRegistratio
n.s3ext (787 bytes)
**********

BUILT:
  /home/grwu/Software/Slicer3/../Slicer3-ext/Extensions/HammerRegistration.s3ext

100.0% succeeded
[grwu@bass-comp4:~/Software/Slicer3] $
```

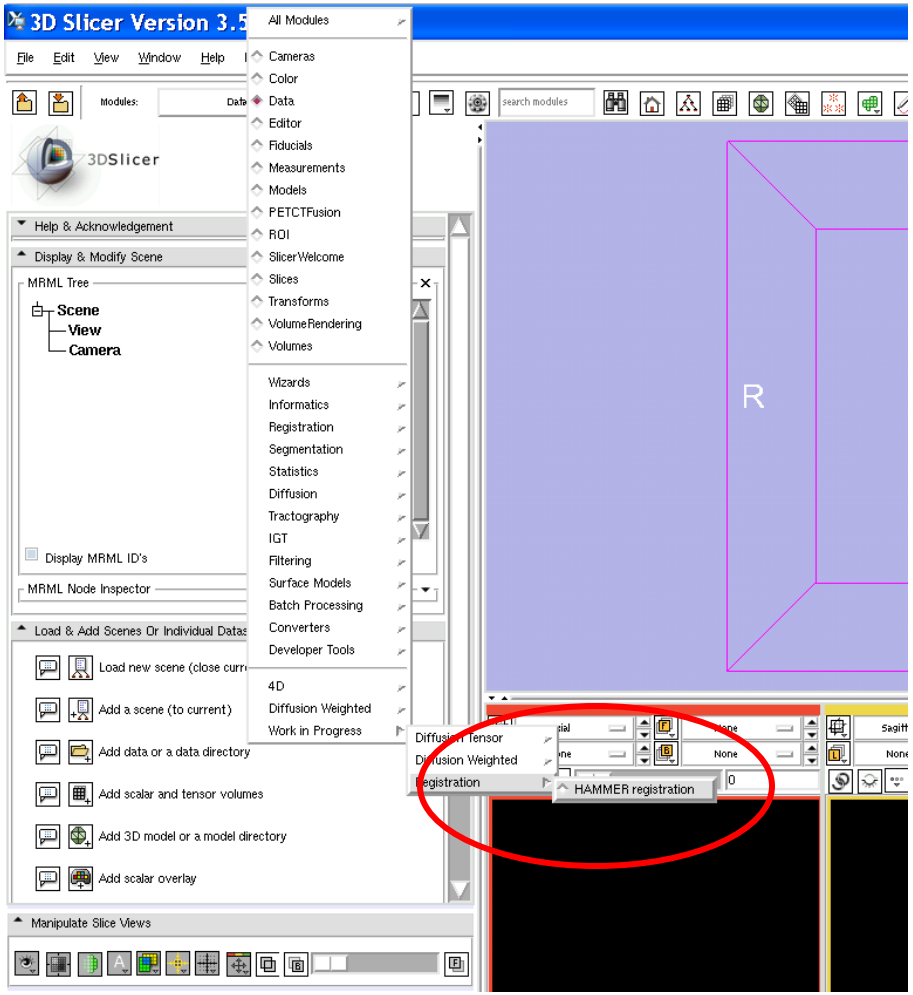
HAMMER – 3D Slicer Setup



HAMMER – 3D Slicer Setup

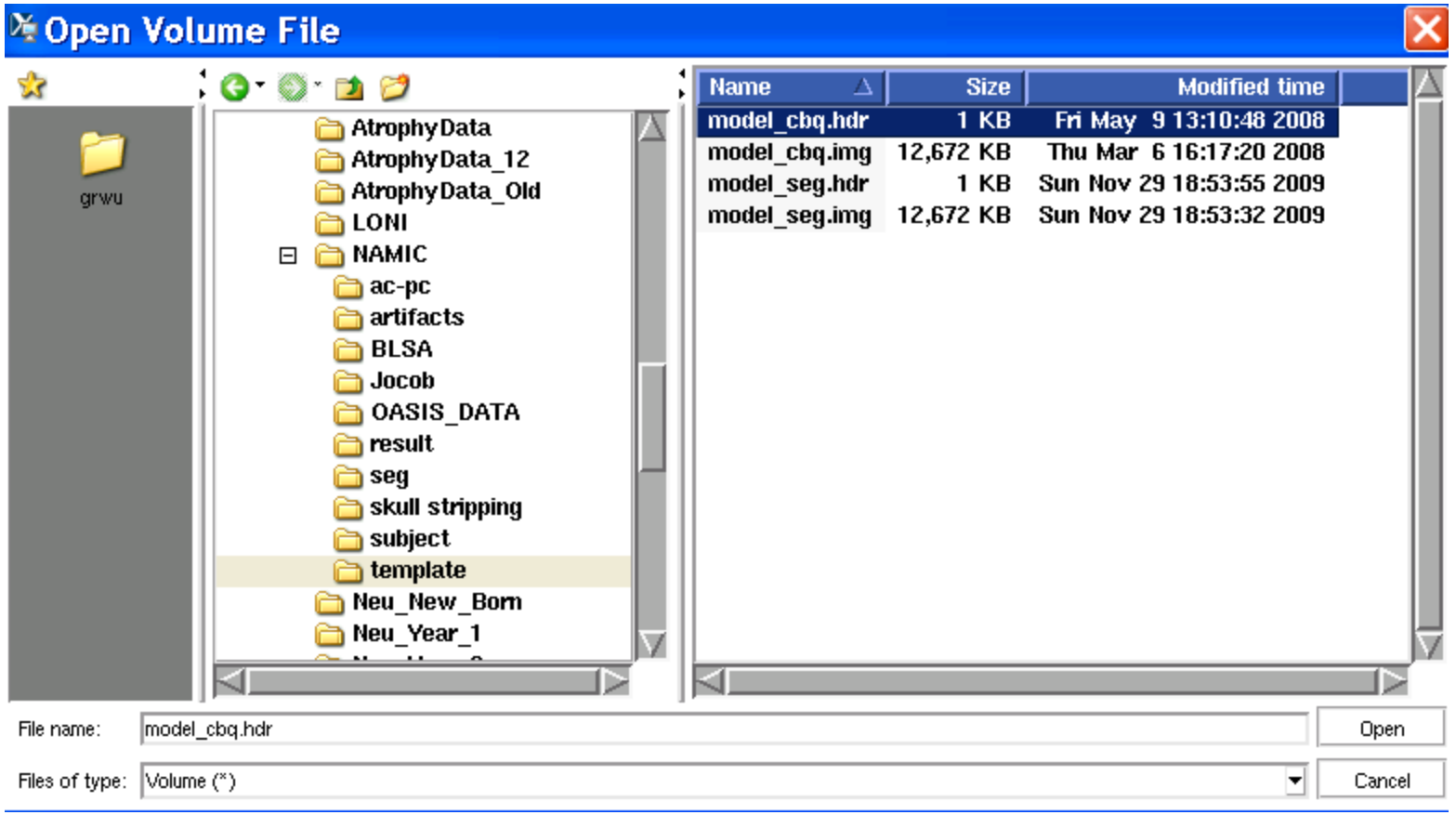


HAMMER – 3D Slicer Setup



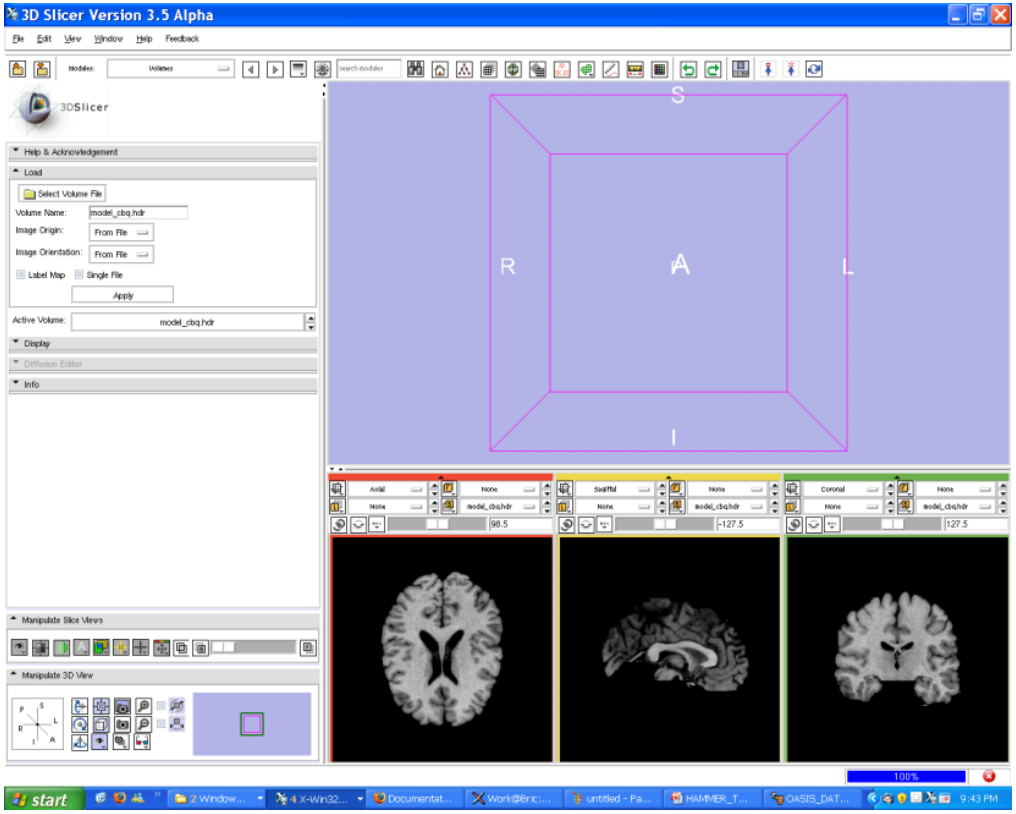
Using HAMMER in 3D Slicer

Load model images



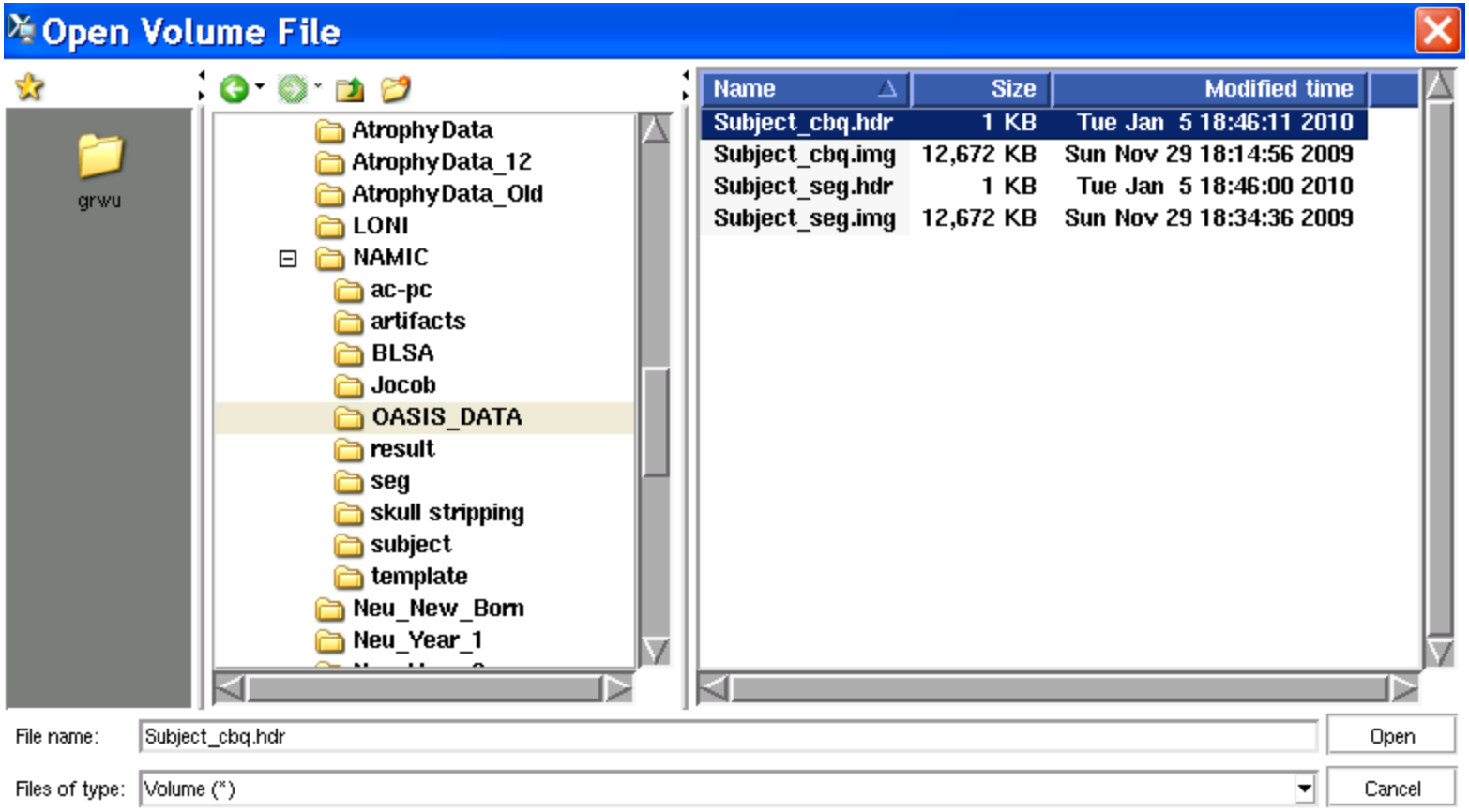
Using HAMMER in 3D Slicer

Load images



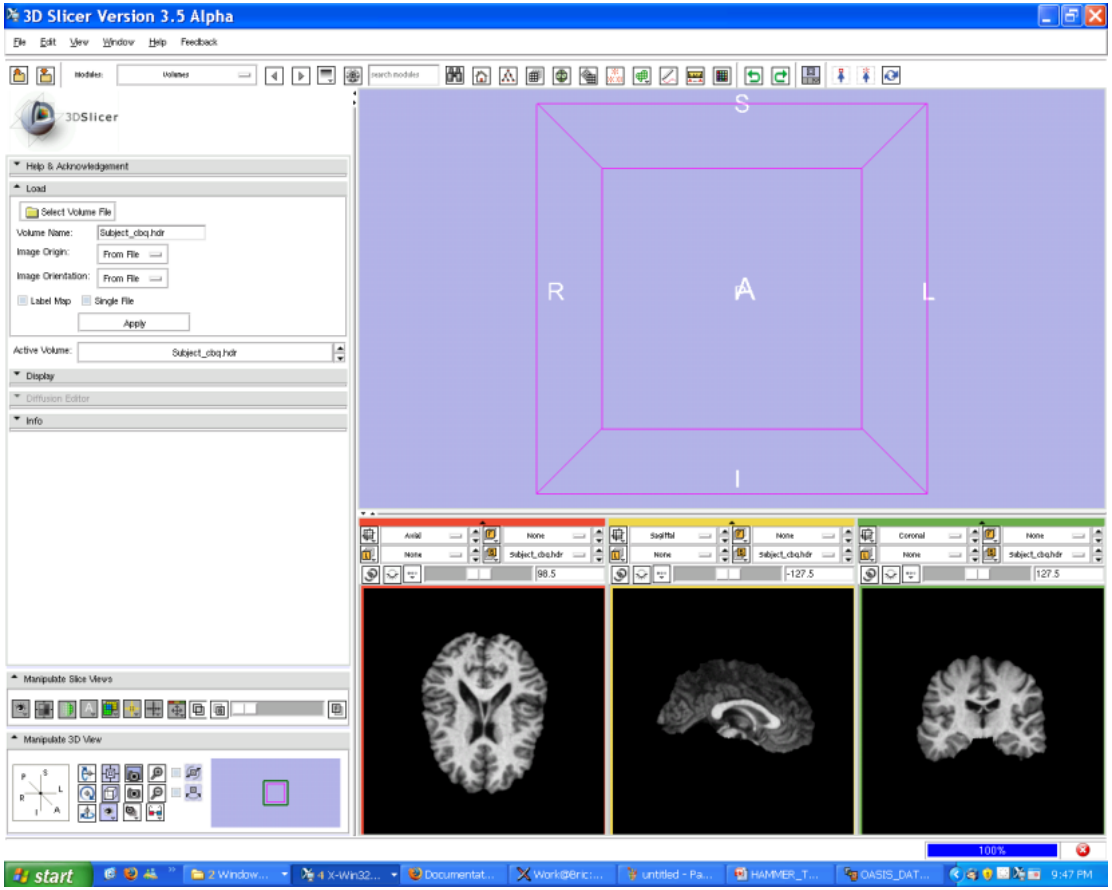
Using HAMMER in 3D Slicer

Load subject images



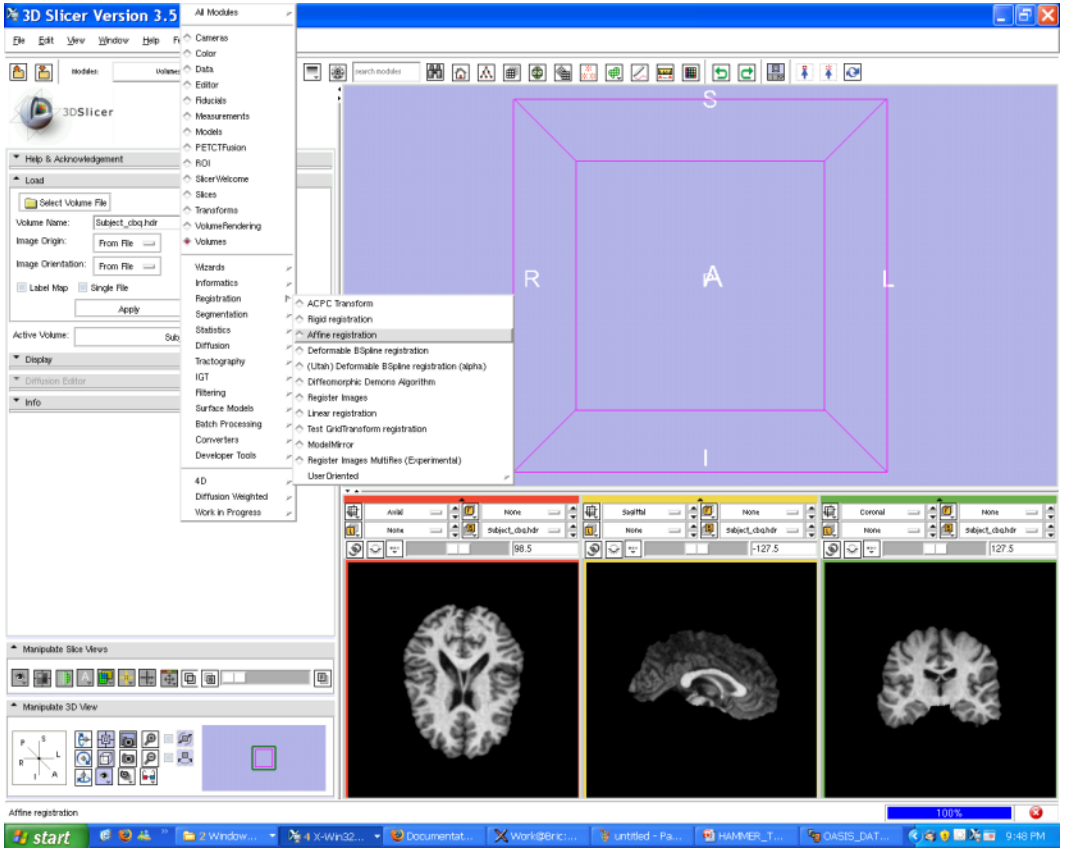
Using HAMMER in 3D Slicer

Load subject images



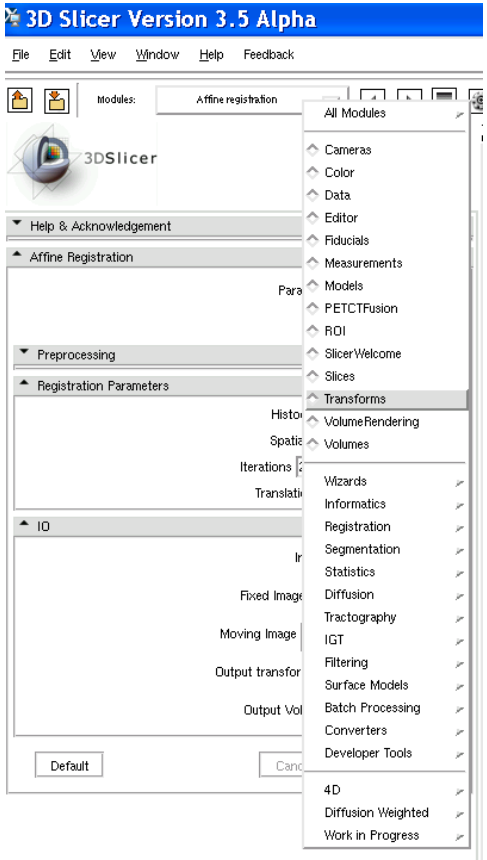
Using HAMMER in 3D Slicer

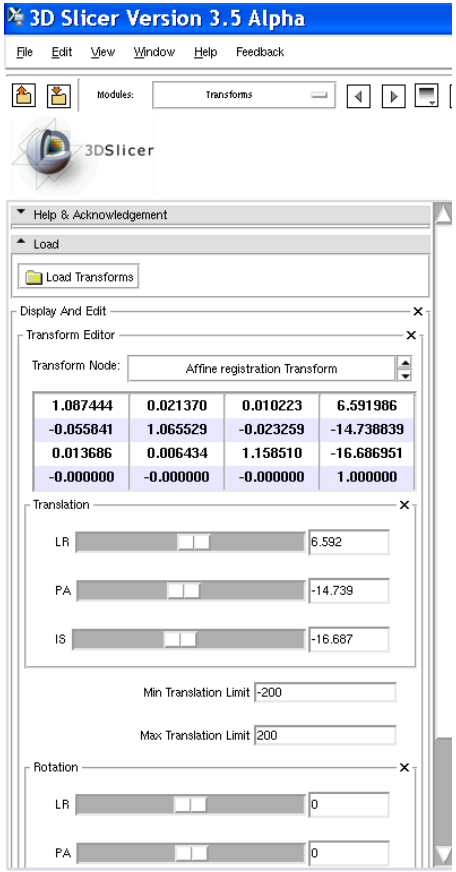
Affine registration in 3D Slicer



Using HAMMER in 3D Slicer

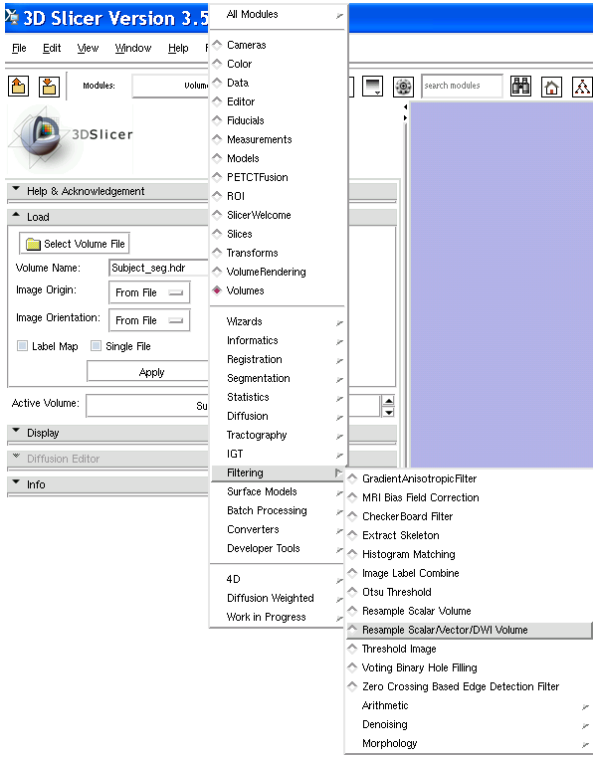
Check the 4x4 affine transformation matrix

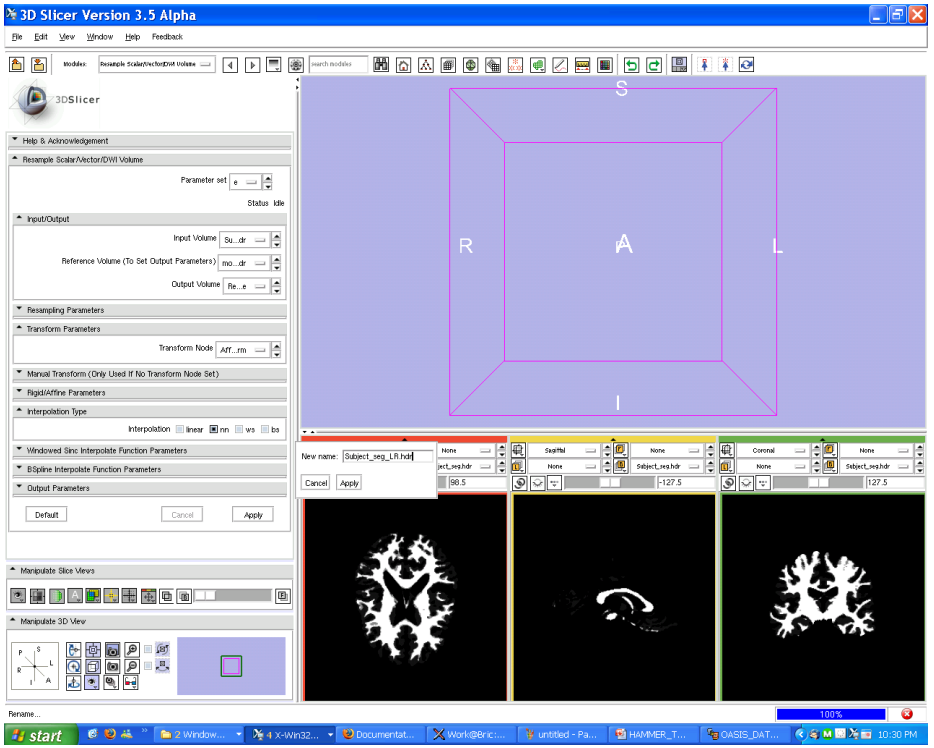




Using HAMMER in 3D Slicer

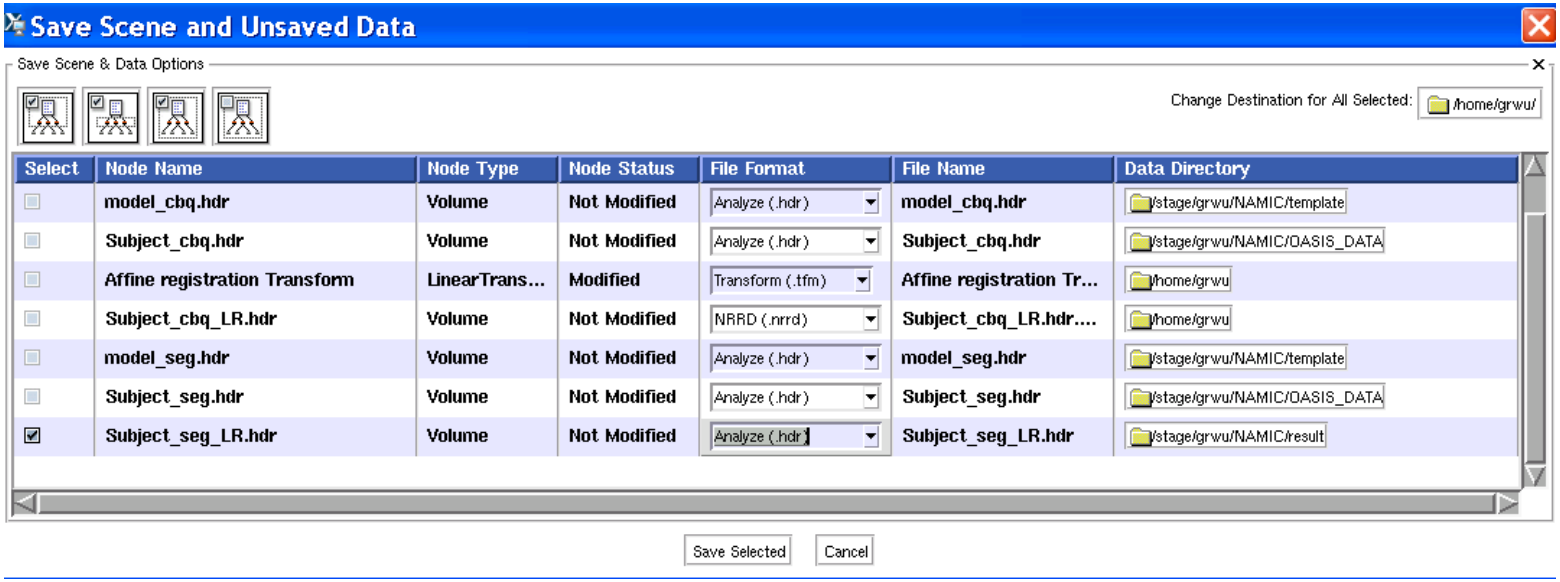
Apply affine matrix to segmented image





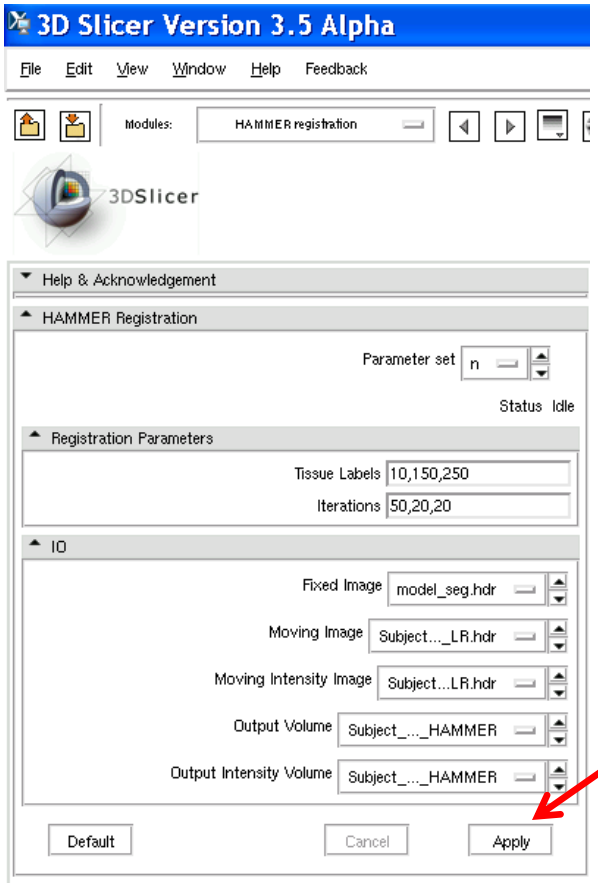
Using HAMMER in 3D Slicer

The input to HAMMER



Using HAMMER in 3D Slicer

Parameters for HAMMER



Hit “Apply” button to run HAMMER

Acknowledgments

National Alliance for Medical Image Computing

NIH U54EB005149

Minjeong Kim, Ph.D.

UNC at Chapel Hill