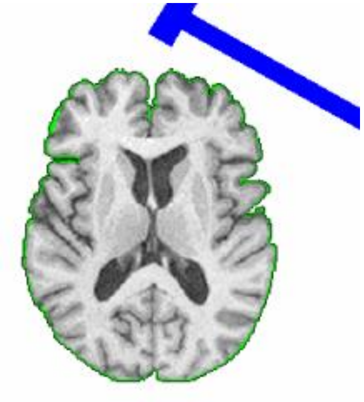
HAMMER: Hierarchical Attribute Matching Mechanism for Elastic Registration



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

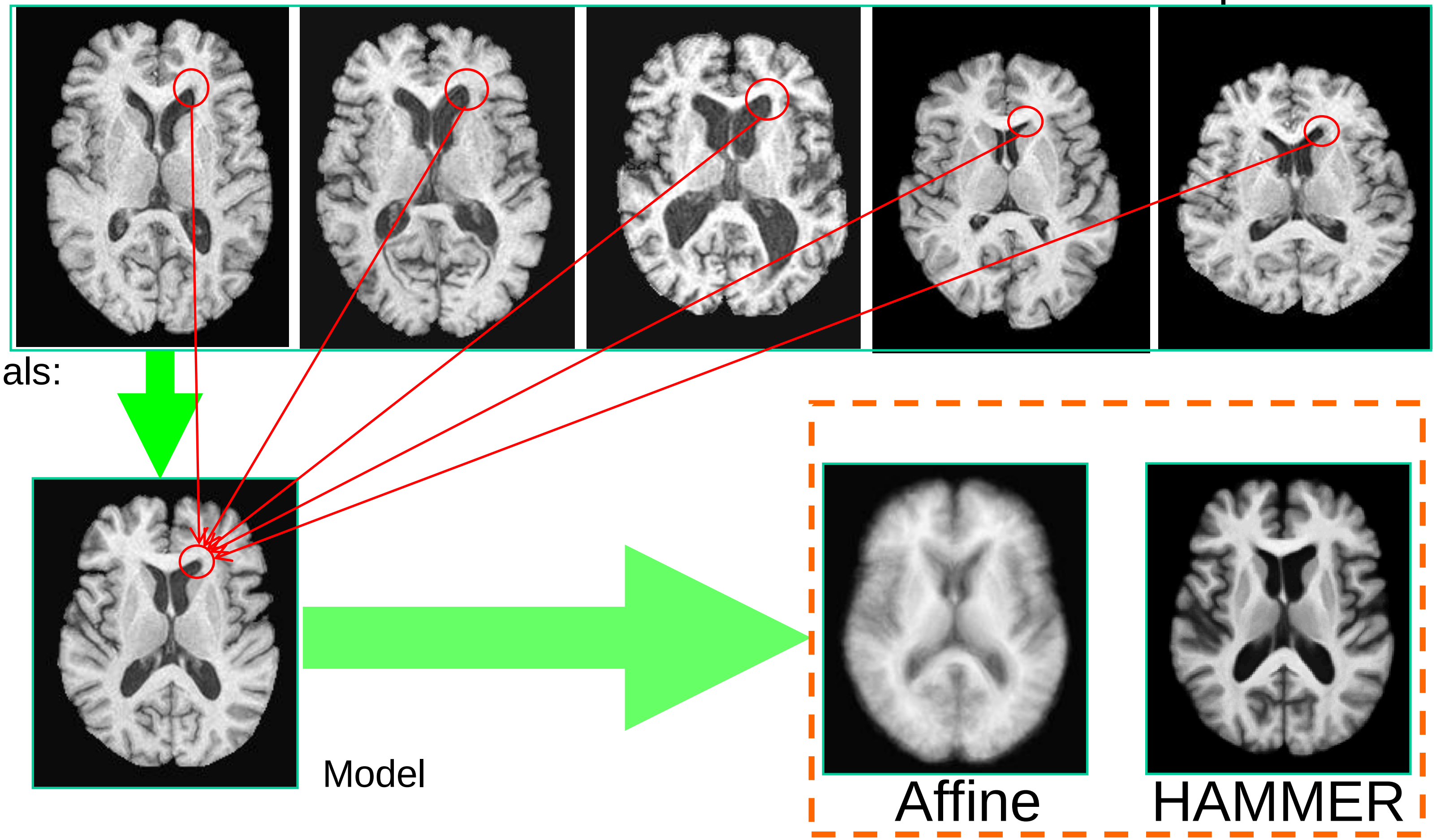
Learning Objective

- The objective of this tutorial is to present how to use HAMMER registration algorithm in Slicer3.
- Deformable registration has many important clinical applications:
  - Spatial normalization for group analysis;
  - Measurement of structure by deforming a model to individual;
  - Image data mining in lesion-deficit studies.

HAMMER: Background

- The goal of deformable registration of brain images

  --- Establish the anatomical correspondence



Individuals:

Model

Affine

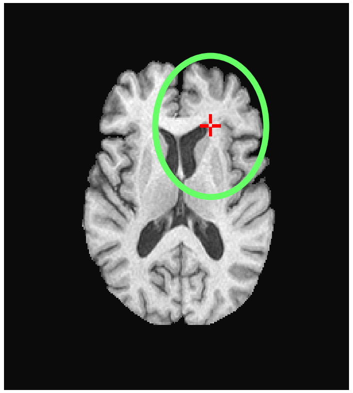
HAMMER

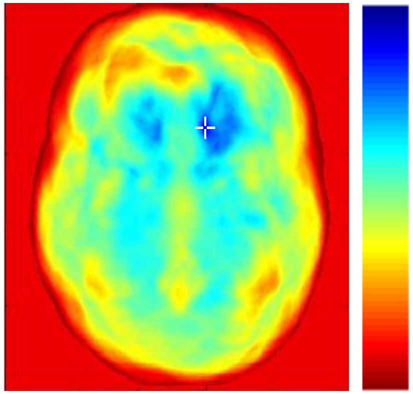
HAMMER: Background

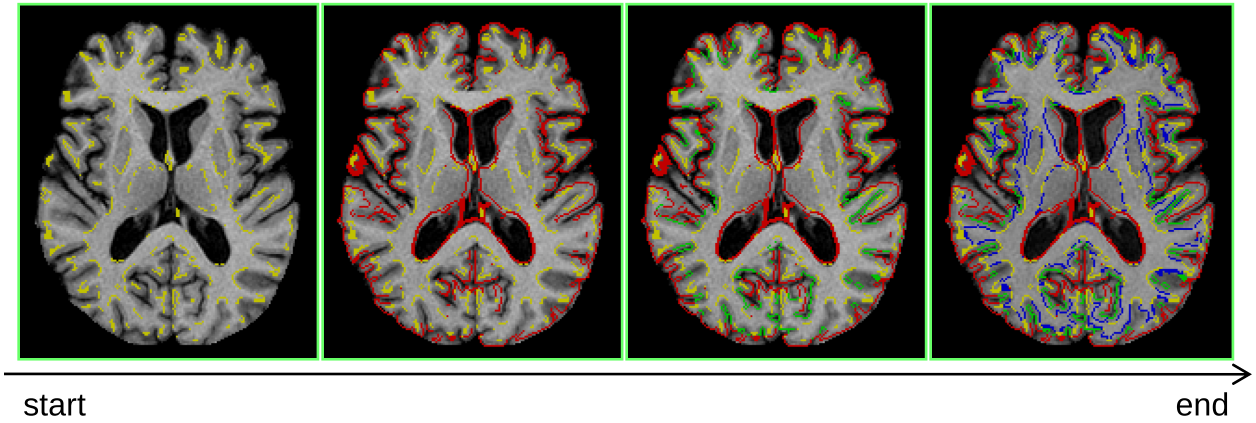
- Two novelties:

An *attribute vector*, defined for each voxel in an image, and reflecting the underlying structures at different scales.

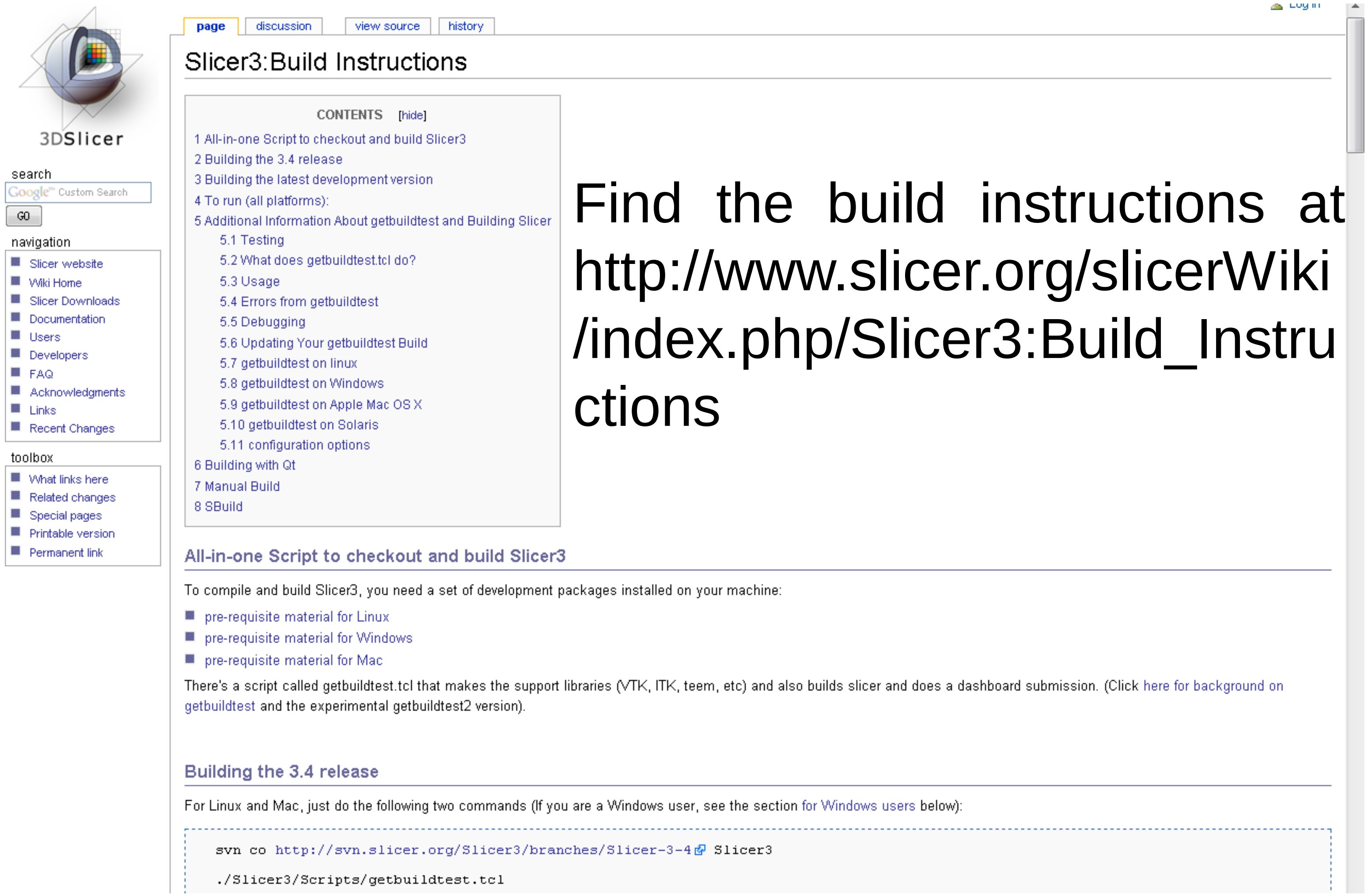
Driving voxel is used to hierarchically estimate the deformation, initially in sulcal root, gyrus crown, and ventricle corners







Build Latest Slicer



navigation

- Slicer website
- Wiki Home
- Slicer Downloads
- Documentation
- Users
- Developers
- FAQ
- Acknowledgments
- Links
- Recent Changes

toolbox

- What links here
- Related changes
- Special pages
- Printable version
- Permanent link

Slicer3:Build Instructions

CONTENTS [hide]

All-in-one Script to checkout and build Slicer3

To compile and build Slicer3, you need a set of development packages installed on your machine:

- pre-requisite material for Linux
- pre-requisite material for Windows
- pre-requisite material for Mac

There's a script called getbuildtest.tcl that makes the support libraries (VTK, ITK, teem, etc) and also builds slicer and does a dashboard submission. (Click here for background on getbuildtest and the experimental getbuildtest2 version).

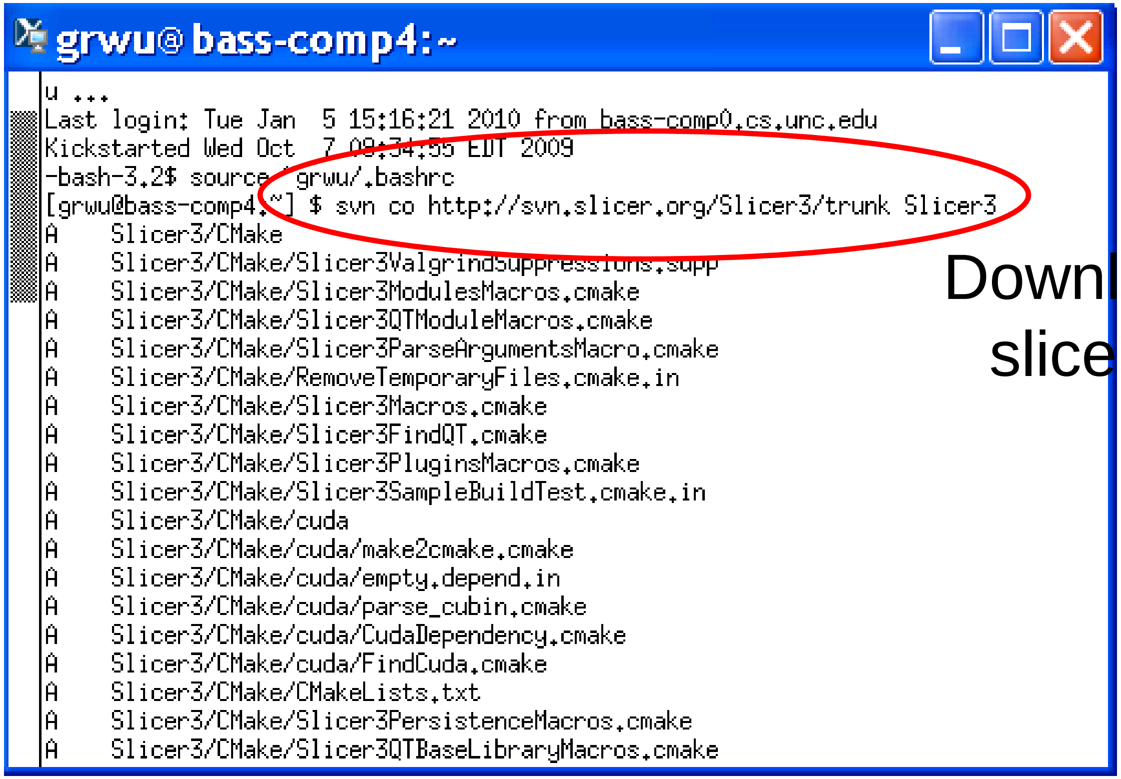
Building the 3.4 release

For Linux and Mac, just do the following two commands (If you are a Windows user, see the section for Windows users below):

```
svn co http://svn.slicer.org/Slicer3/branches/Slicer-3-4 Slicer3
./Slicer3/Scripts/getbuildtest.tcl
```

Find the build instructions at http://www.slicer.org/slicerWiki/index.php/Slicer3:Build_Instructions

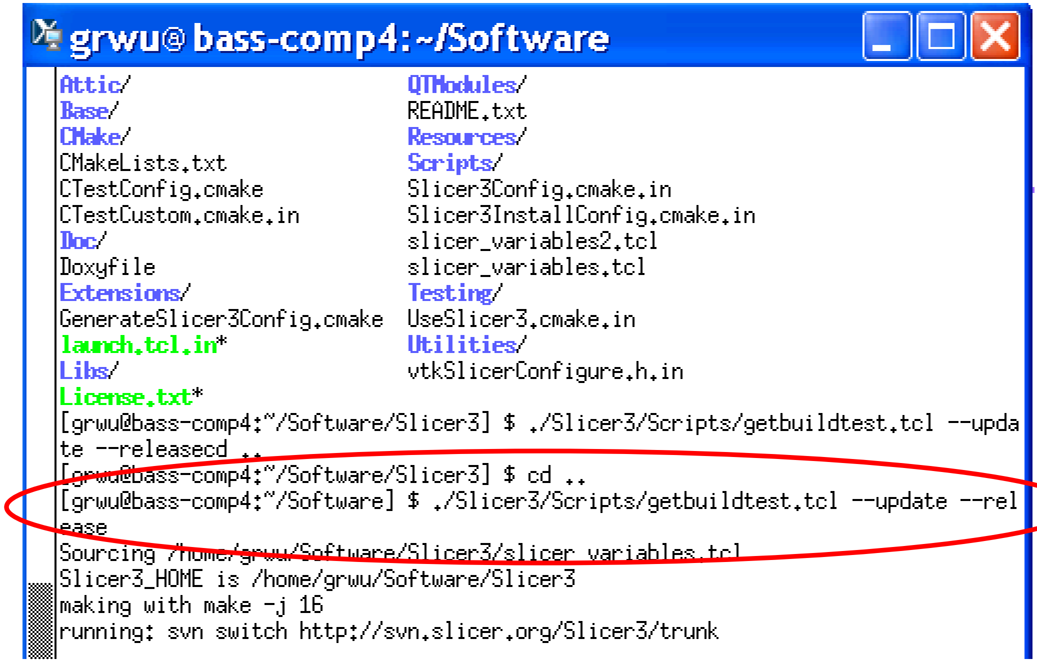
Build Latest Slicer



```
u ...
Last login: Tue Jan  5 15:16:21 2010 from bass-comp0.cs.unc.edu
Kickstarted Wed Oct  7 09:34:55 EDT 2009
-bash-3.2$ source ~grwu/.bashrc
[grwu@bass-comp4 ~] $ svn co http://svn.slicer.org/Slicer3/trunk Slicer3
A    Slicer3/CMake
A    Slicer3/CMake/Slicer3ValgrindSuppressions.supp
A    Slicer3/CMake/Slicer3ModulesMacros.cmake
A    Slicer3/CMake/Slicer3QTModuleMacros.cmake
A    Slicer3/CMake/Slicer3ParseArgumentsMacro.cmake
A    Slicer3/CMake/RemoveTemporaryFiles.cmake.in
A    Slicer3/CMake/Slicer3Macros.cmake
A    Slicer3/CMake/Slicer3FindQT.cmake
A    Slicer3/CMake/Slicer3PluginsMacros.cmake
A    Slicer3/CMake/Slicer3SampleBuildTest.cmake.in
A    Slicer3/CMake/cuda
A    Slicer3/CMake/cuda/make2cmake.cmake
A    Slicer3/CMake/cuda/empty.depend.in
A    Slicer3/CMake/cuda/parse_cubin.cmake
A    Slicer3/CMake/cuda/CudaDependency.cmake
A    Slicer3/CMake/cuda/FindCuda.cmake
A    Slicer3/CMake/CMakeLists.txt
A    Slicer3/CMake/Slicer3PersistenceMacros.cmake
A    Slicer3/CMake/Slicer3QTBaseLibraryMacros.cmake
```

Download the latest slicer source code

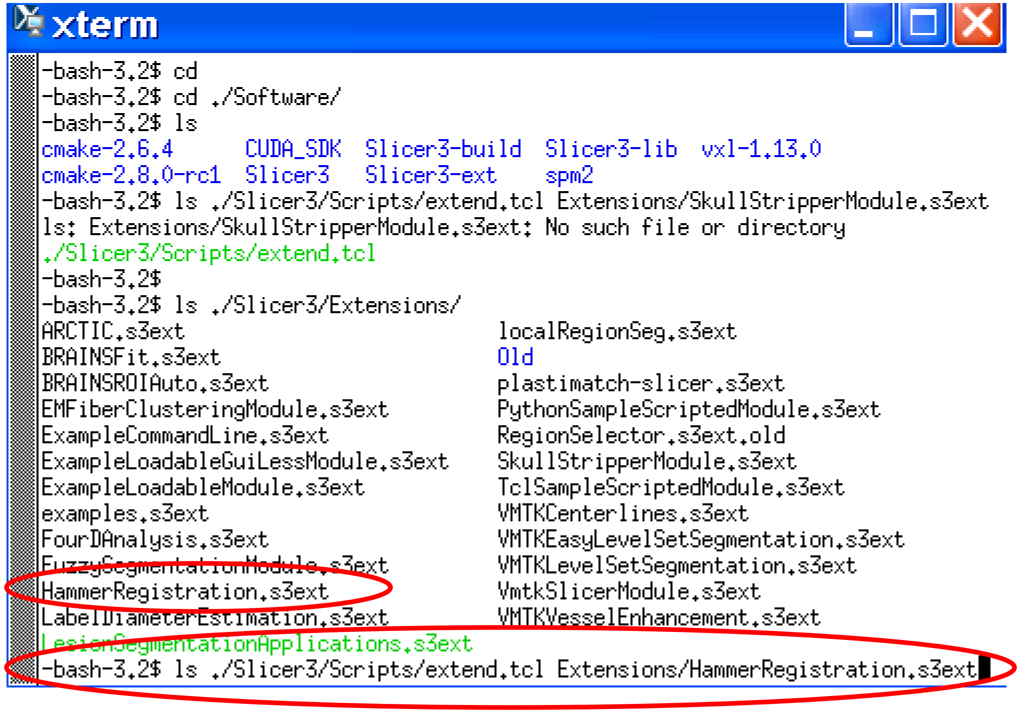
Build Latest Slicer



```
Attic/                         QTModules/
Base/                          README.txt
CMake/                         Resources/
CMakeLists.txt                 Scripts/
CTestConfig.cmake              Slicer3Config.cmake.in
CTestCustom.cmake.in           Slicer3InstallConfig.cmake.in
Doc/                           slicer_variables2.tcl
Doxyfile                       slicer_variables.tcl
Extensions/                    Testing/
GenerateSlicer3Config.cmake    UseSlicer3.cmake.in
launch.tcl.in*                 Utilities/
Libs/                          vtkSlicerConfigure.h.in
License.txt*
[grwu@bass-comp4:~/Software/Slicer3] $ ./Slicer3/Scripts/getbuildtest.tcl --upda
te --releasecd ..
[grwu@bass-comp4:~/Software/Slicer3] $ cd ..
[grwu@bass-comp4:~/Software] $ ./Slicer3/Scripts/getbuildtest.tcl --update --rel
ease
Sourcing /home/grwu/Software/Slicer3/slicer_variables.tcl
Slicer3_HOME is /home/grwu/Software/Slicer3
making with make -j 16
running: svn switch http://svn.slicer.org/Slicer3/trunk
```

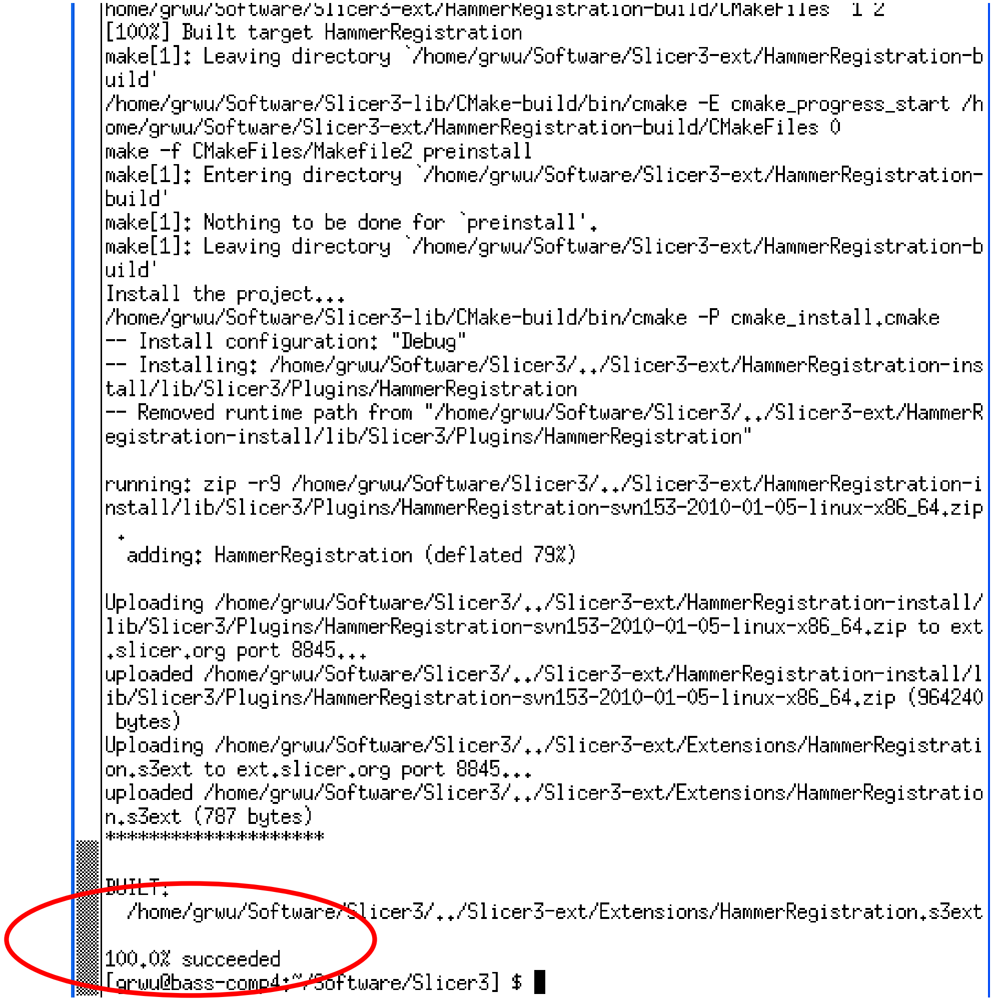
Build Slicer3

Install HAMMER Module



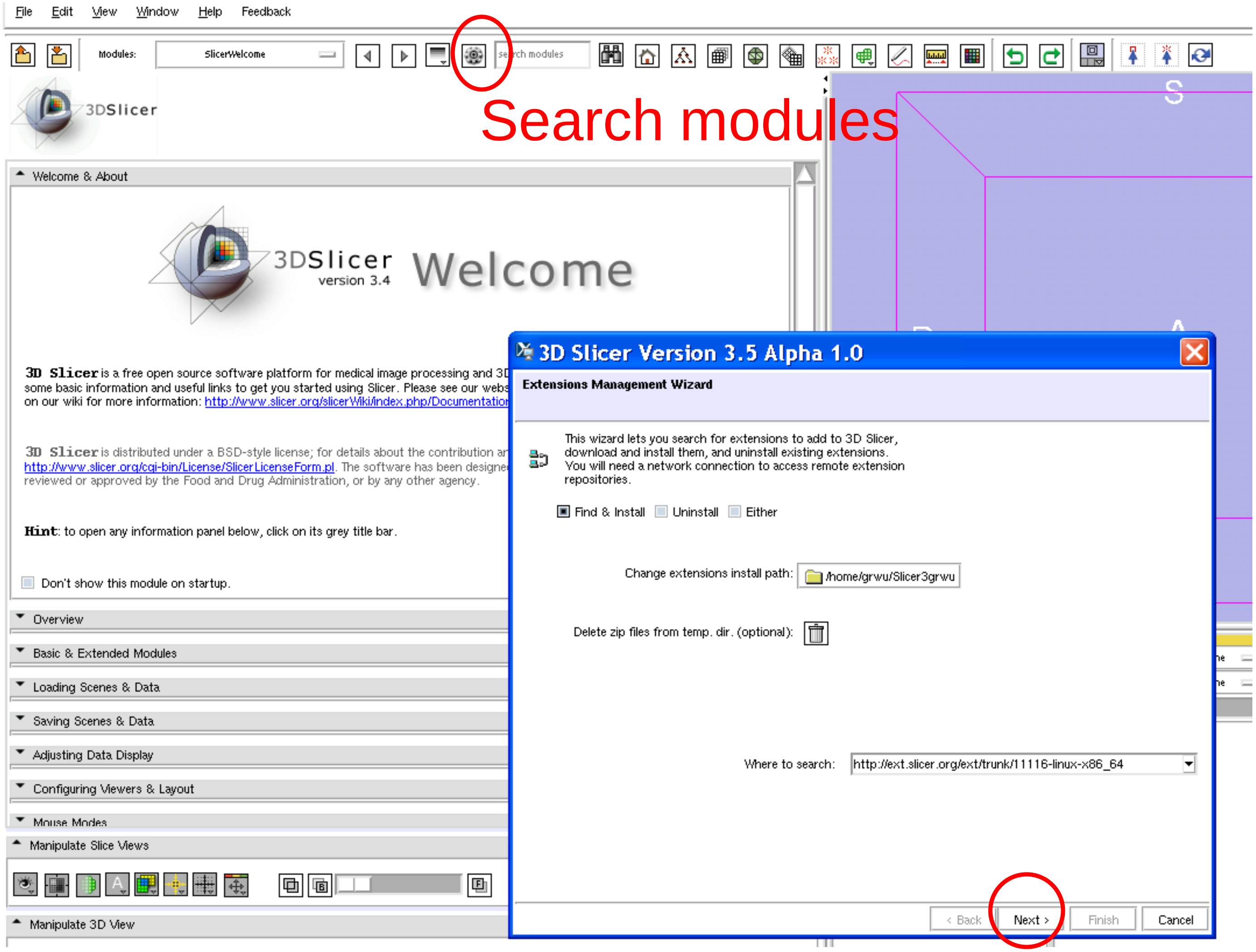
```
-bash-3.2$ cd
-bash-3.2$ cd ./Software/
-bash-3.2$ ls
cmake-2.6.4      CUDA_SDK  Slicer3-build  Slicer3-lib  vxl-1.13.0
cmake-2.8.0-rc1  Slicer3   Slicer3-ext    spm2
-bash-3.2$ ls ./Slicer3/Scripts/extend.tcl Extensions/SkullStripperModule.s3ext
ls: Extensions/SkullStripperModule.s3ext: No such file or directory
./Slicer3/Scripts/extend.tcl
-bash-3.2$
-bash-3.2$ ls ./Slicer3/Extensions/
ARCTIC.s3ext                          localRegionSeg.s3ext
BRAINSFit.s3ext                       Old
BRAINSROIAuto.s3ext                   plastimatch-slicer.s3ext
EMFiberClusteringModule.s3ext         PythonSampleScriptedModule.s3ext
ExampleCommandLine.s3ext              RegionSelector.s3ext.old
ExampleLoadableGuiLessModule.s3ext    SkullStripperModule.s3ext
ExampleLoadableModule.s3ext           TclSampleScriptedModule.s3ext
examples.s3ext                        VMTKCenterlines.s3ext
FourDAnalysis.s3ext                   VMTKEasyLevelSetSegmentation.s3ext
FuzzySegmentationModule.s3ext         VMTKLevelSetSegmentation.s3ext
HammerRegistration.s3ext              VmtkSlicerModule.s3ext
LabelDiameterEstimation.s3ext         VMTKVesselEnhancement.s3ext
LesionSegmentationApplications.s3ext
-bash-3.2$ ls ./Slicer3/Scripts/extend.tcl Extensions/HammerRegistration.s3ext
```

Install HAMMER Module



```
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] $ 
```

Install HAMMER Module



Search modules

3D Slicer is a free open source software platform for medical image processing and 3D
some basic information and useful links to get you started using Slicer. Please see our webs
on our wiki for more information: http://www.slicer.org/slicerWiki/index.php/Documentation

3D Slicer is distributed under a BSD-style license; for details about the contribution ar
http://www.slicer.org/cgi-bin/License/SlicerLicenseForm.pl. The software has been designed
reviewed or approved by the Food and Drug Administration, or by any other agency.

Hint: to open any information panel below, click on its grey title bar.

□ Don't show this module on startup.

3D Slicer Version 3.5 Alpha 1.0

Extensions Management Wizard

This wizard lets you search for extensions to add to 3D Slicer, download and install them, and uninstall existing extensions. You will need a network connection to access remote extension repositories.

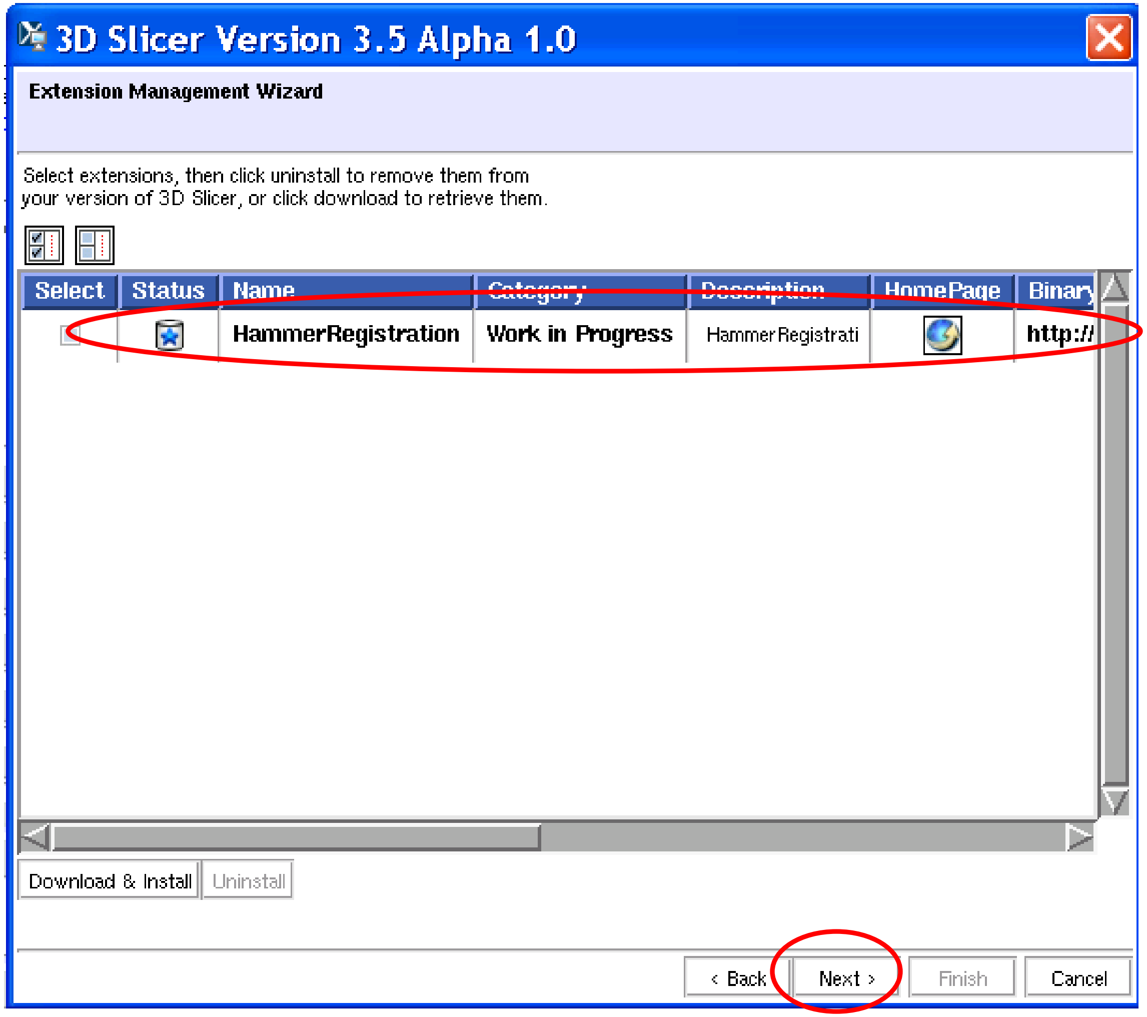
☒ Find & Install □ Uninstall □ Either

Change extensions install path: /home/grwu/Slicer3grwu

Delete zip files from temp. dir. (optional):

Where to search: http://ext.slicer.org/ext/trunk/11116-linux-x86_64

Install HAMMER Module

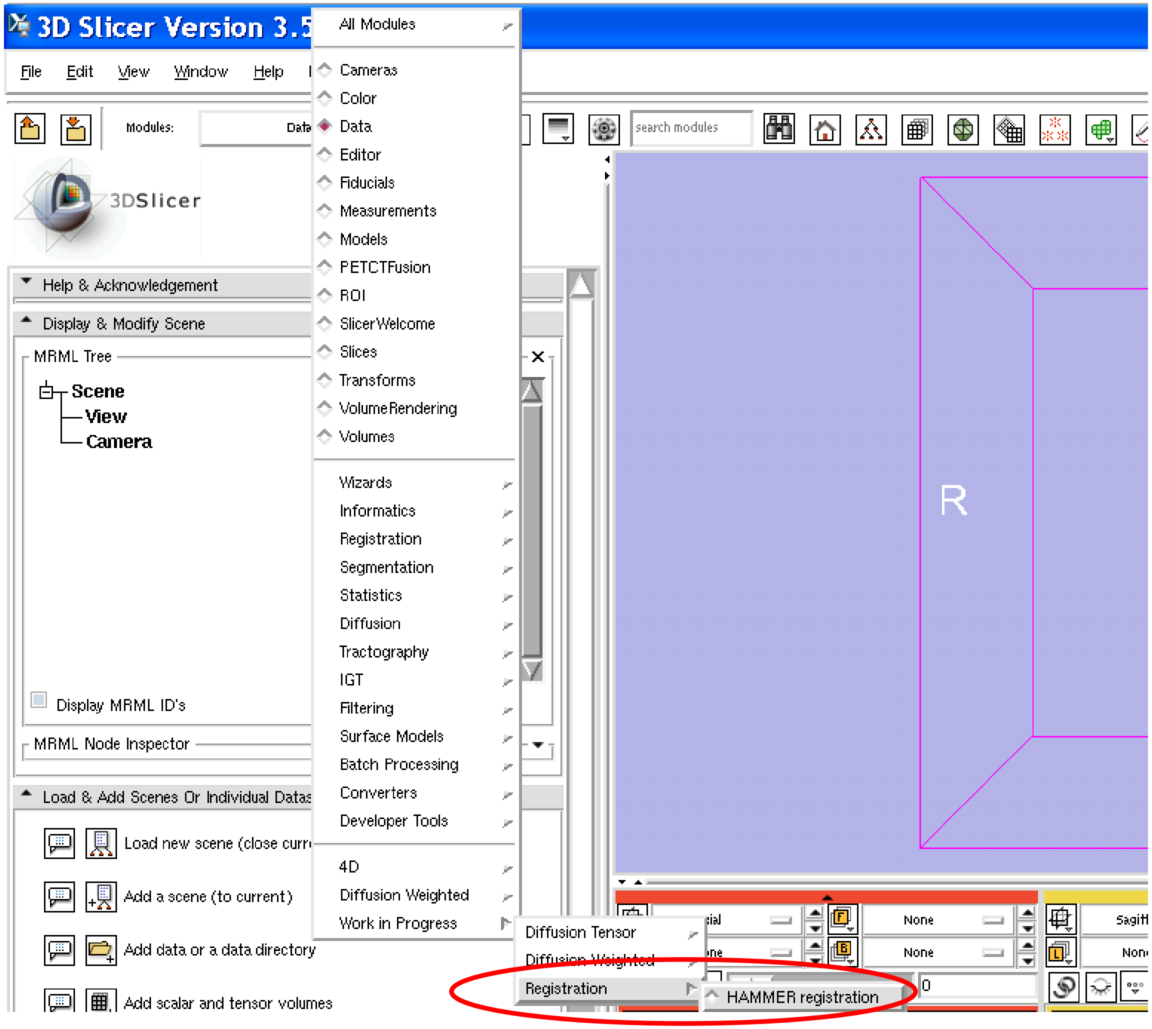


Extension Management Wizard

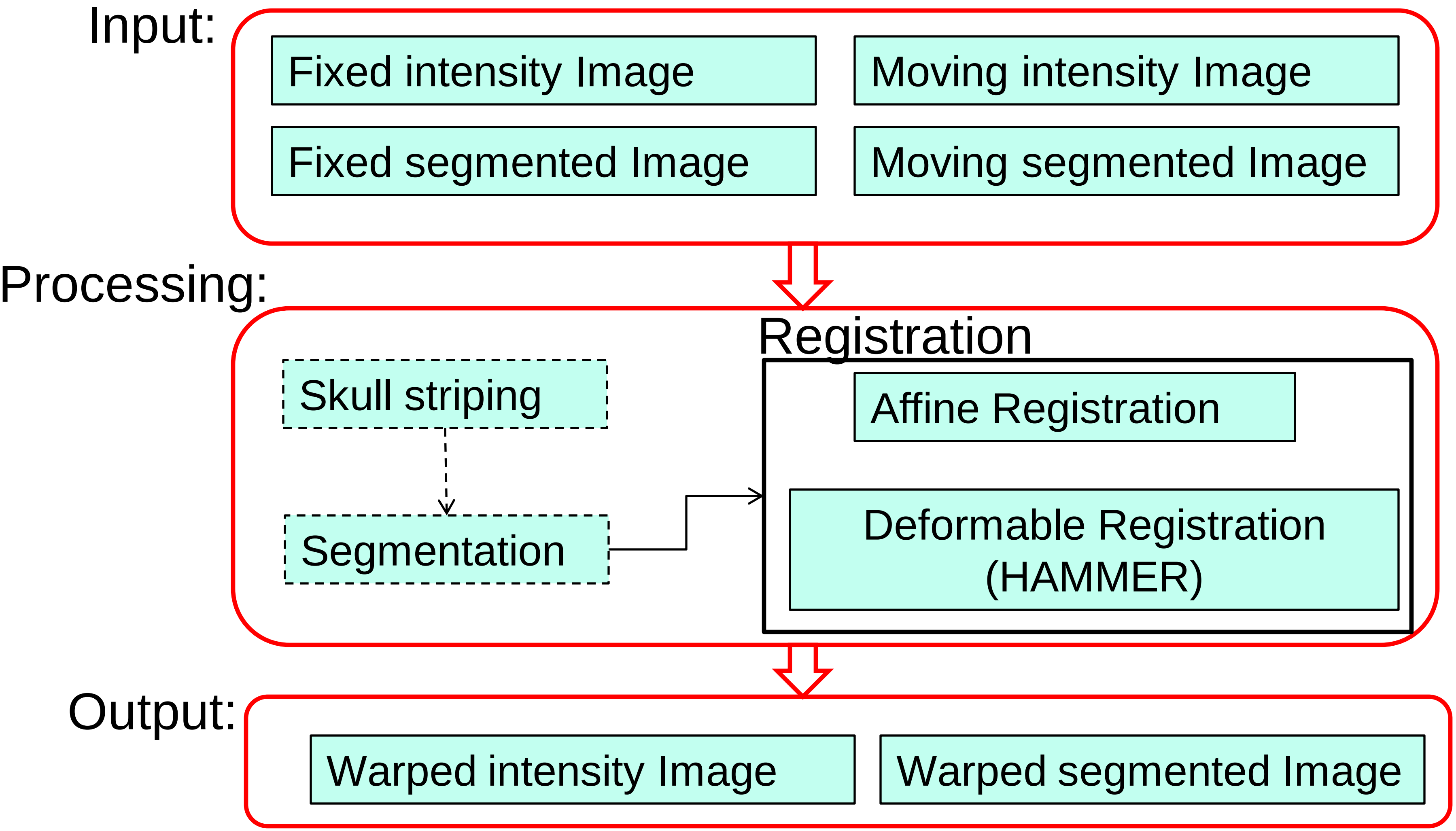
Select extensions, then click uninstall to remove them from your version of 3D Slicer, or click download to retrieve them.

Select	Status	Name	Category	Description	HomePage	Binary
□	★	HammerRegistration	Work in Progress	Hammer Registrati	🌐	http://

Install HAMMER Module



Using HAMMER



Input:

Fixed intensity Image

Moving intensity Image

Fixed segmented Image

Moving segmented Image

Processing:

Skull striping

Segmentation

Registration

Affine Registration

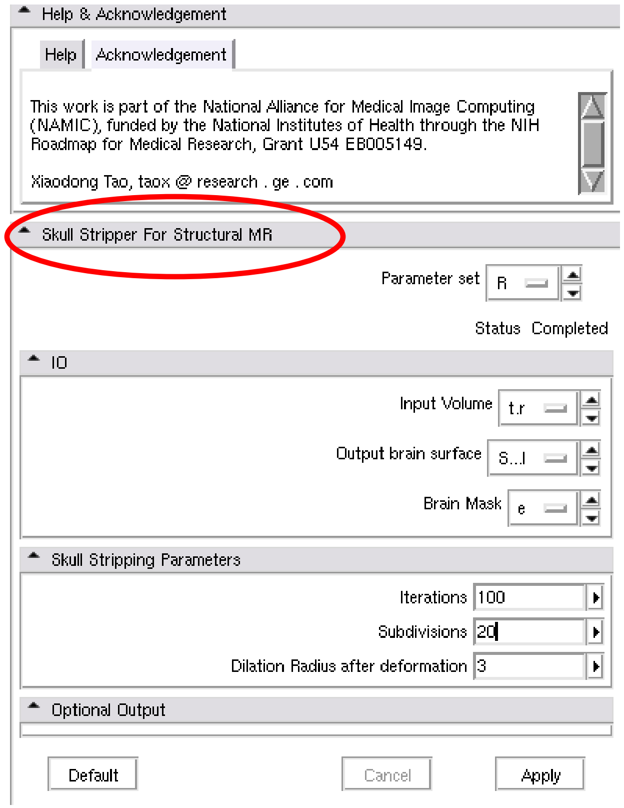
Deformable Registration (HAMMER)

Output:

Warped intensity Image

Warped segmented Image

Using HAMMER



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 . ge . com

Skull Stripper For Structural MR

Parameter set R

Status Completed

IO

Input Volume t.r

Output brain surface S...l

Brain Mask e

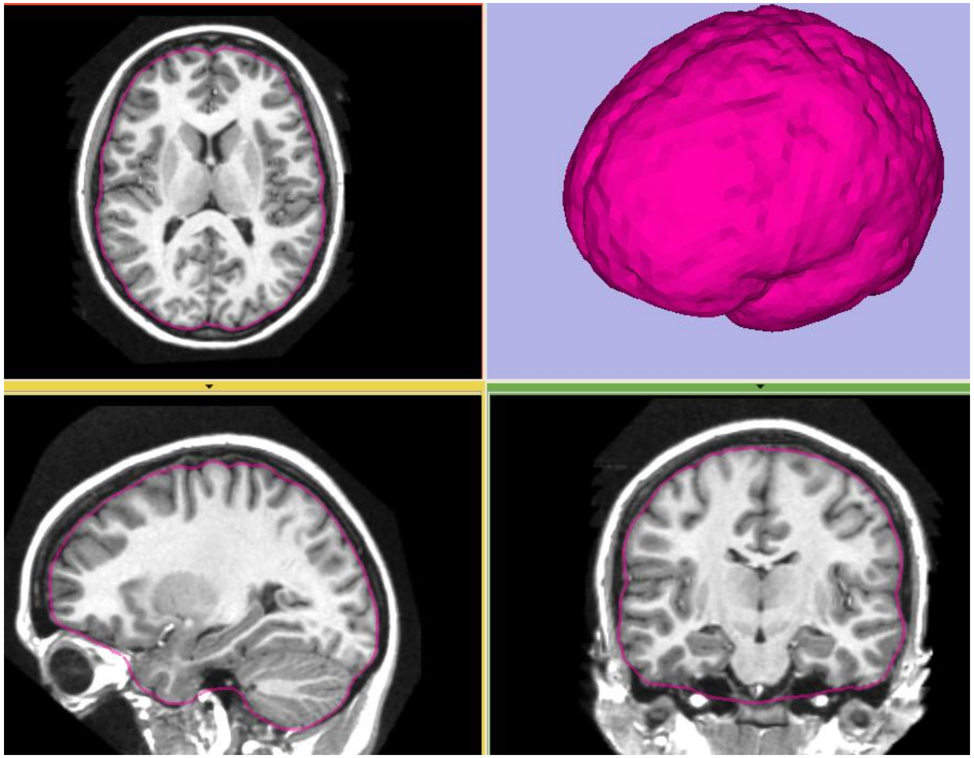
Skull Stripping Parameters

Iterations 100

Subdivisions 20

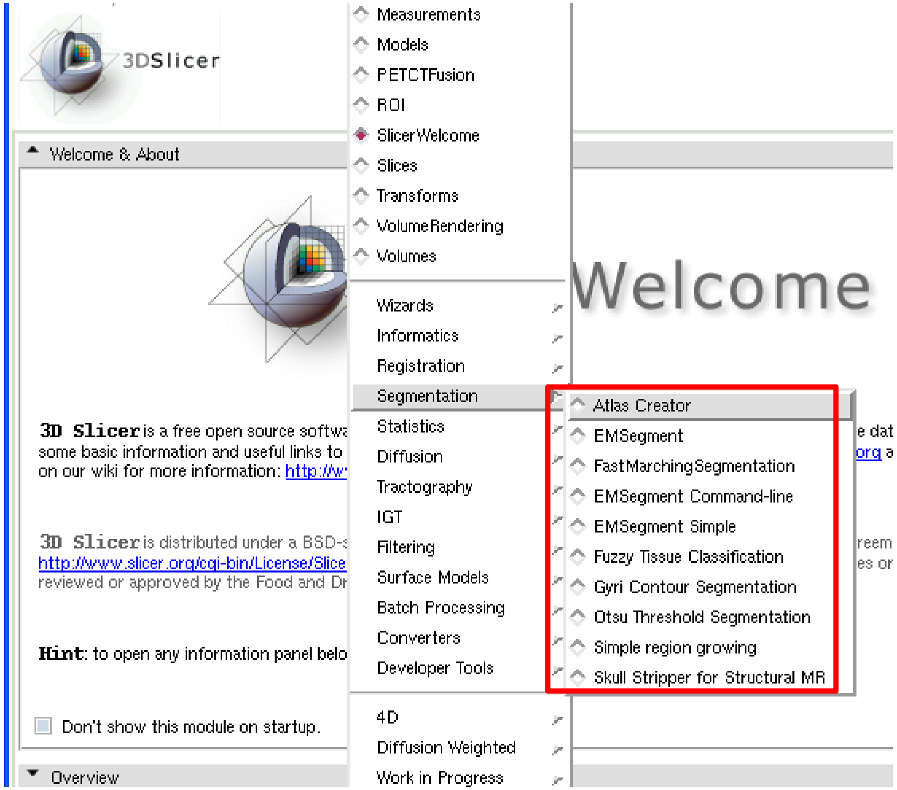
Dilation Radius after deformation 3

Optional Output



Using HAMMER

http://www.slicer.org/slicerWiki/index.php/Documentation-3.4#Segmentation



3D Slicer is a free open source softwa
some basic information and useful links to
on our wiki for more information: http://w

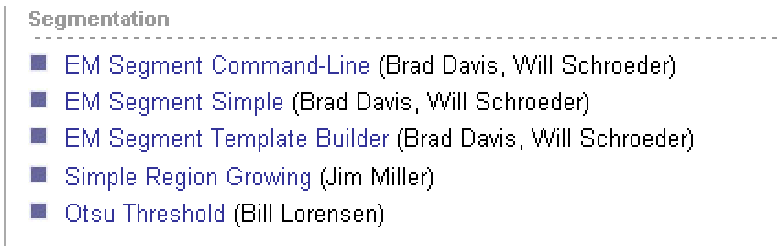
e dat
org a

3D Slicer is distributed under a BSD-s
http://www.slicer.org/cgi-bin/License/Slice
reviewed or approved by the Food and Dr

reem
es or

Hint: to open any information panel belo

□ Don't show this module on startup.

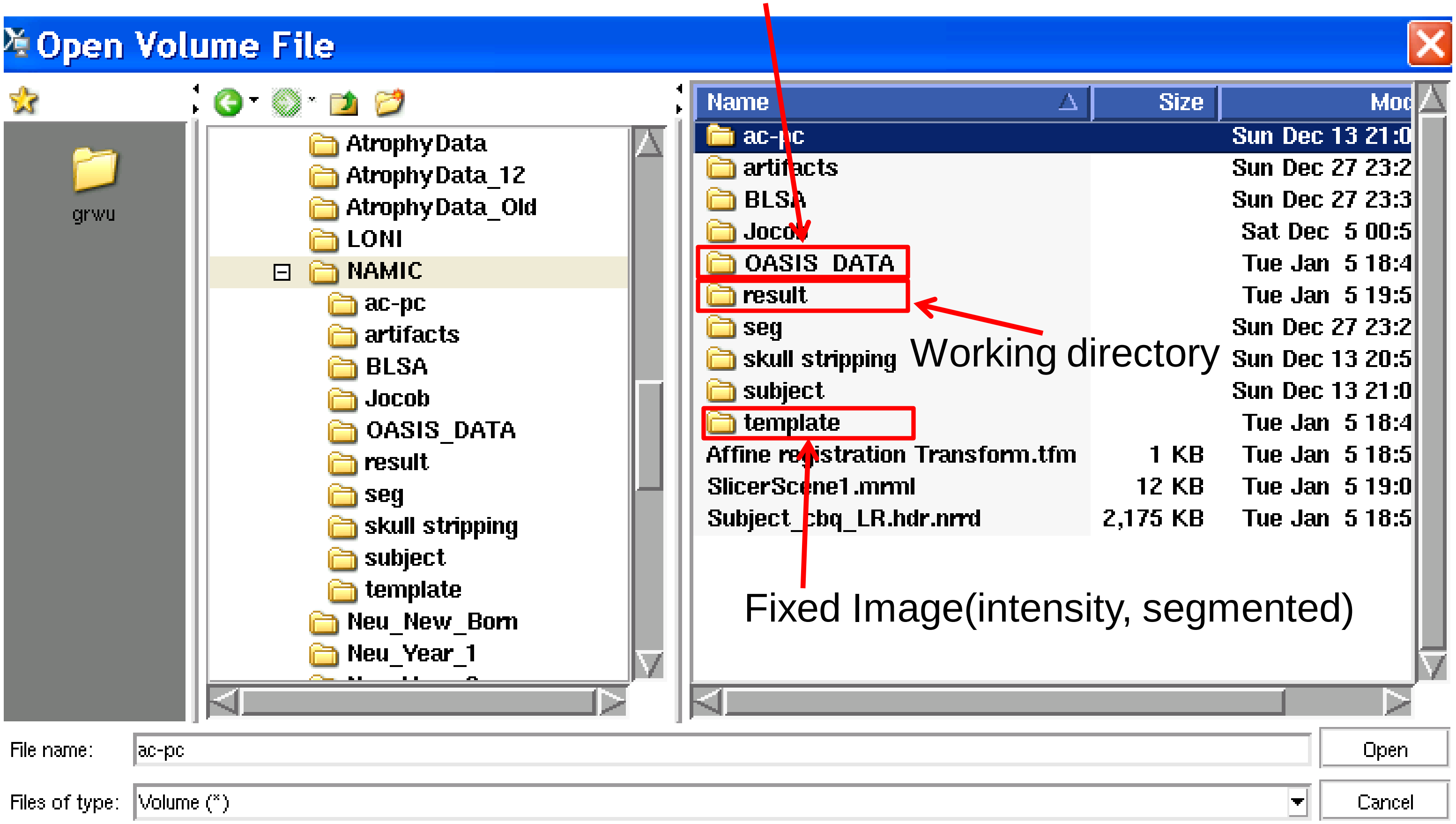


Segmentation

- EM Segment Command-Line (Brad Davis, Will Schroeder)
- EM Segment Simple (Brad Davis, Will Schroeder)
- EM Segment Template Builder (Brad Davis, Will Schroeder)
- Simple Region Growing (Jim Miller)
- Otsu Threshold (Bill Lorensen)

Using HAMMER

Moving Image(intensity, segmented)



Open Volume File

grwu

- AtrophyData
- AtrophyData_12
- AtrophyData_Old
- LONI
- NAMIC
  - ac-pc
  - artifacts
  - BLSA
  - Jocob
  - OASIS_DATA
  - result
  - seg
  - skull stripping
  - subject
  - template
- Neu_New_Born
- Neu_Year_1

Name	Size	Mod
ac-pc		Sun Dec 13 21:0
artifacts		Sun Dec 27 23:2
BLSA		Sun Dec 27 23:3
Jocob		Sat Dec 5 00:5
OASIS_DATA		Tue Jan 5 18:4
result		Tue Jan 5 19:5
seg		Sun Dec 27 23:2
skull stripping		Sun Dec 13 20:5
subject		Sun Dec 13 21:0
template		Tue Jan 5 18:4
Affine registration Transform.tfm	1 KB	Tue Jan 5 18:5
SlicerScene1.mrml	12 KB	Tue Jan 5 19:0
Subject_cbq_LR.hdr.nrrd	2,175 KB	Tue Jan 5 18:5

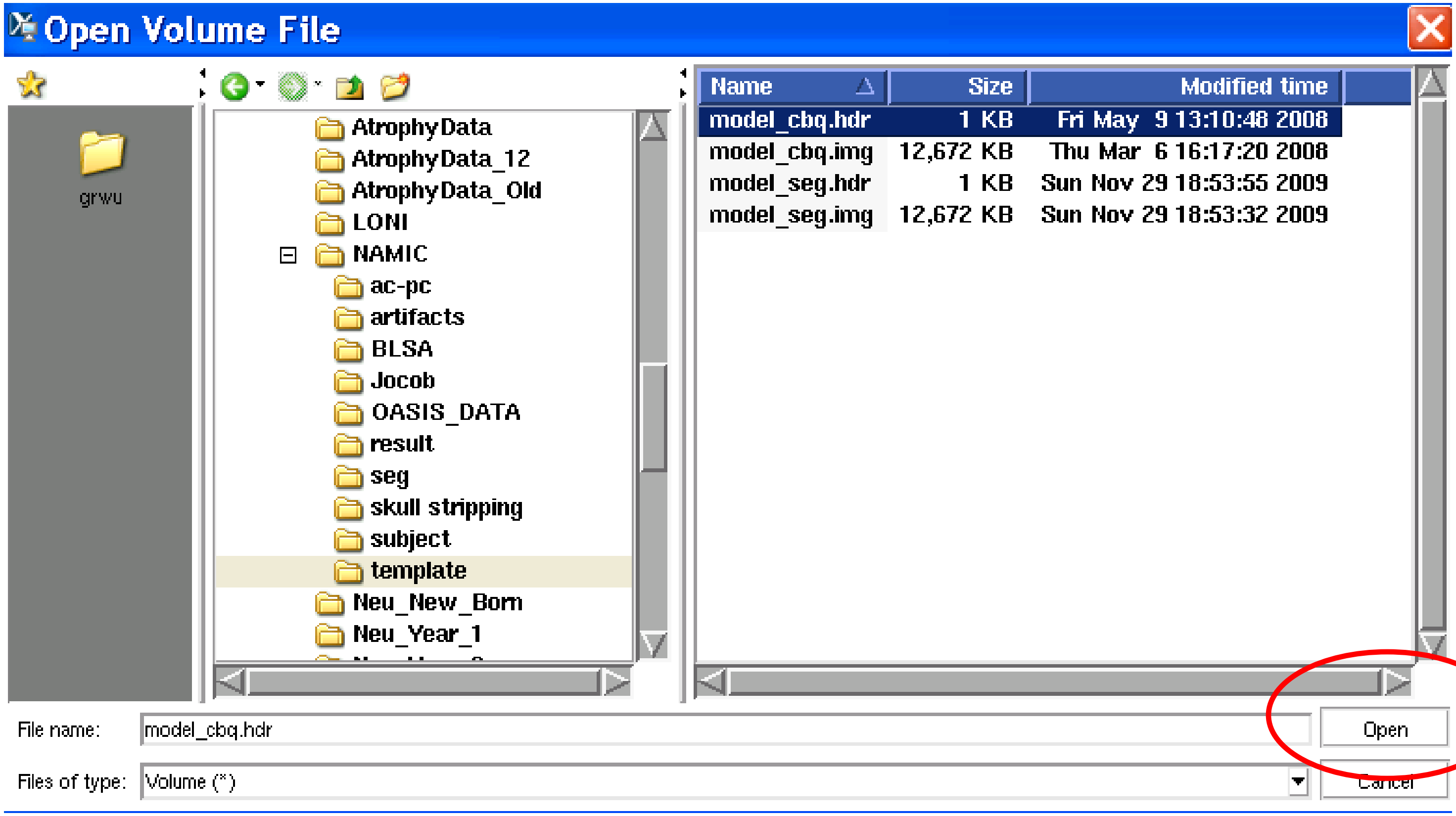
Working directory

Fixed Image(intensity, segmented)

File name: ac-pc

Files of type: Volume (*)

Open the Fixed Intensity Brain



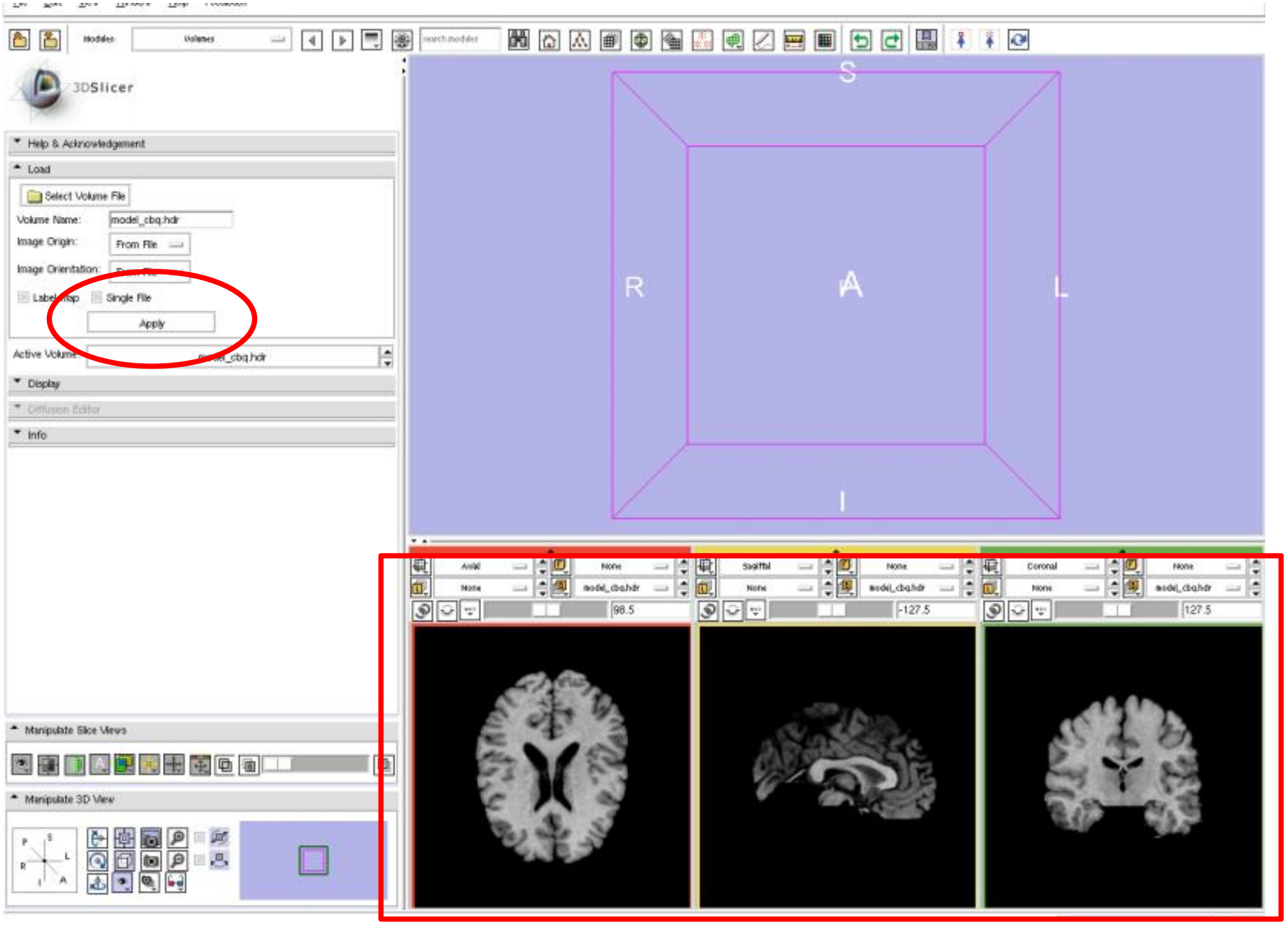
Open Volume File

Name	Size	Modified time
model_cbq.hdr	1 KB	Fri May 9 13:10:48 2008
model_cbq.img	12,672 KB	Thu Mar 6 16:17:20 2008
model_seg.hdr	1 KB	Sun Nov 29 18:53:55 2009
model_seg.img	12,672 KB	Sun Nov 29 18:53:32 2009

File name: model_cbq.hdr

Files of type: Volume (*)

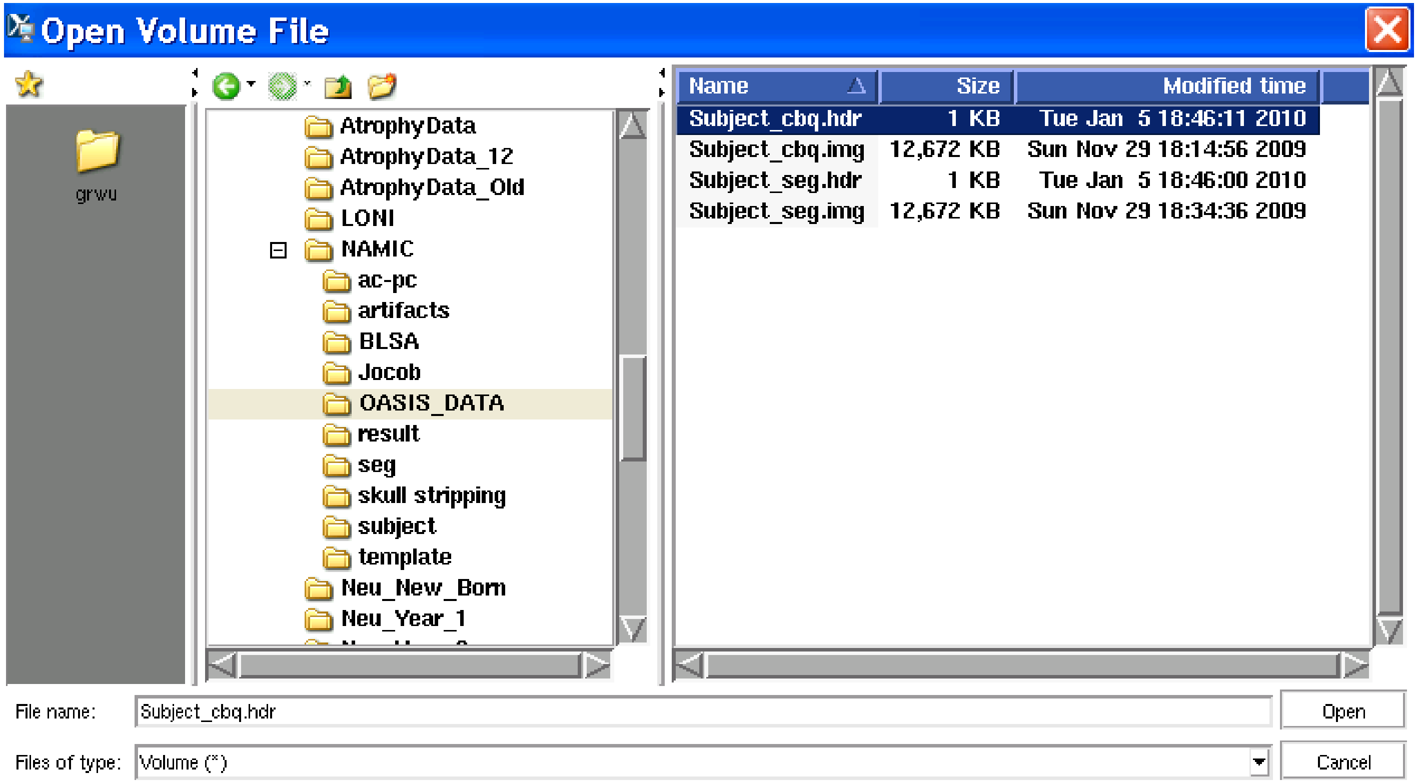
Open the Fixed Intensity Brain



Volume Name: model_cbq.hdr

Active Volume: model_cbq.hdr

Open the Moving Intensity Brain

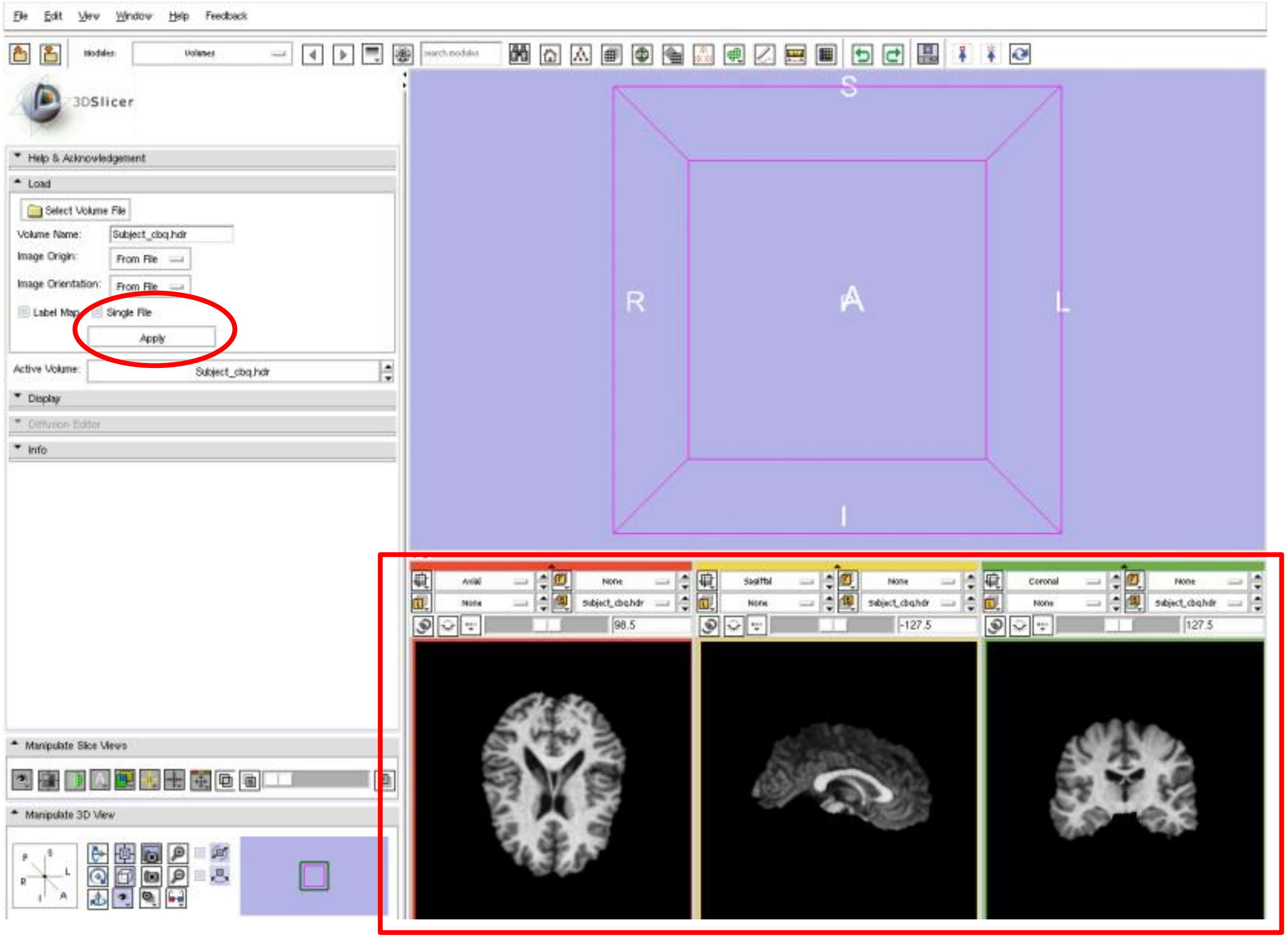


Name	Size	Modified time
Subject_cbq.hdr	1 KB	Tue Jan 5 18:46:11 2010
Subject_cbq.img	12,672 KB	Sun Nov 29 18:14:56 2009
Subject_seg.hdr	1 KB	Tue Jan 5 18:46:00 2010
Subject_seg.img	12,672 KB	Sun Nov 29 18:34:36 2009

File name: Subject_cbq.hdr

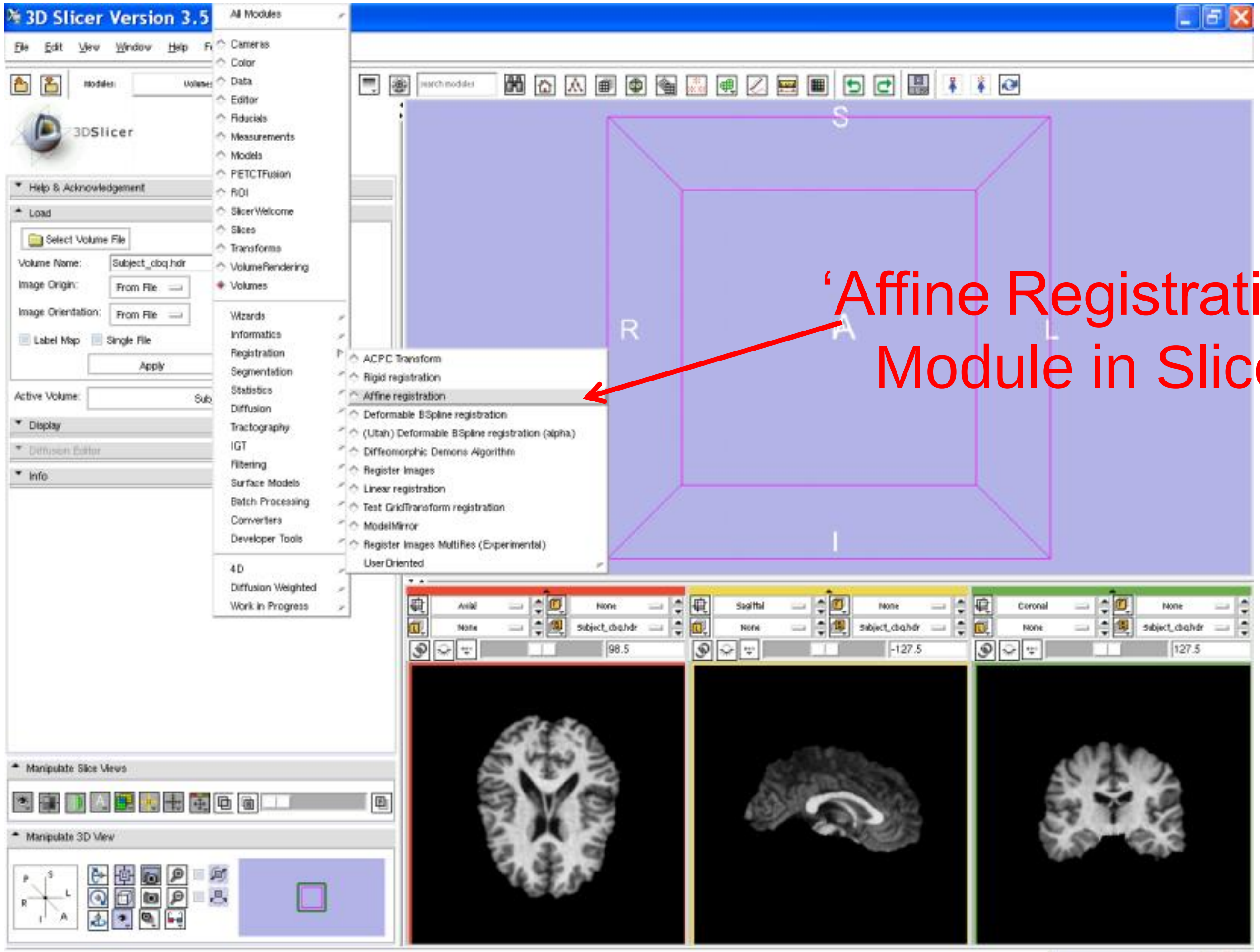
Files of type: Volume (*)

Open the Moving Intensity Brain



Volume Name: Subject_cbq.hdr
Image Origin: From File
Image Orientation: From File
□ Label Map □ Single File
Active Volume: Subject_cbq.hdr
Axial: None / None / Subject_cbq.hdr, 98.5
Sagittal: None / None / Subject_cbq.hdr, -127.5
Coronal: None / None / Subject_cbq.hdr, 127.5

Affine Registration



Volume Name: Subject_cbq.hdr

Image Origin: From File

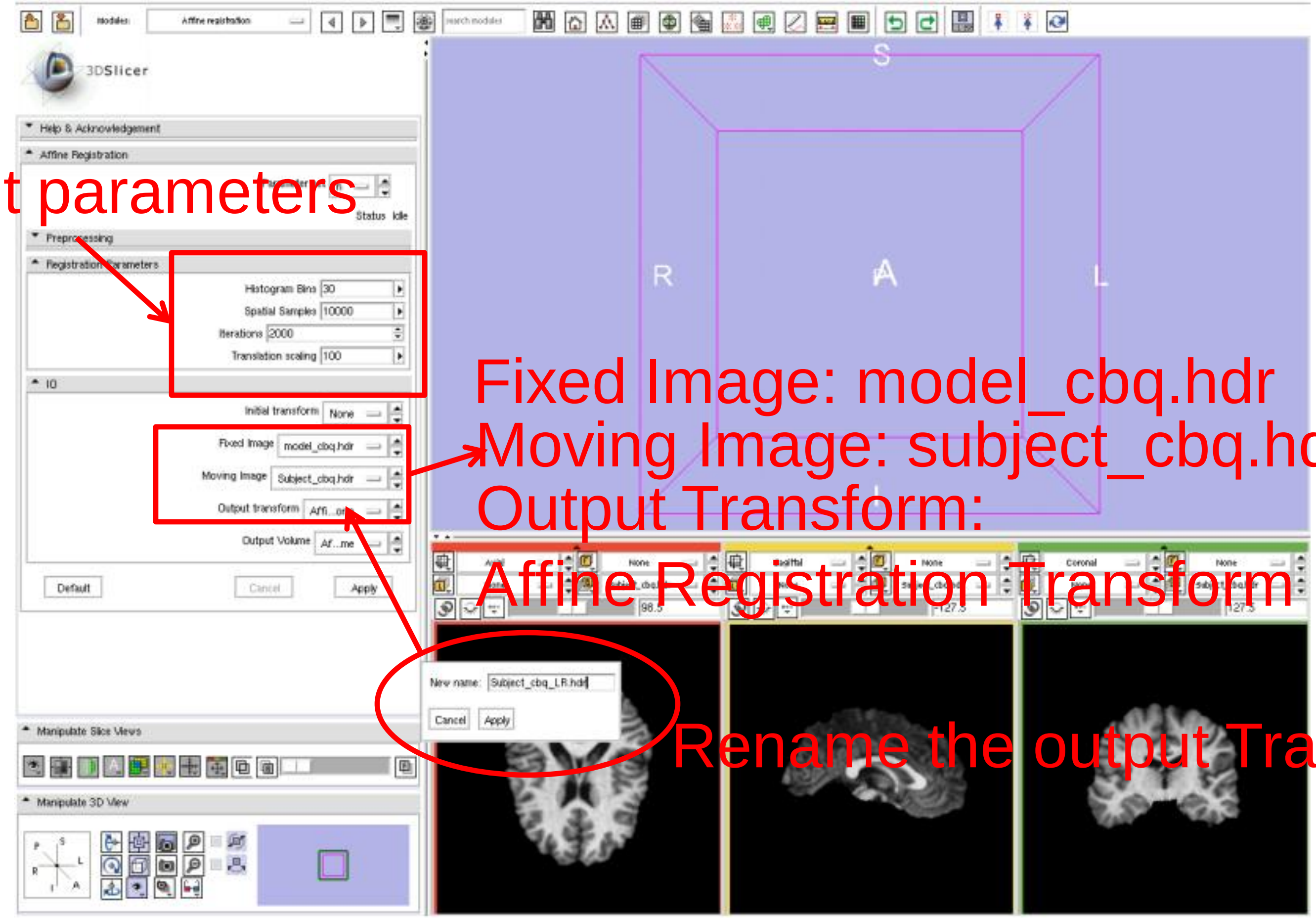
Image Orientation: From File

□ Label Map □ Single File

Active Volume: Sub

'Affine Registration'
Module in Slicer3

Affine Registration



Status Idle

Histogram Bins 30

Spatial Samples 10000

Iterations 2000

Translation scaling 100

Initial transform None

Fixed Image model_cbq.hdr

Moving Image Subject_cbq.hdr

Output transform Affi...or

Output Volume Af...me

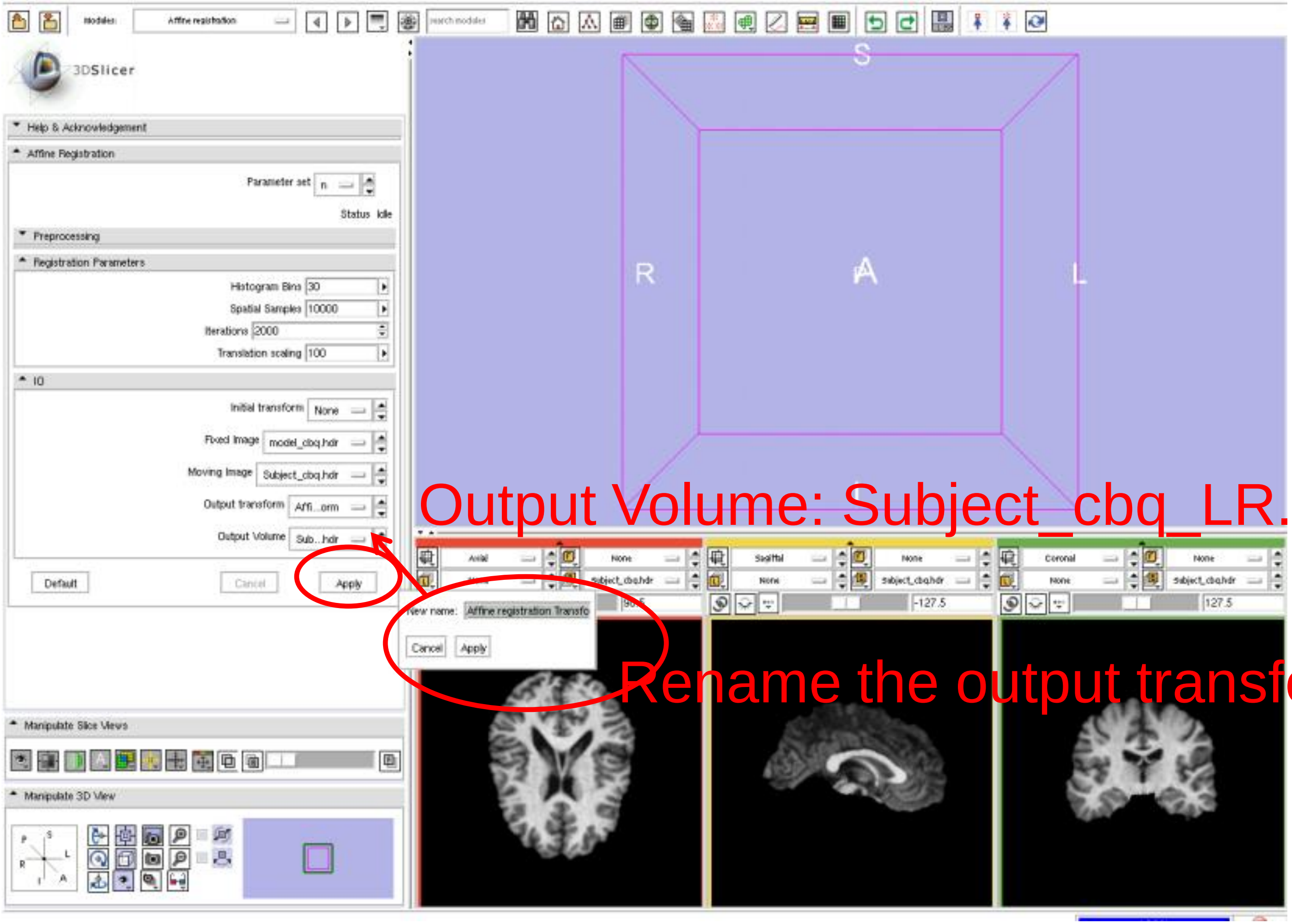
New name: Subject_cbq_LR.hdr

Default parameters

Fixed Image: model_cbq.hdr
Moving Image: subject_cbq.hdr
Output Transform:
Affine Registration Transform

Rename the output Transform

Affine Registration



Help & Acknowledgement

Affine Registration

Parameter set: n

Status: Idle

Preprocessing

Registration Parameters

Histogram Bins: 30

Spatial Samples: 10000

Iterations: 2000

Translation scaling: 100

IO

Initial transform: None

Fixed Image: model_cbq.hdr

Moving Image: Subject_cbq.hdr

Output transform: Affi...orm

Output Volume: Sub...hdr

Default | Cancel | Apply

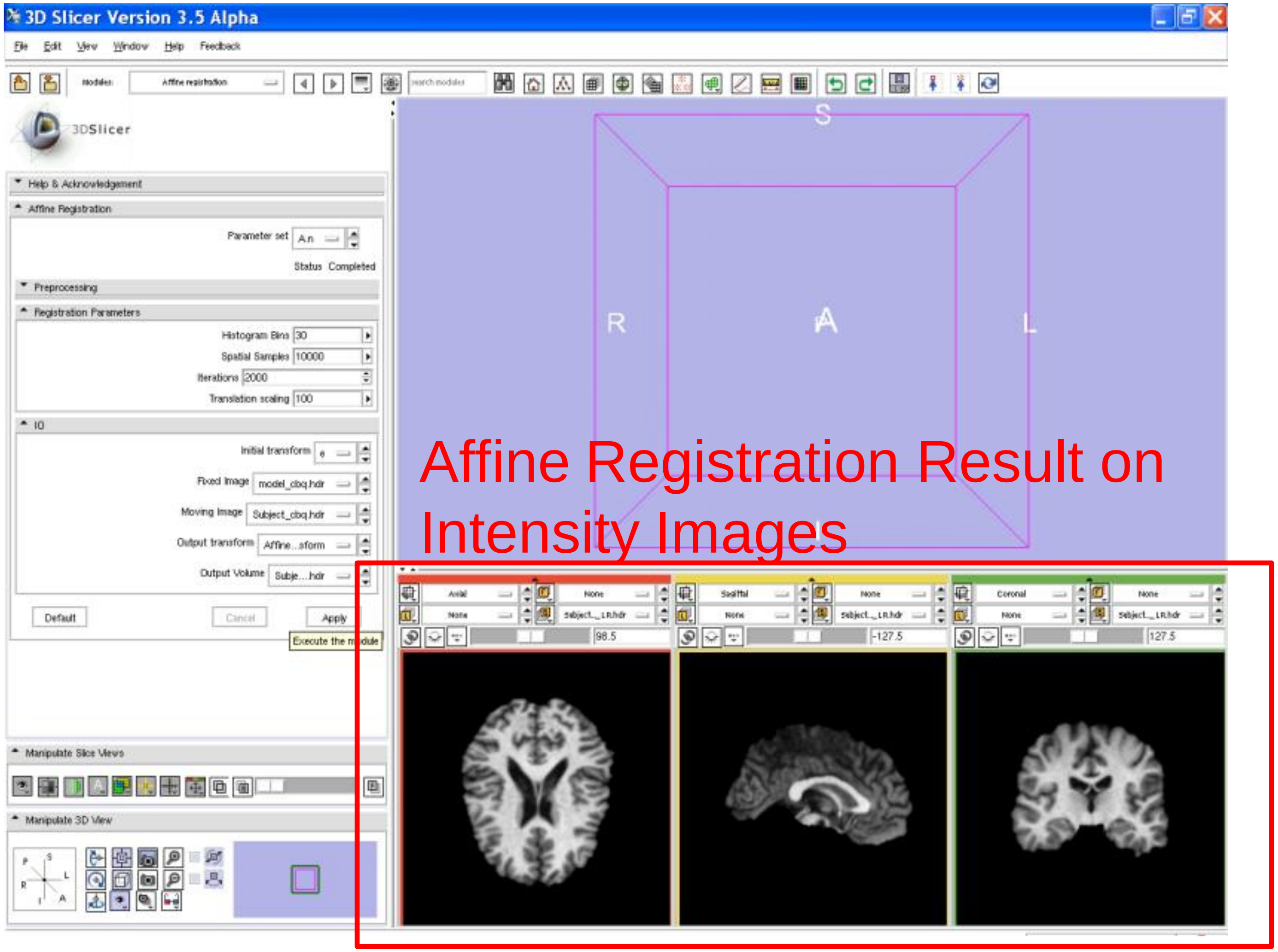
New name: Affine registration Transfo

Cancel | Apply

Output Volume: Subject_cbq_LR.hdr

Rename the output transform

Affine Registration



Help & Acknowledgement

Affine Registration

Parameter set: A.n

Status: Completed

Preprocessing

Registration Parameters

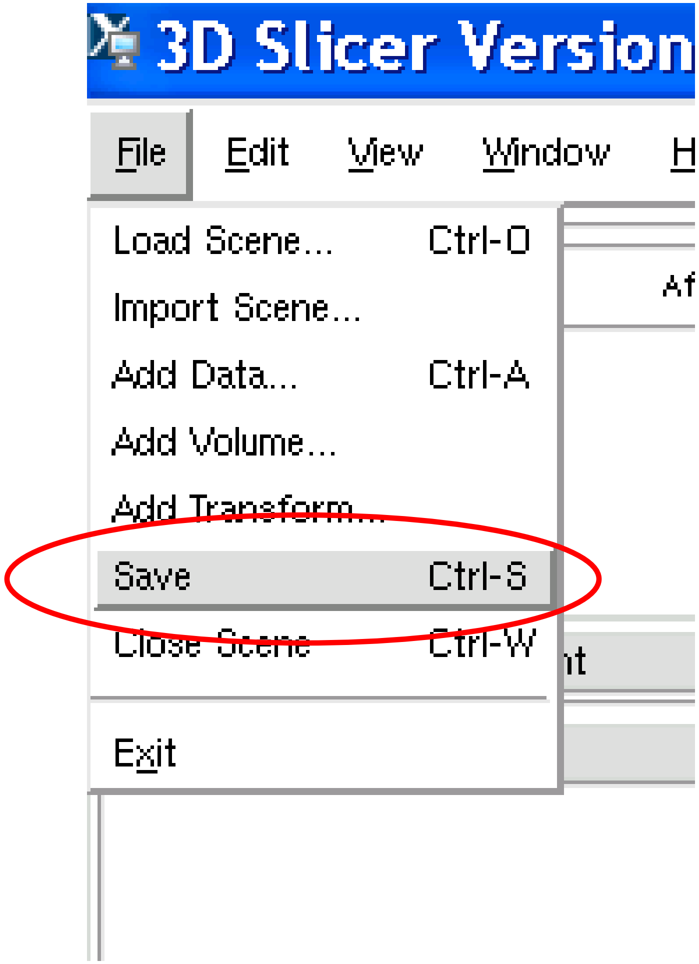
- Histogram Bins: 30
- Spatial Samples: 10000
- Iterations: 2000
- Translation scaling: 100

IO

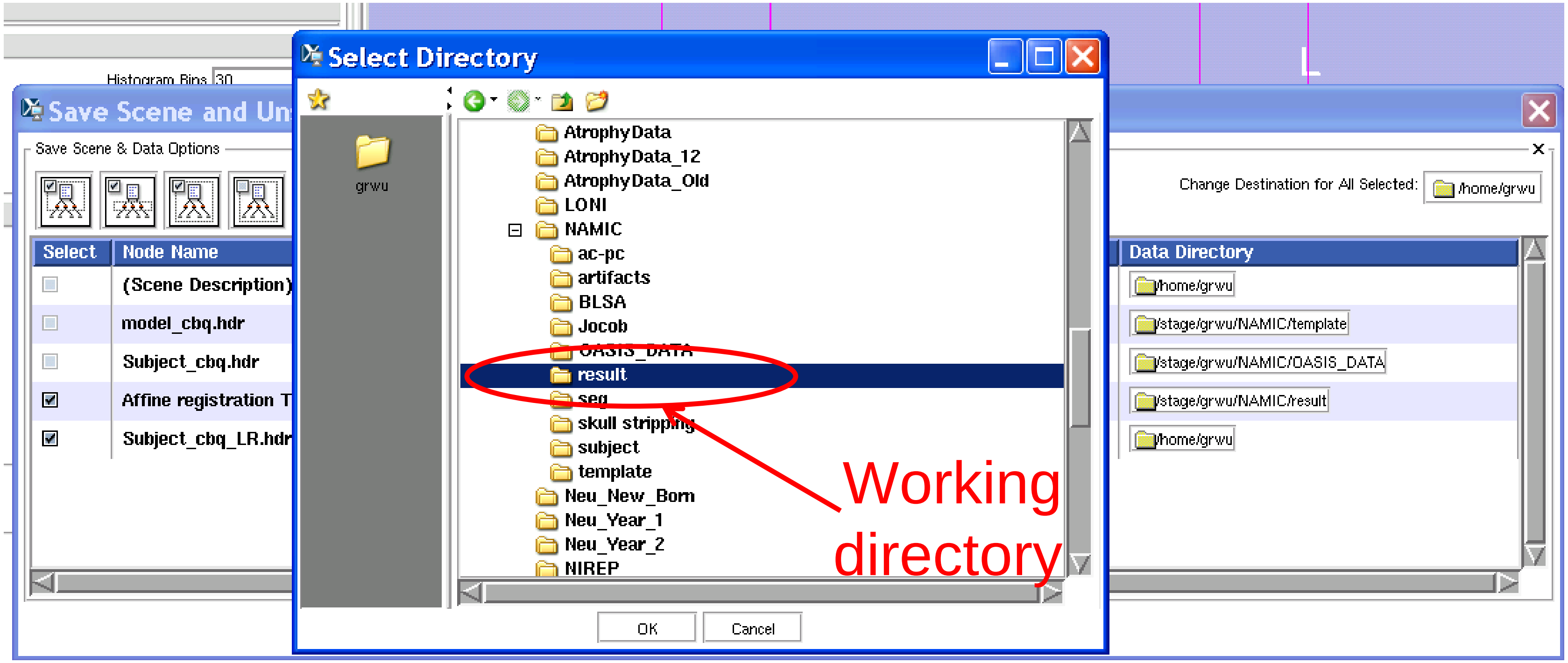
- Initial transform: e
- Fixed Image: model_cbq.hdr
- Moving Image: Subject_cbq.hdr
- Output transform: Affine...sform
- Output Volume: Subje....hdr

Affine Registration Result on Intensity Images

Save the Affine Results



Save the Affine Results

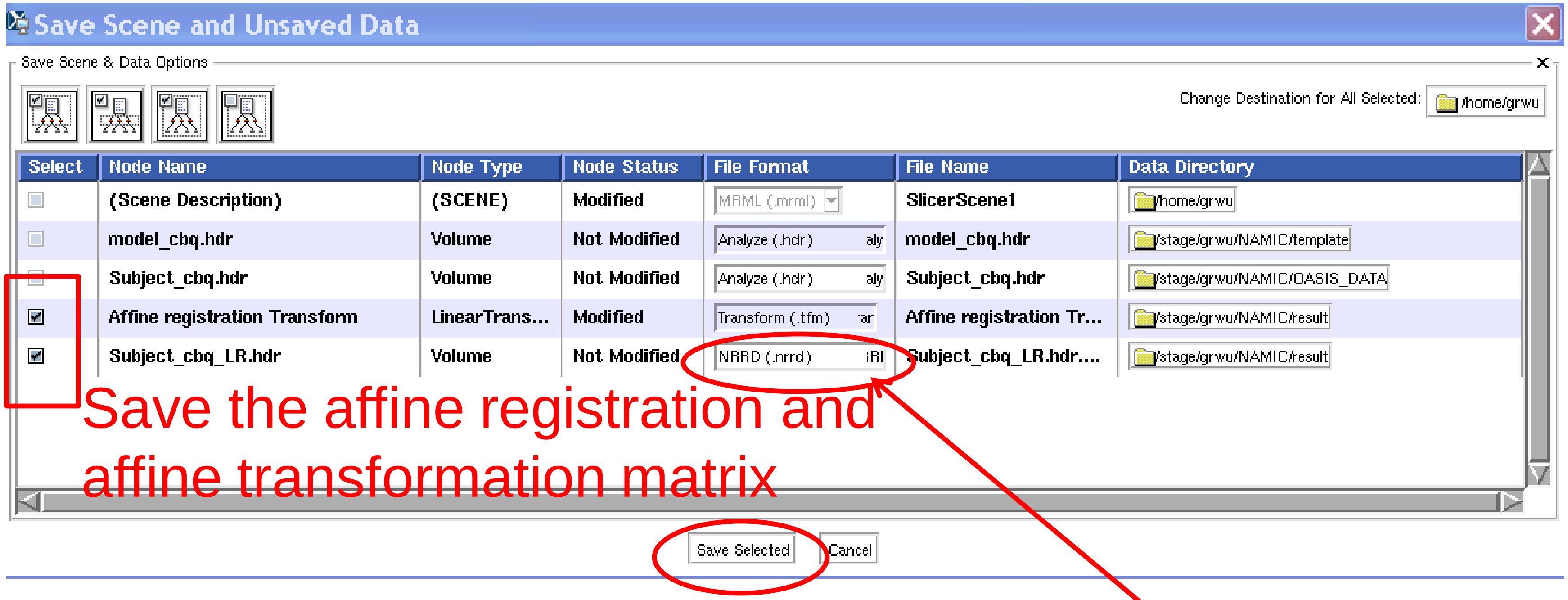

Histogram Bins 30
Save Scene and Un
Save Scene & Data Options
Change Destination for All Selected: /home/grwu
Select Directory
grwu
OK
Cancel

Select	Node Name	Data Directory
☐	(Scene Description)	/home/grwu
☐	model_cbq.hdr	/stage/grwu/NAMIC/template
☐	Subject_cbq.hdr	/stage/grwu/NAMIC/OASIS_DATA
☑	Affine registration T	/stage/grwu/NAMIC/result
☑	Subject_cbq_LR.hdr	/home/grwu

- AtrophyData
- AtrophyData_12
- AtrophyData_Old
- LONI
- NAMIC
  - ac-pc
  - artifacts
  - BLSA
  - Jocob
  - OASIS_DATA
  - result
  - seg
  - skull stripping
  - subject
  - template
- Neu_New_Born
- Neu_Year_1
- Neu_Year_2
- NIREP

Working directory

Save the Affine Results



Save Scene and Unsaved Data

Save Scene & Data Options

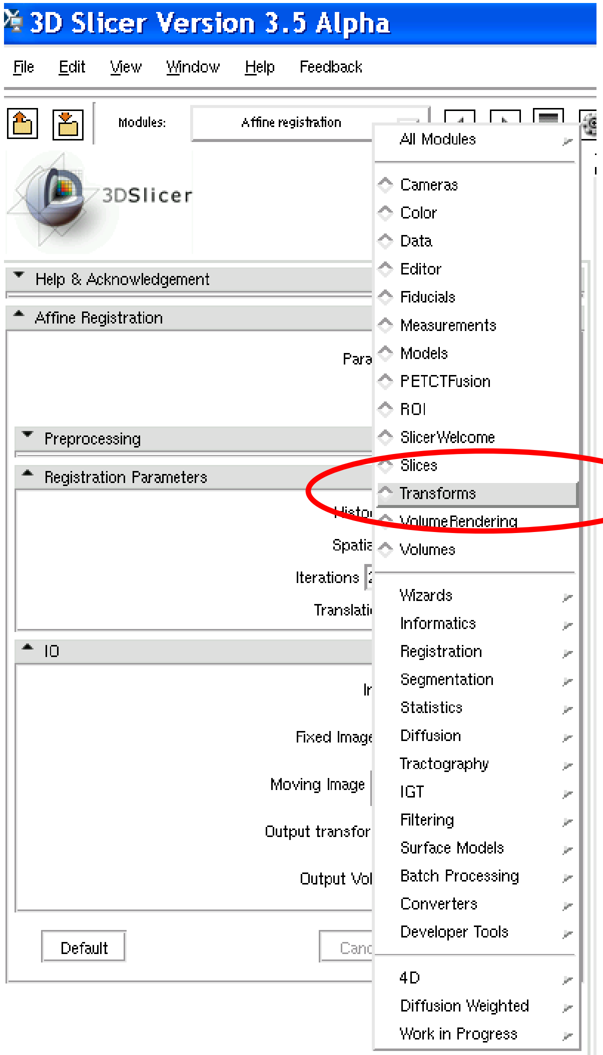
Change Destination for All Selected: /home/grwu

Select	Node Name	Node Type	Node Status	File Format	File Name	Data Directory
□	(Scene Description)	(SCENE)	Modified	MRML (.mrml)	SlicerScene1	/home/grwu
□	model_cbq.hdr	Volume	Not Modified	Analyze (.hdr) aly	model_cbq.hdr	/stage/grwu/NAMIC/template
□	Subject_cbq.hdr	Volume	Not Modified	Analyze (.hdr) aly	Subject_cbq.hdr	/stage/grwu/NAMIC/OASIS_DATA
☑	Affine registration Transform	LinearTrans...	Modified	Transform (.tfm) ar	Affine registration Tr...	/stage/grwu/NAMIC/result
☑	Subject_cbq_LR.hdr	Volume	Not Modified	NRRD (.nrrd) iRI	Subject_cbq_LR.hdr....	/stage/grwu/NAMIC/result

Save the affine registration and affine transformation matrix

Change to 'analyze' format

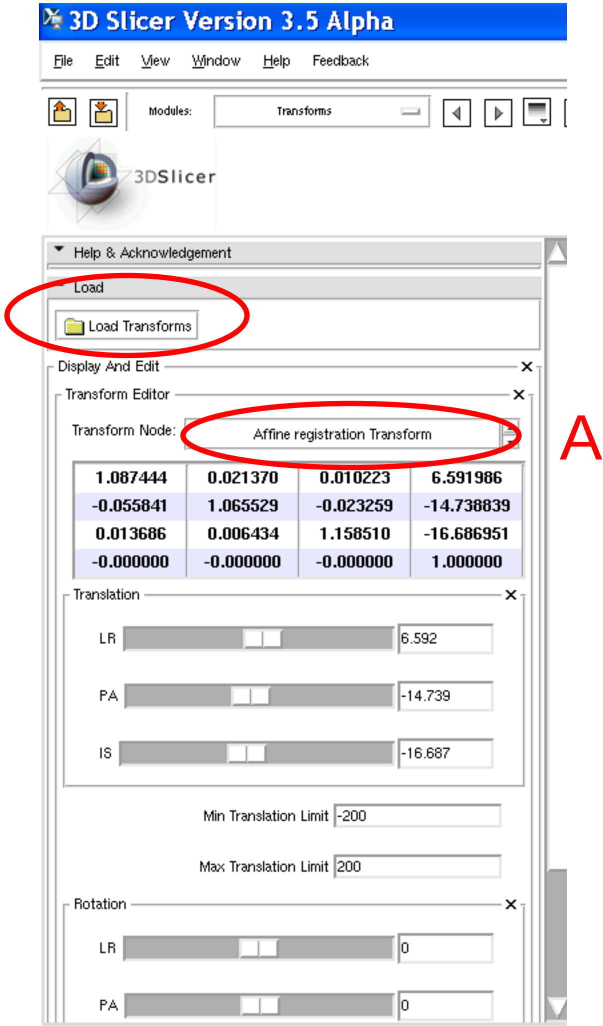
Check the Transformation



Modules: Affine registration

Transforms

Check the Transformation



Transform Node: Affine registration Transform

1.087444	0.021370	0.010223	6.591986
-0.055841	1.065529	-0.023259	-14.738839
0.013686	0.006434	1.158510	-16.686951
-0.000000	-0.000000	-0.000000	1.000000

Translation

LR 6.592

PA -14.739

IS -16.687

Min Translation Limit -200

Max Translation Limit 200

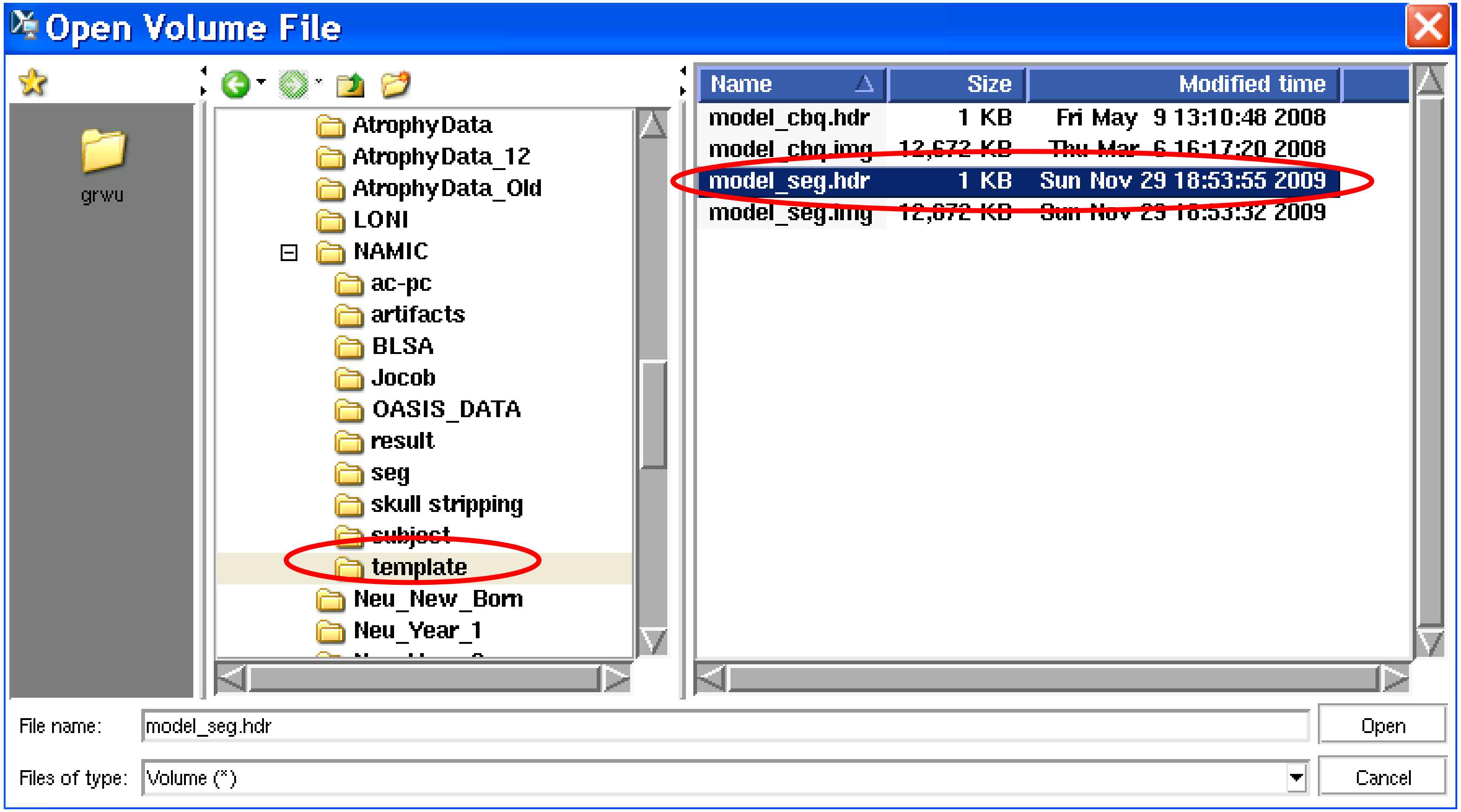
Rotation

LR 0

PA 0

Affine registration Transform

Open the Fixed Segmented Brain



Open Volume File

- grwu

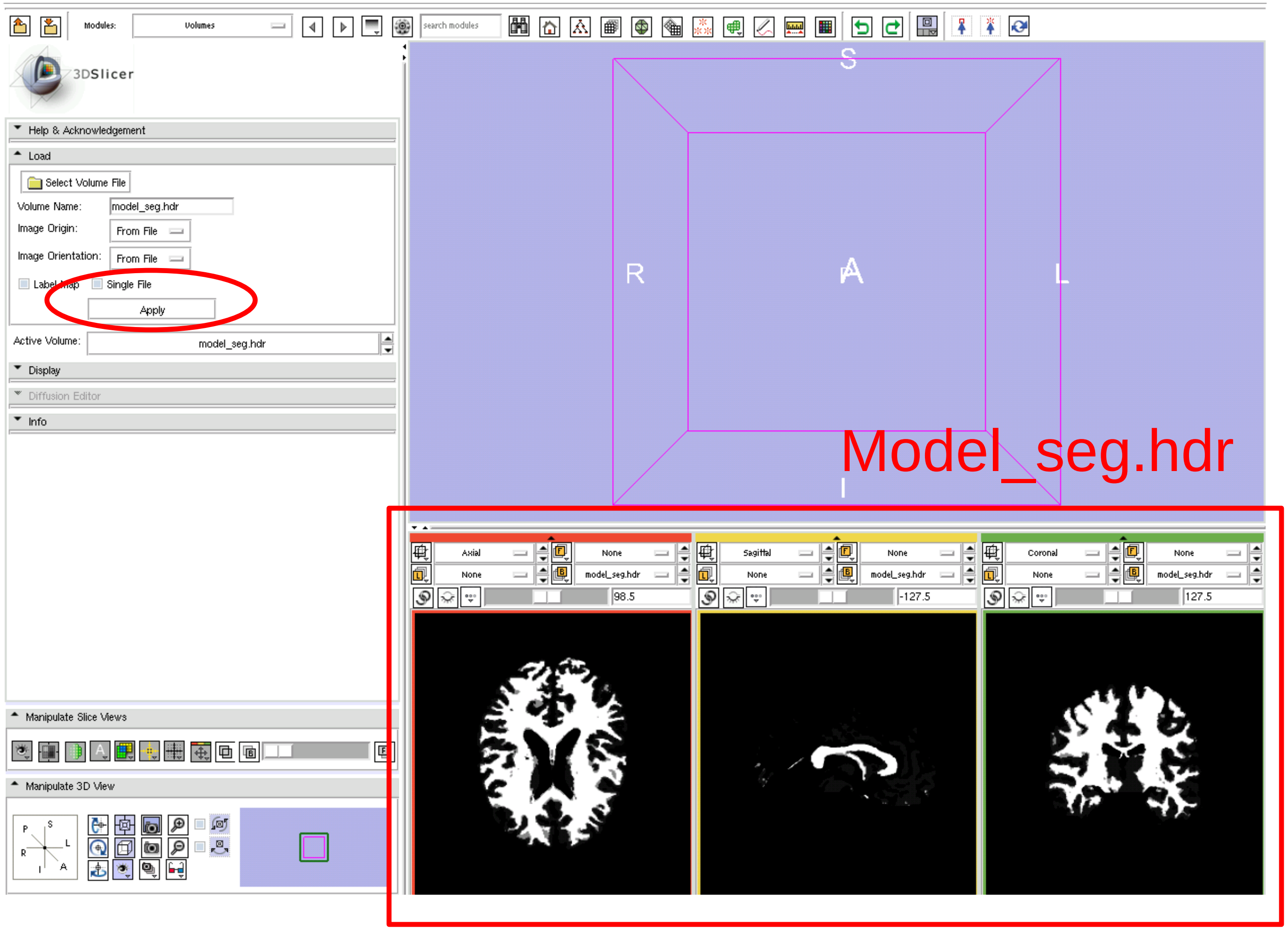
- AtrophyData
- AtrophyData_12
- AtrophyData_Old
- LONI
- NAMIC
  - ac-pc
  - artifacts
  - BLSA
  - Jocob
  - OASIS_DATA
  - result
  - seg
  - skull stripping
  - subject
  - template
- Neu_New_Born
- Neu_Year_1

Name	Size	Modified time
model_cbq.hdr	1 KB	Fri May 9 13:10:48 2008
model_cbq.img	12,672 KB	Thu Mar 6 16:17:20 2008
model_seg.hdr	1 KB	Sun Nov 29 18:53:55 2009
model_seg.img	12,672 KB	Sun Nov 29 18:53:32 2009

File name: model_seg.hdr

Files of type: Volume (*)

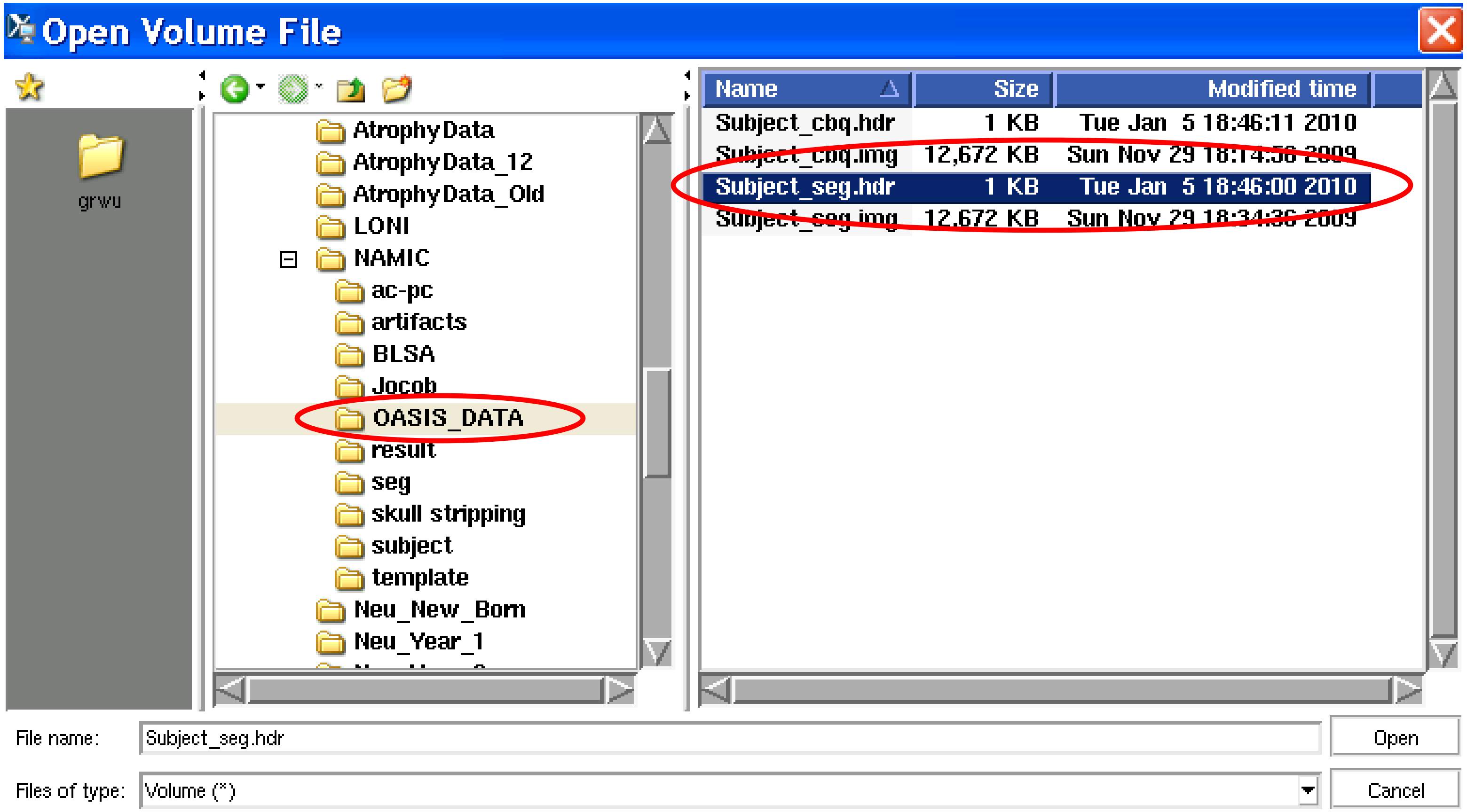
Open the Fixed Segmented Brain



Volume Name: model_seg.hdr
Image Origin: From File
Image Orientation: From File
□ Label Map □ Single File
Apply
Active Volume: model_seg.hdr

Model_seg.hdr

Open the MovingSegmented Brain



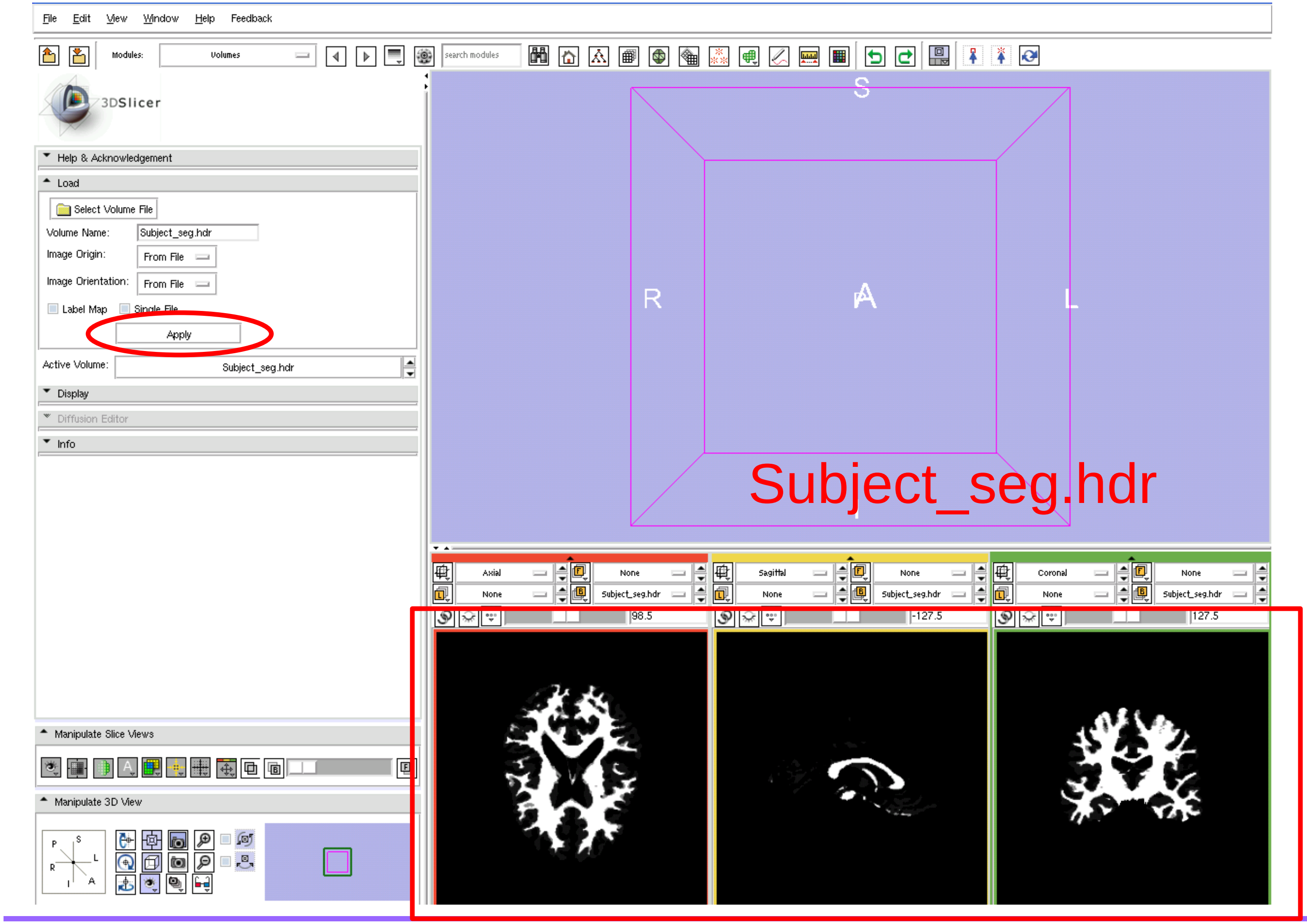
Open Volume File

Name	Size	Modified time
Subject_cbq.hdr	1 KB	Tue Jan 5 18:46:11 2010
Subject_cbq.img	12,672 KB	Sun Nov 29 18:14:58 2009
Subject_seg.hdr	1 KB	Tue Jan 5 18:46:00 2010
Subject_seg.img	12,672 KB	Sun Nov 29 18:34:36 2009

File name: Subject_seg.hdr

Files of type: Volume (*)

Open the MovingSegmented Brain



Help & Acknowledgement

Load

Select Volume File

Volume Name: Subject_seg.hdr

Image Origin: From File

Image Orientation: From File

□ Label Map □ Single File

Apply

Active Volume: Subject_seg.hdr

Display

Diffusion Editor

Info

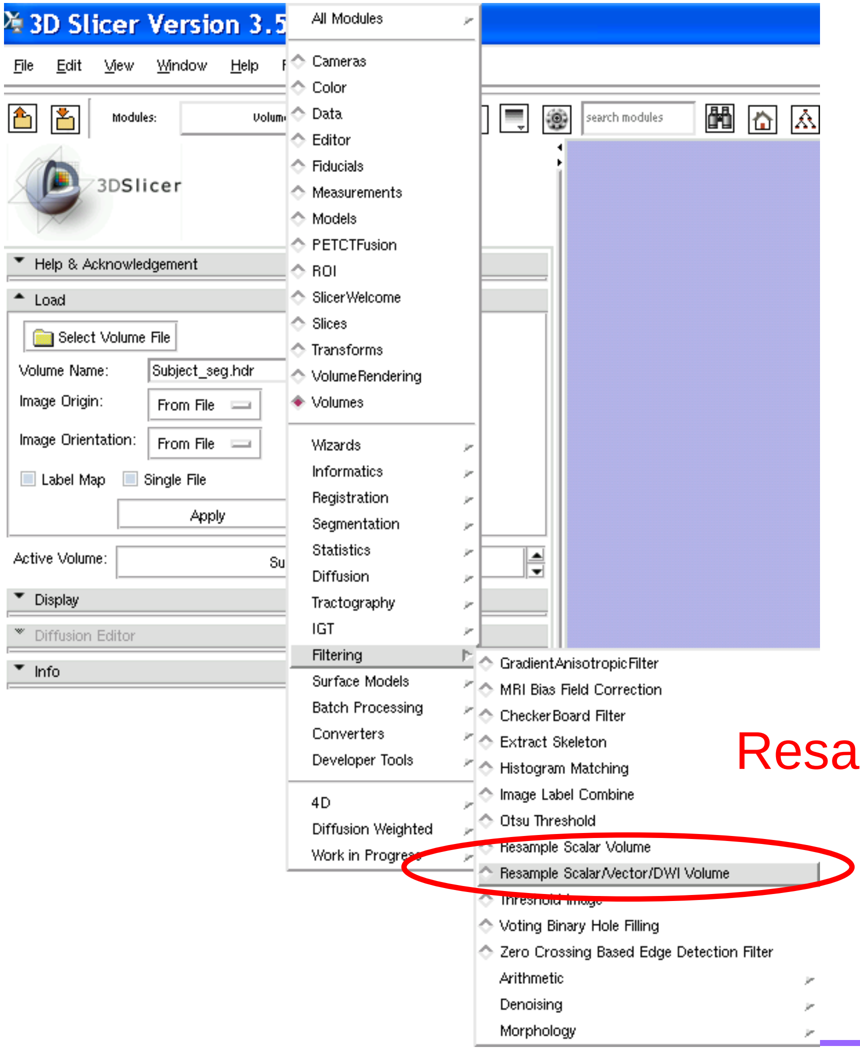
Axial: None / None / Subject_seg.hdr — 98.5

Sagittal: None / None / Subject_seg.hdr — -127.5

Coronal: None / None / Subject_seg.hdr — 127.5

Subject_seg.hdr

Perform Affine Transform



3D Slicer Version 3.5

File Edit View Window Help

Modules: Volumes

Help & Acknowledgement

Load

Select Volume File

Volume Name: Subject_seg.hdr

Image Origin: From File

Image Orientation: From File

□ Label Map □ Single File

Apply

Active Volume:

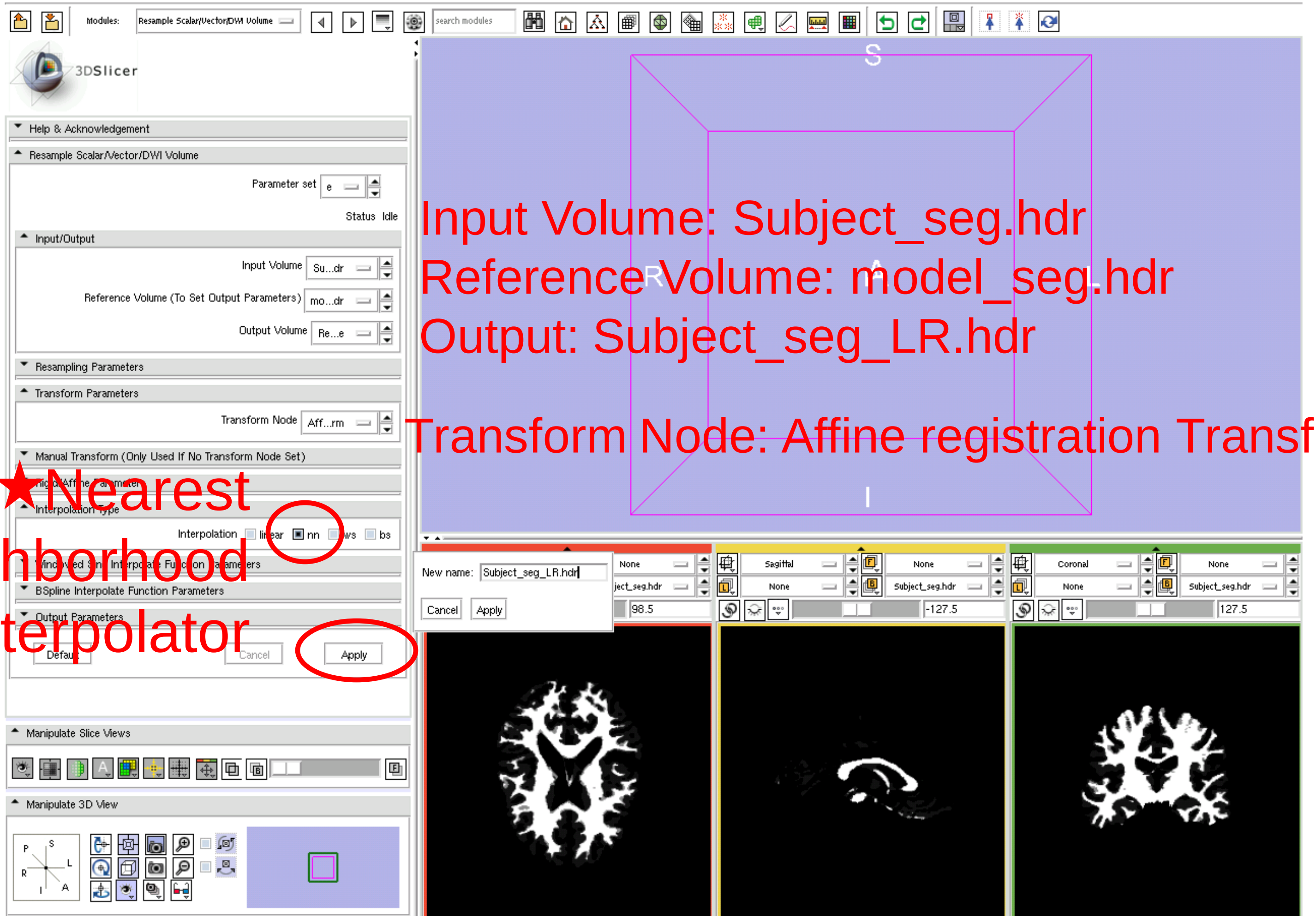
Display

Diffusion Editor

Info

Resample Scalar/Vector/DWI Volume

Perform Affine Transform



Modules: Resample Scalar/Vector/DWI Volume

Resample Scalar/Vector/DWI Volume

Parameter set e

Status Idle

Input/Output

Input Volume Su...dr

Reference Volume (To Set Output Parameters) mo...dr

Output Volume Re...e

Transform Parameters

Transform Node Aff...rm

Interpolation type

Interpolation □ linear ☒ nn □ ws □ bs

New name: Subject_seg_LR.hdr

Cancel Apply

Input Volume: Subject_seg.hdr

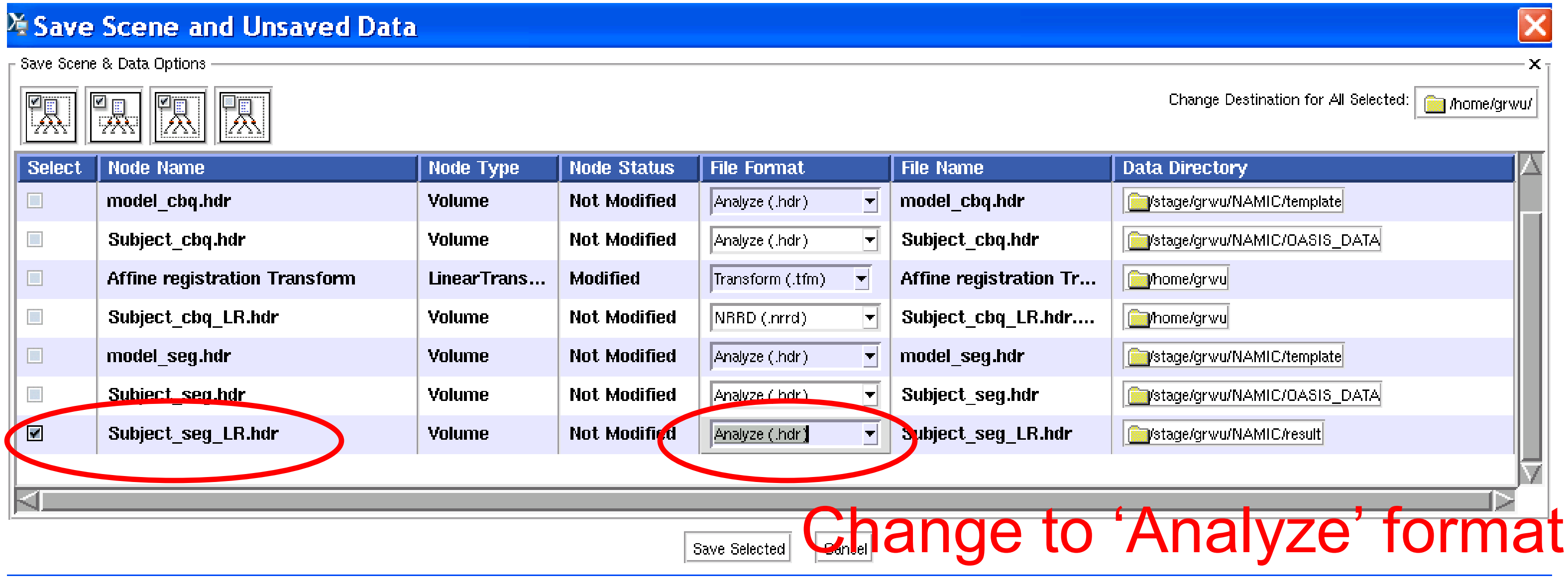
Reference Volume: model_seg.hdr

Output: Subject_seg_LR.hdr

Transform Node: Affine registration Transform.tfm

★Nearest neighborhood Interpolator

Save the Affine Results



Save Scene and Unsaved Data

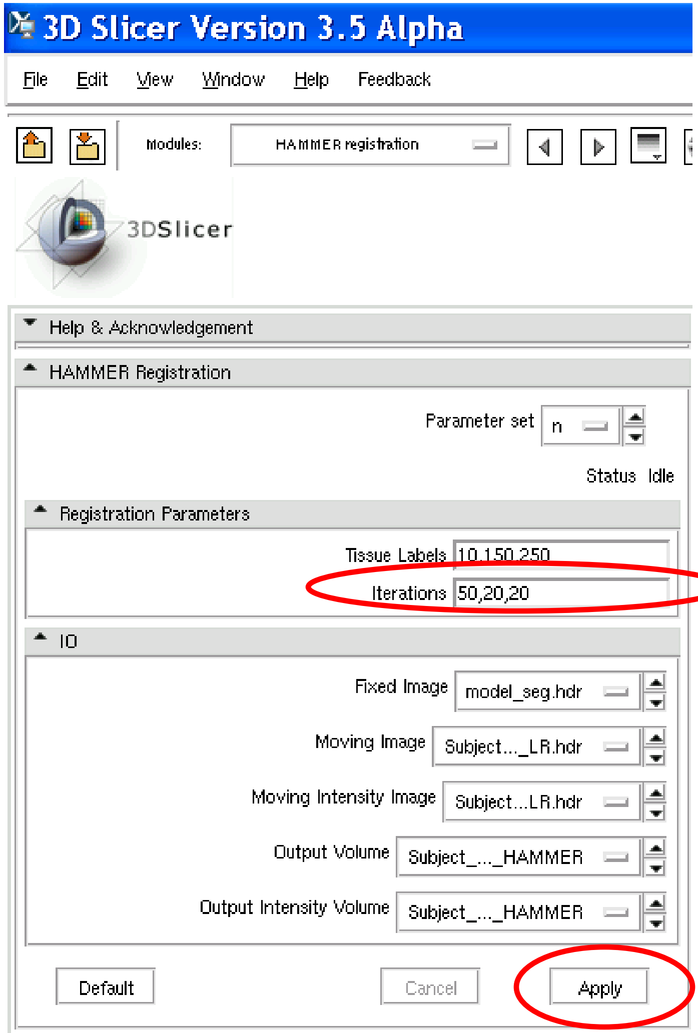
Save Scene & Data Options

Change Destination for All Selected: /home/grwu/

Select	Node Name	Node Type	Node Status	File Format	File Name	Data Directory
□	model_cbq.hdr	Volume	Not Modified	Analyze (.hdr)	model_cbq.hdr	/stage/grwu/NAMIC/template
□	Subject_cbq.hdr	Volume	Not Modified	Analyze (.hdr)	Subject_cbq.hdr	/stage/grwu/NAMIC/OASIS_DATA
□	Affine registration Transform	LinearTrans...	Modified	Transform (.tfm)	Affine registration Tr...	/home/grwu
□	Subject_cbq_LR.hdr	Volume	Not Modified	NRRD (.nrrd)	Subject_cbq_LR.hdr....	/home/grwu
□	model_seg.hdr	Volume	Not Modified	Analyze (.hdr)	model_seg.hdr	/stage/grwu/NAMIC/template
□	Subject_seg.hdr	Volume	Not Modified	Analyze (.hdr)	Subject_seg.hdr	/stage/grwu/NAMIC/OASIS_DATA
☑	Subject_seg_LR.hdr	Volume	Not Modified	Analyze (.hdr)	Subject_seg_LR.hdr	/stage/grwu/NAMIC/result

Change to 'Analyze' format

Run HAMMER



3D Slicer Version 3.5 Alpha

Modules: HAMMER registration

Parameter set: n

Status: Idle

Tissue Labels: 10,150,250

Iterations: 50,20,20

Fixed Image: model_seg.hdr

Moving Image: Subject..._LR.hdr

Moving Intensity Image: Subject...LR.hdr

Output Volume: Subject_..._HAMMER

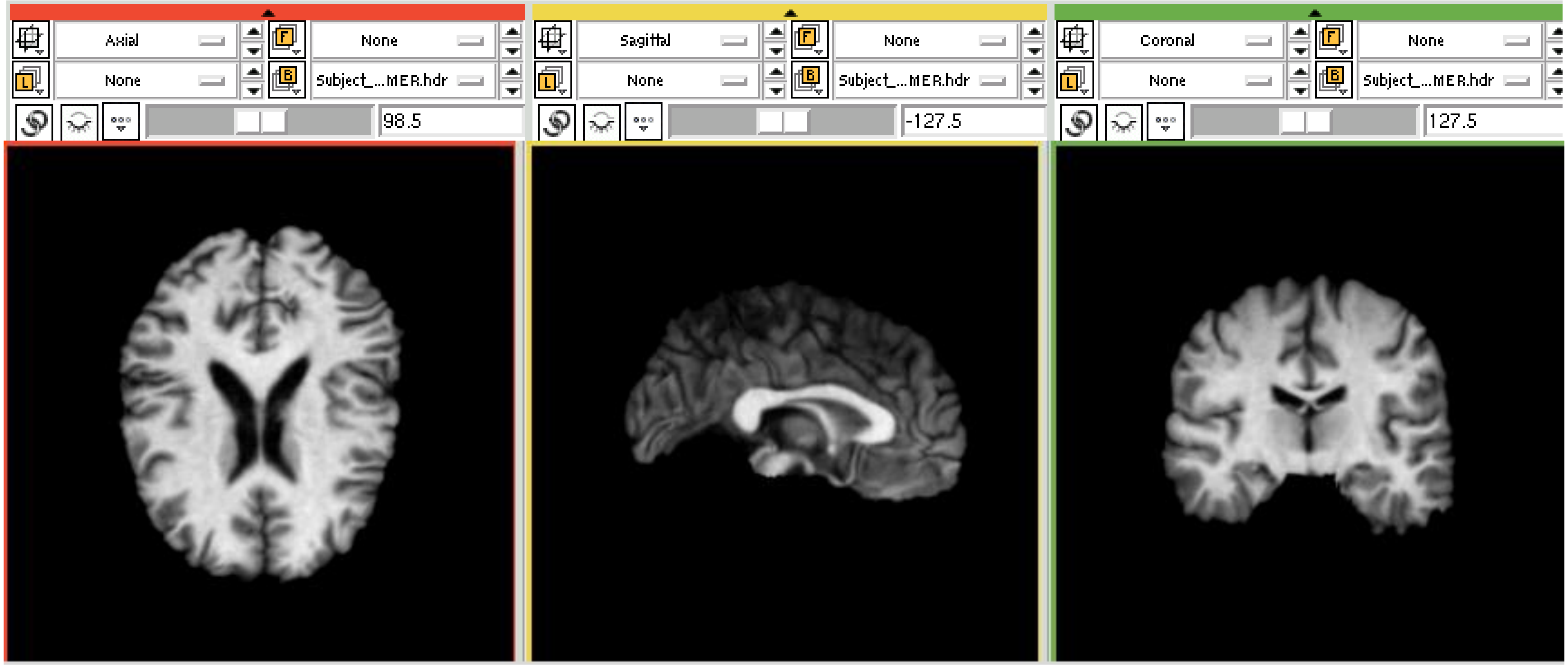
Output Intensity Volume: Subject_..._HAMMER

Iterations in low, middle, and high resolution

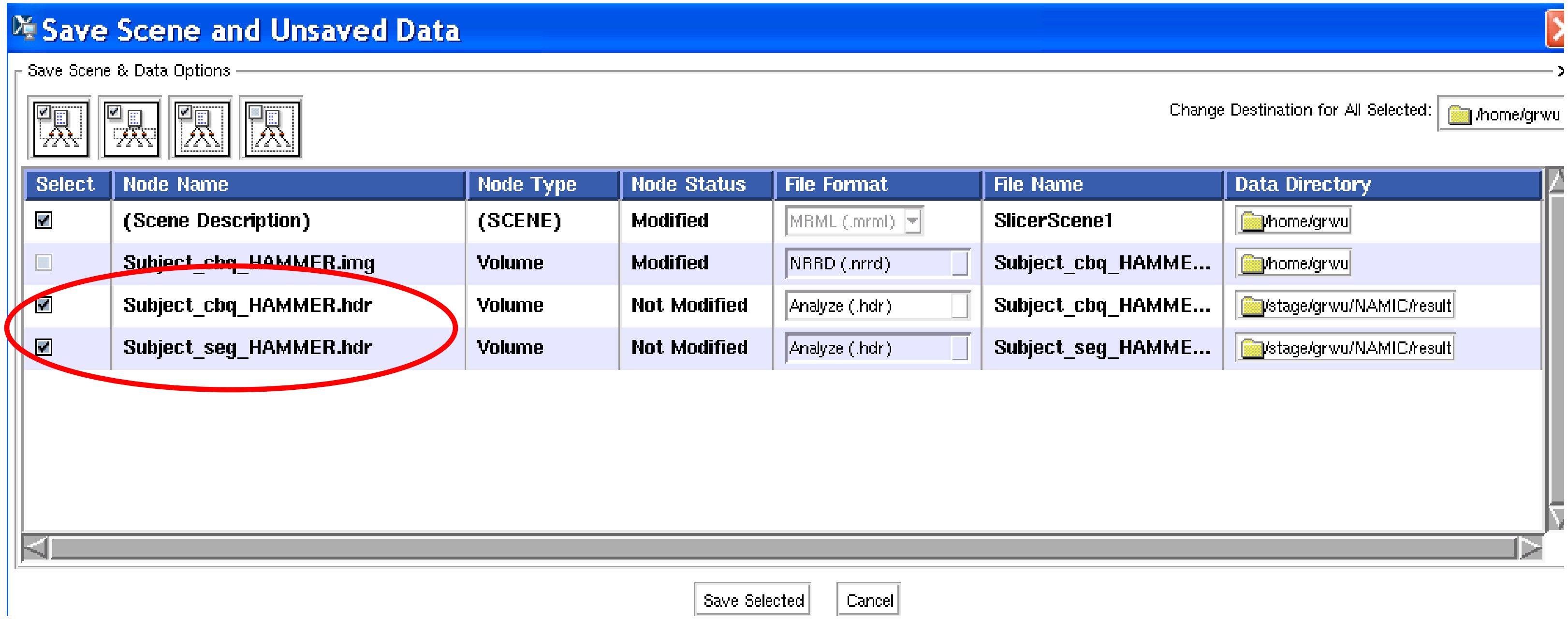
Fixed Image: model_seg.hdr
Moving Image: Subject_seg_LR.hdr
Moving Intensity Image: Subject_cbq_LR.hdr
Output Volume: Subject_seg_HAMMER.hdr
Output intensity Volume: Subject_cbq_HAMMER.hdr

Run HAMMER

Warping Result (intensity image)



Run HAMMER



Save Scene and Unsaved Data

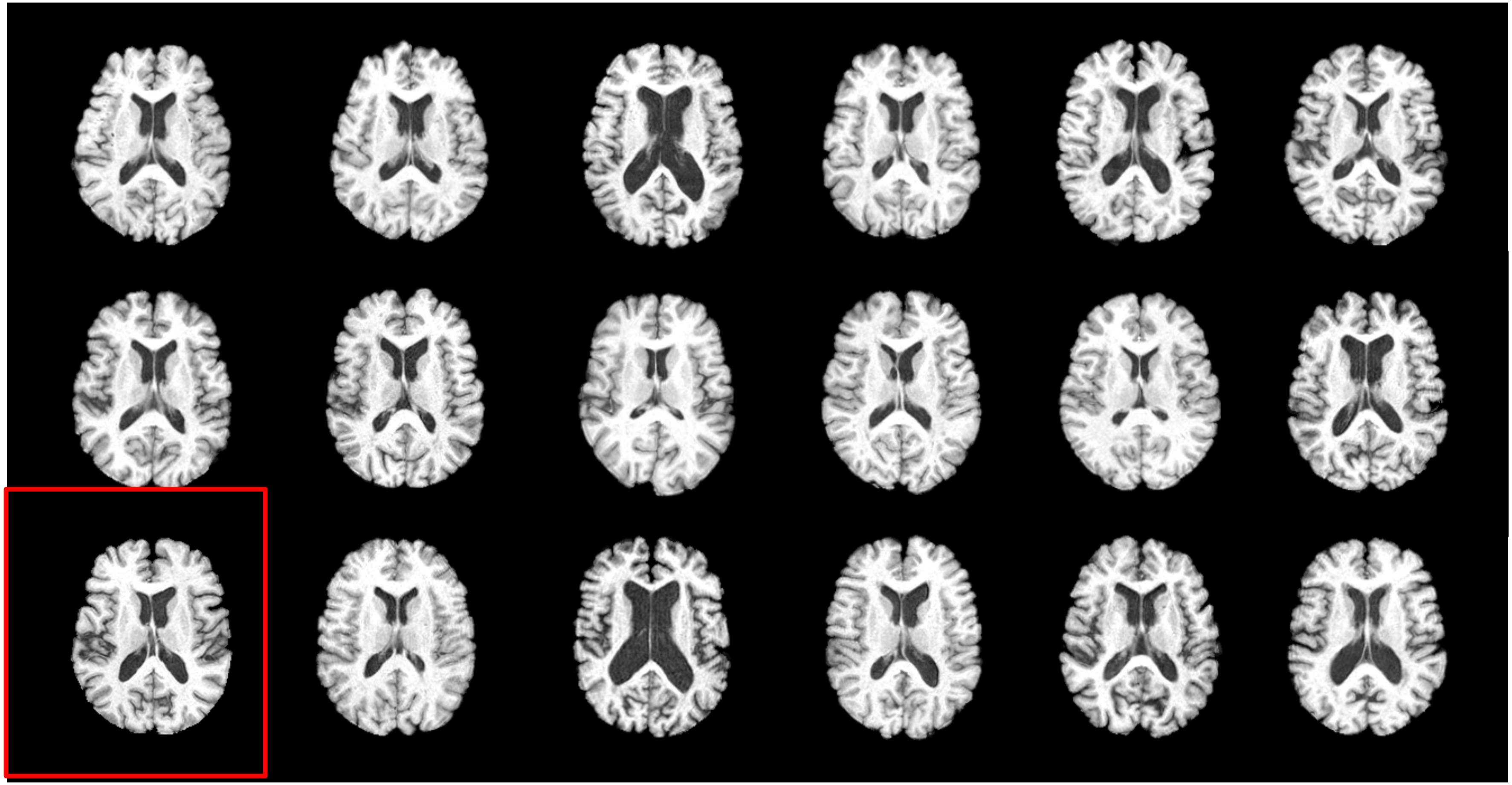
Save Scene & Data Options

Change Destination for All Selected: /home/grwu

Select	Node Name	Node Type	Node Status	File Format	File Name	Data Directory
☑	(Scene Description)	(SCENE)	Modified	MRML (.mrml)	SlicerScene1	/home/grwu
☐	Subject_cbq_HAMMER.img	Volume	Modified	NRRD (.nrrd)	Subject_cbq_HAMME...	/home/grwu
☑	Subject_cbq_HAMMER.hdr	Volume	Not Modified	Analyze (.hdr)	Subject_cbq_HAMME...	/stage/grwu/NAMIC/result
☑	Subject_seg_HAMMER.hdr	Volume	Not Modified	Analyze (.hdr)	Subject_seg_HAMME...	/stage/grwu/NAMIC/result

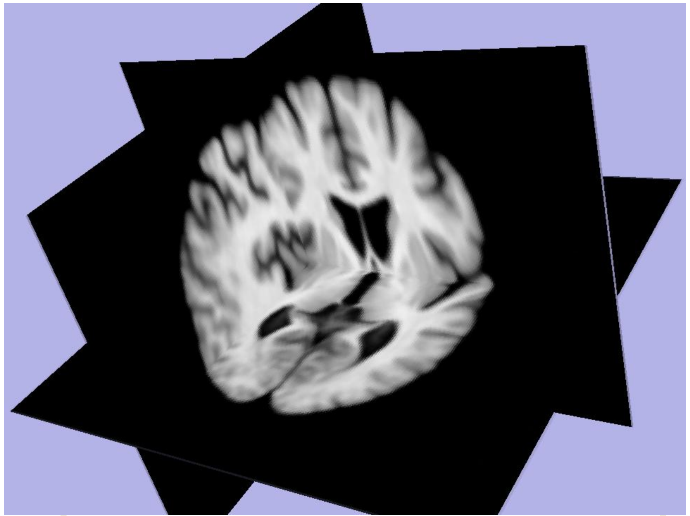
HAMMER: Validation

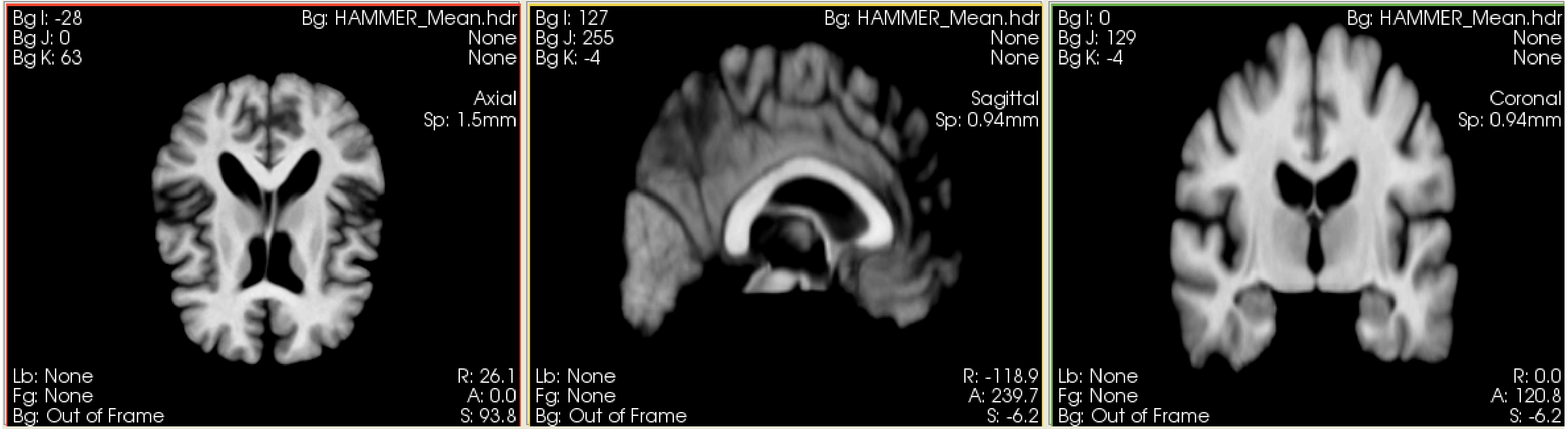
Experiment 1: 18 Elder Brains From BLSA Dataset



HAMMER: Results

Average Image



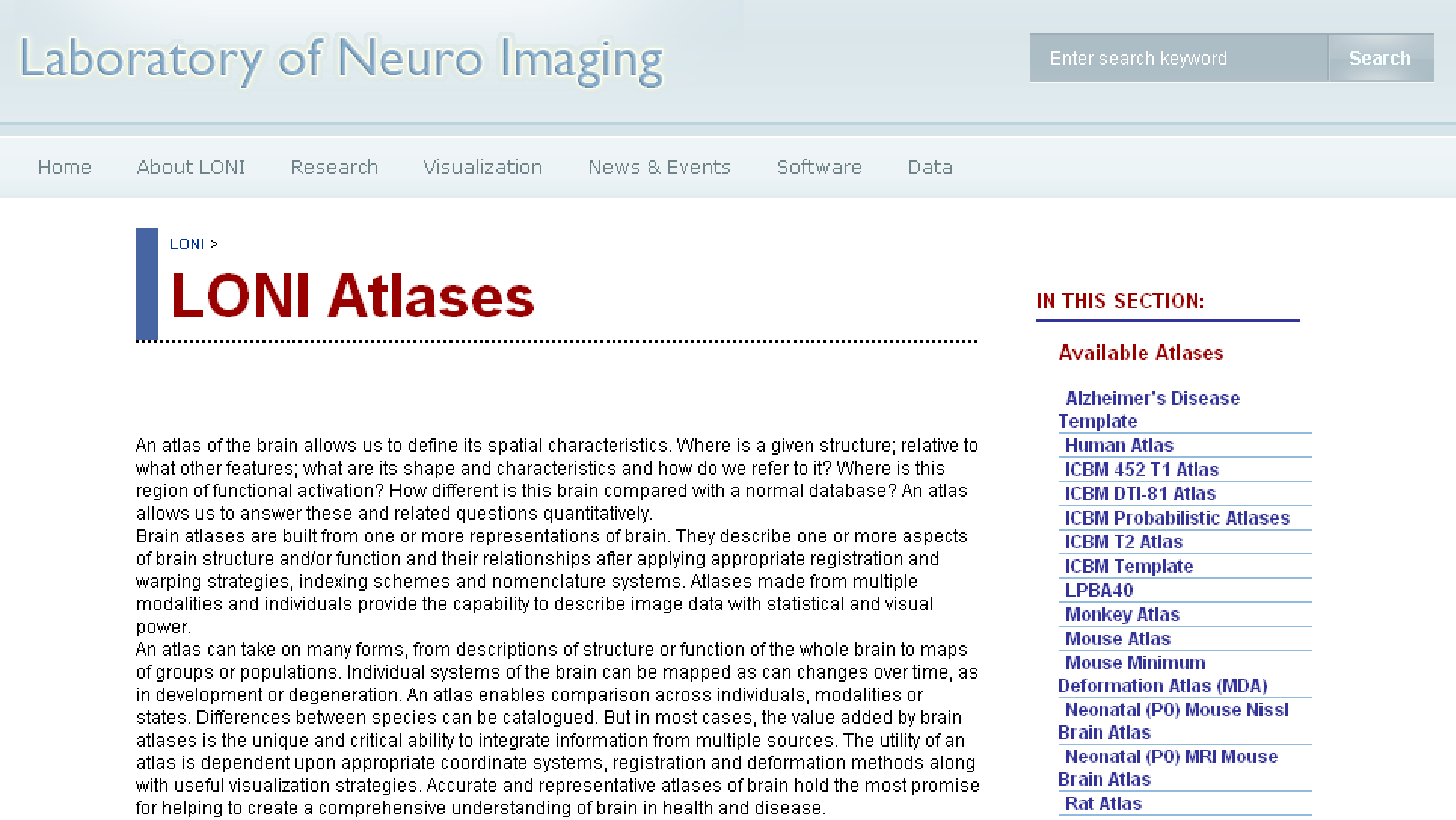


Bg I: -28
Bg J: 0
Bg K: 63
Bg: HAMMER_Mean.hdr
None
None
Axial
Sp: 1.5mm
Lb: None
Fg: None
Bg: Out of Frame
R: 26.1
A: 0.0
S: 93.8

Bg I: 127
Bg J: 255
Bg K: -4
Bg: HAMMER_Mean.hdr
None
None
Sagittal
Sp: 0.94mm
Lb: None
Fg: None
Bg: Out of Frame
R: -118.9
A: 239.7
S: -6.2

Bg I: 0
Bg J: 129
Bg K: -4
Bg: HAMMER_Mean.hdr
None
None
Coronal
Sp: 0.94mm
Lb: None
Fg: None
Bg: Out of Frame
R: 0.0
A: 120.8
S: -6.2

40 LONI Dataset with 54 manually labeled RIOs



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.

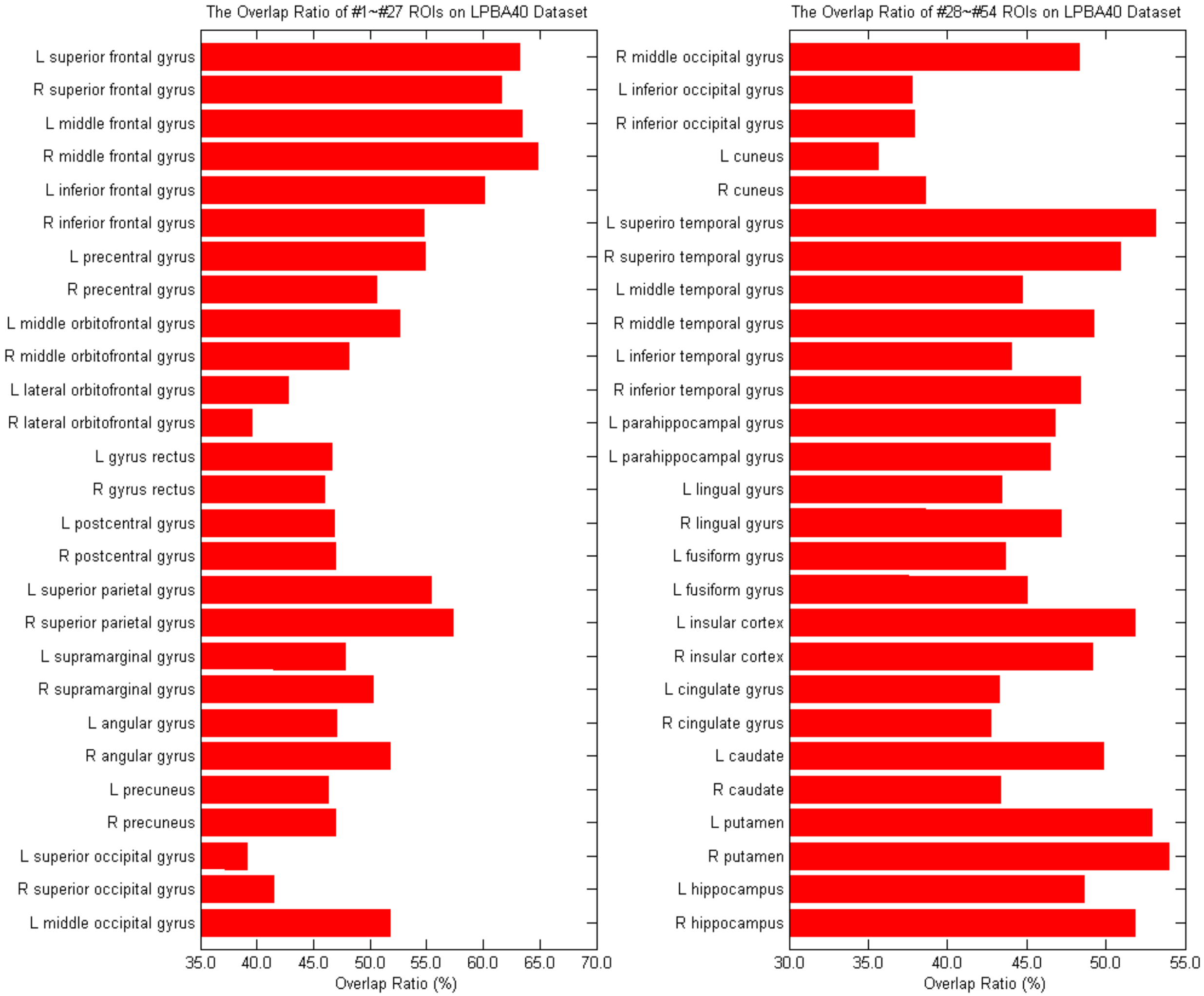
Brain atlases are built from one or more representations of brain. They describe one or more aspects of brain structure and/or function and their relationships after applying appropriate registration and warping strategies, indexing schemes and nomenclature systems. Atlases made from multiple modalities 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.

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

HAMMER: Results



Acknowledgement

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