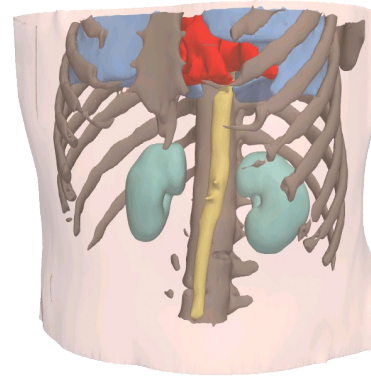
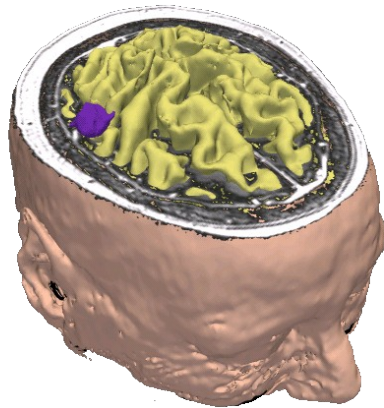




EMSegmenter Tutorial (Advanced Mode)



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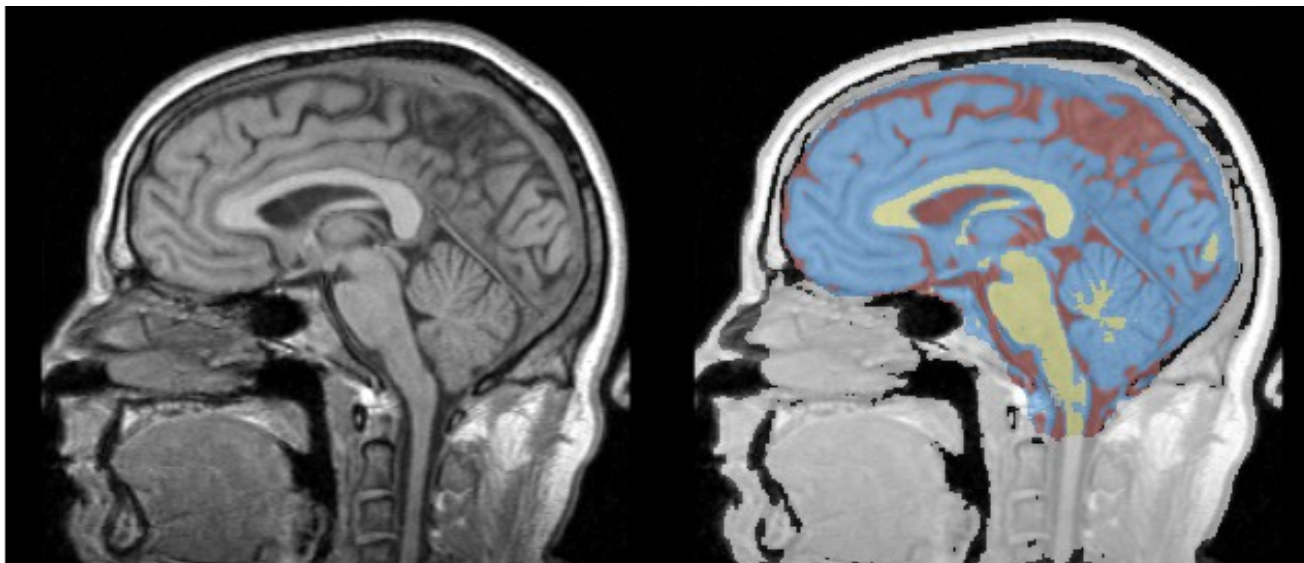


Overview

The goal of this tutorial is to apply the EMSegmenter to MRI brain scans. We will segment the clinical T1 scan shown below into **grey matter**, **white matter**, and **cerebrospinal fluid**.

The tutorial is based on Slicer 3.6.2 .

Before



After



Overview

This tutorial leads you through the EMSegmenter steps.

The user has to

- create a new task
- specify the pre-processing
- specify the anatomical structures to segment
- assign atlas data
- tweak the EMSegmenter parameter
- run the segmentation

EMSegmenter (Advanced mode)

3DSlicer

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: SlicerWelcome

3DSlicer

Welcome & About

3DSlicer version 3.6 Welcome

3D Slicer is a free open source software platform for medical image processing and 3D visualization of image data. This module contains some basic information and useful links to get you started using Slicer. Please see our website <http://www.slicer.org> and the documentation on our wiki for more information: <http://www.slicer.org/slicerWiki/index.php/Documentation-3.6>.

3D Slicer is distributed under a BSD-style license; for details about the contribution and software license agreement, please see <http://www.slicer.org/pages/LicenseText>. The software has been designed for research purposes only and has not been 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.

Overview

Basic & Extended Modules

Loading Scenes & Data

Manipulate Slice Views

Manipulate 3D View

Left-click on the Modules menu



3DSlicer

Select EMSegmenter Module

The screenshot shows the 3D Slicer Version 3.6.3-beta interface. On the left, the 'Modules' list is expanded to 'Segmentation', and the 'EMSegmenter' module is highlighted. A red arrow points from a blue callout box to the 'EMSegmenter' module. The callout box contains the text: 'Select Segmentation → EMSegmenter'. The main window displays three orthogonal views: Axial, Sagittal, and Coronal. The Axial view shows a purple rectangular region with labels 'S', 'R', 'A', and 'L'. The Sagittal and Coronal views show similar regions. The bottom status bar indicates the 'EMSegmenter' module is active.

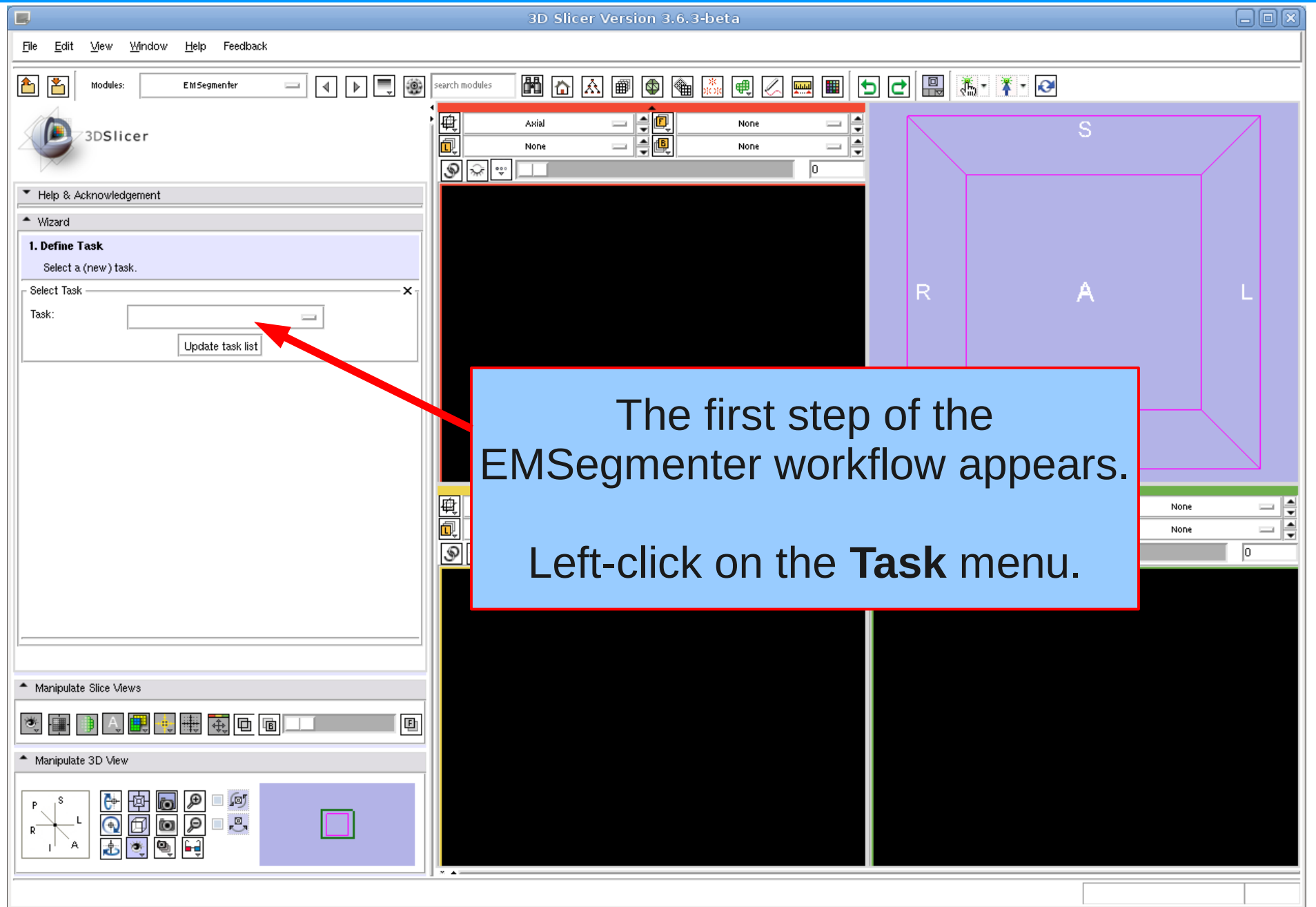


Define Task

Step 1



Select Task





Create New Task

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

search modules

3DSlicer

Help & Acknowledgement

Wizard

1. Define Task

Select a (new) task.

Select Task

Task:

- Non Human Primate
- MRI Human Brain Parcellation
- MRI Human Brain
- Create new task**

Update task list

Sagittal

None

None

None

None

S

R

A

L

I

Manipulate Slice Views

Manipulate 3D View

Create new task

Select
Create new task



Create New Task

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

search modules

3DSlicer

Help & Acknowledgement

Wizard

1. Define Task

Select a (new) task.

Select Task

Task:

Update task list

Preprocessing:

- MRI Human Brain
- None

Apply

Choose **Tutorial** as a new task name and select **MRI Human Brain** Pre-processing Click **Apply**



Define Input Channels

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

search modules

3DSlicer

Help & Acknowledgement

Wizard

Define Input Channels

Add Channel Remove Channel

Input-to-Input Channel Registration

Align Input Scans:

Input Channel Error

Please define at least one input channel

OK

Click OK

< Back Next > Segment

Manipulate Slice Views

Manipulate 3D View

P S R L I A

Slice views: Axial, None, Coronal, None

3D View: 3D visualization of a slice with axes S, R, A, L, I.



Add Subject Data

The screenshot shows the 3D Slicer 3.6.3-beta interface. The 'File' menu is open, and the 'Add Volume...' option is highlighted. A blue callout box with the text 'To load the subject data click on **Add Volume**' is positioned over the menu. The main window displays a 3D view with a purple bounding box labeled 'S', 'R', 'A', 'L', and 'I'. The interface includes a menu bar, a toolbar, and various panels for defining input channels and manipulating slice views.



Load Subject Data

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

search modules

3DSlicer

Help & Acknowledgement

Wizard

2/3. Define Input Channels

Name the input channels and choose the set of scans for segment

Define Input Channels

Add Channel Remove Channel

Input-to-Input Channel Registration

Align Input Scans:

Volume Properties

Name Size Modified

Name	Size	Modified
t1.nrrd	5,214 KB	Tue Nov 16 17:01:14

DICOM Information

Parse Directory Divide Subseries

Description	Value
-------------	-------

Recent Volumes: - Browse to CWD

Apply Cancel

Manipulate Slice Views

Manipulate 3D View

Add Volume...

Browse to the tutorial data set and select the file t1.nrrd



3DSlicer

Define Input Channel

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EMSegmenter

search modules

3DSlicer

Help & Acknowledgement

Wizard

2/3. Define Input Channels

Name the input channels and choose the set of scans for segmentation.

Define Input Channels

Input Channel

Name: T1 Volume: t1

Add Channel Remove Channel

Input to Input Channel Registration

Align Input Scans:

< Back **Next >** Segment

Manipulate Slice Views

Manipulate 3D View

t1

Click on **Add Channel**.
Type 'T1' into the **Name** field.
Assign the **Volume** t1.
Click Next



Define Input Channel

The screenshot shows the 3D Slicer Version 3.6.3-beta interface. The 'Define Input Channels' wizard is active, showing a single input channel named 'T1' with volume 't1'. A blue text box overlaid on the wizard says 'To confirm click Yes'. A dialog box titled 'Change the number of input channels?' is open, asking 'Are you sure you want to change the number of input images?' with 'Yes' and 'No' buttons. The 'Yes' button is being clicked. The background shows three slice views: Axial, Coronal, and Sagittal, with a purple bounding box in the Axial view and a green bounding box in the Coronal view. The interface includes a menu bar, a toolbar, and various panels for slice manipulation and 3D view manipulation.



Define Anatomical Tree

Step 3

In this step we are defining the anatomical structures we want to segment and store the information in a tree data structure.

Each node represents a anatomical structure.

Additionally, a color can be assigned to each node for a better visualization of the segmentation result.



3DSlicer

Define Anatomical Tree

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

search modules

3DSlicer

Help & Acknowledgement

Wizard

3/9. Define Anatomical Tree
Define a hierarchy of structures.

Anatomical Tree

- Root
 - Add sub-class
 - Delete sub-class

Node Attributes

Name: Root
Label: 1000 Color: [Black]

Select colormap: L...s

Entry	Name	Color
0	Black	[Black]
1	jake	[Blue]
2	Peach	[Orange]
3	Brain	[Purple]

Manipulate Slice Views

Manipulate 3D View

Right-click on **Root**, and select **Add sub-class**



Define Anatomical Tree

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

3DSlicer

Help & Acknowledgement

Wizard

3/9. Define Anatomical Tree
Define a hierarchy of structures.

Anatomical Tree

- Root
 - node_1008

Node Attributes

Name: node_1008
Label: 1008
Color: [Black]

Select colormap: L...s

Entry	Name	Color
0	Black	[Black]
1	jake	[Blue]
2	Peach	[Orange]
3	Brain	[Purple]

Manipulate Slice Views

Manipulate 3D View

129 0

129 0

63 1.4211e

A new node appears



3DSlicer

Define Anatomical Tree

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

search modules

3DSlicer

Help & Acknowledgement

Wizard

3/9. Define Anatomical Tree
Define a hierarchy of structures.

Anatomical Tree

- Root
 - Background

Node Attributes

Name: Background

Label: 1008 Color: [Black]

Select colormap: L...s

Entry	Name	Color
0	Black	[Black]
1	jake	[Blue]
2	Peach	[Orange]
3	Brain	[Purple]

Manipulate Slice Views

Manipulate 3D View

View

Change the node name to **Background**

S
R A L
I

Sagittal

Coronal



3DSlicer

Define Anatomical Tree

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

search modules

3DSlicer

Help & Acknowledgement

Wizard

3/9. Define Anatomical Tree
Define a hierarchy of structures.

Anatomical Tree

- Root
 - B

Node Attributes

Name: Background
Label: 1008 Color: [Black]

Select colormap: L...s

Entry	Name	Color
0	Black	[Black]
1	jake	[Blue]
2	Peach	[Orange]
3	Brain	[Purple]

Manipulate Slice Views

Manipulate 3D View

Add sub-class

Right-click on Root, and select Add sub-class



Define Anatomical Tree

3DSlicer

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

3DSlicer

Help & Acknowledgement

Wizard

3/9. Define Anatomical Tree

Define a hierarchy of structures.

Anatomical Tree

- Root
 - Background
 - Intracranial Cavity

Node Attributes

Name: Intracranial Cavity

Label: 1003 Color: [Black]

Select colormap: L...s

Entry	Name	Color
0	Black	[Black]
1	jake	[Blue]
2	Peach	[Orange]
3	Brain	[Purple]

Manipulate Slice Views

Manipulate 3D View

S A L I

Sagittal None Coronal None

The anatomical tree contains two components: **Background** and **Intracranial Cavity**



Define Anatomical Tree

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EMSegmenter

3DSlicer

Help & Acknowledgement

Wizard

3/9. Define Anatomical Tree

Define a hierarchy of structures.

Anatomical Tree

- Root
 - Background
 - Air
 - Intracranial Cavity

Node Attributes

Name: Air

Label: 0 Color: [Black]

Select colormap: L...s

Entry	Name	Color
0	Black	[Black]
1	jake	[Blue]
2	Peach	[Orange]
3	Brain	[Grey]

Manipulate Slice Views

Manipulate 3D View

Right click on **Background**, and select **Add sub-class**.

Add the sub-class **Air** to **Background**.

Set the label value for **Air** to 0.



Define Anatomical Tree

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

3DSlicer

Help & Acknowledgement

Wizard

3/9. Define Anatomical Tree

Define a hierarchy of structures.

Anatomical Tree

- Background
 - Air
 - Skull
- Intracranial Cavity
 - Grey Matter
 - White Matter
 - CSF

Node Attributes

Name: CSF

Label: 5 Color: [Red Swatch]

Select colormap: L...s

Entry	Name	Color
0	Black	[Black Swatch]
1	jake	[Blue Swatch]
2	Peach	[Orange Swatch]
3	Brain	[White Swatch]

Manipulate Slice Views

Manipulate 3D View

File

Using the same process, right-click on **Intracranial Cavity**, and add the three following Sub-classes:

- Grey Matter, label 4
- White Matter, label 8
- CSF, label 5

Click on **Next** to assign the atlas to the structures



Define Atlas

Step 4



3DSlicer

Define Atlas

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EMSegmenter

search modules

3DSlicer

Help & Acknowledgement

Wizard

4/9. Define Atlas
Assign structure specific atlases to corresponding anatomy in the tree.

Anatomical Tree

- Background
 - Air
 - Skull
- Intracranial Cavity
 - Grey Matter
 - White Matter
 - CSF

Probability Map

Class: Air

Select Volume:

< Back Next > Segment

Manipulate Slice Views

Manipulate 3D View

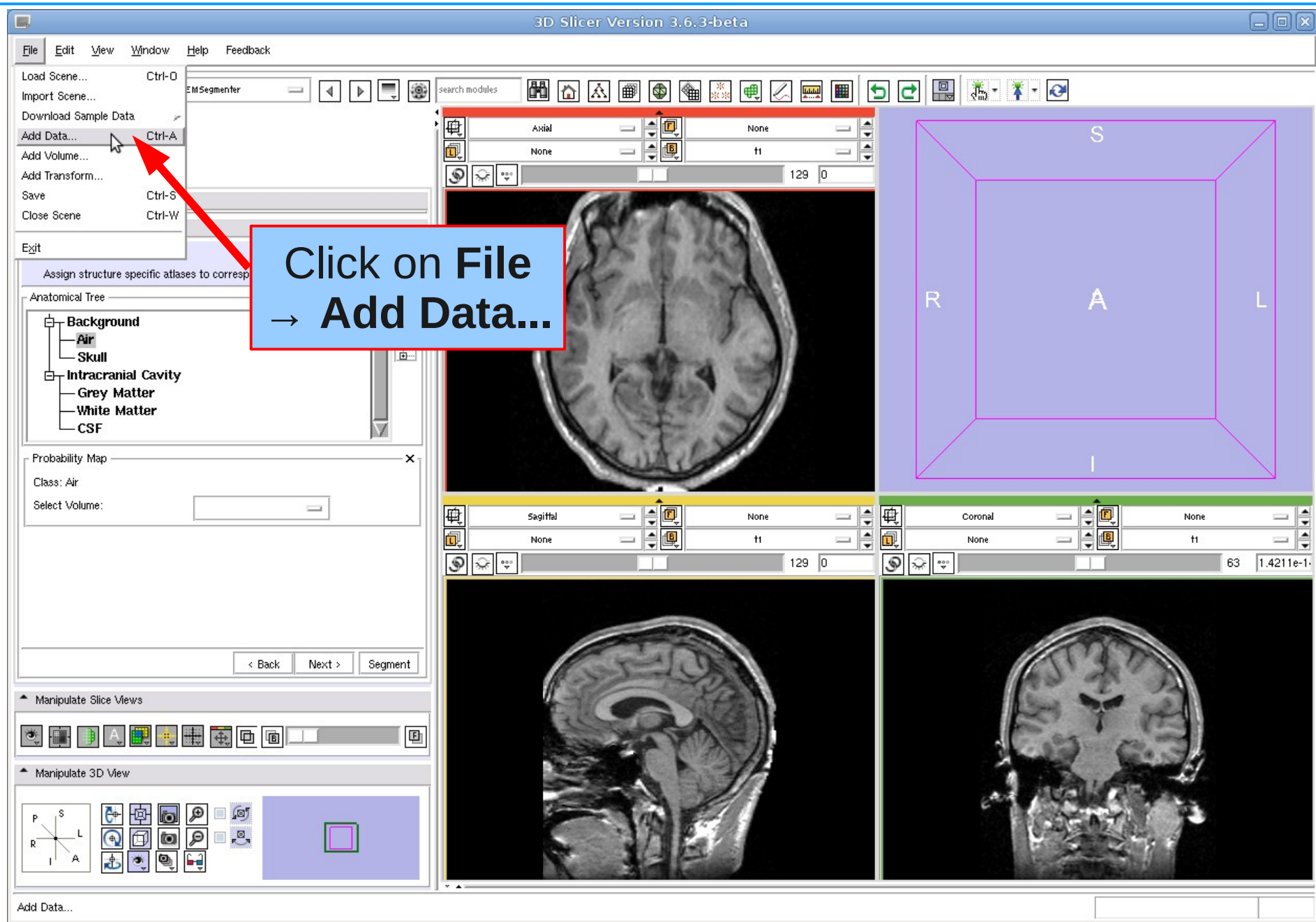
Edit

In the following steps we are assigning atlas volume data to each structure.



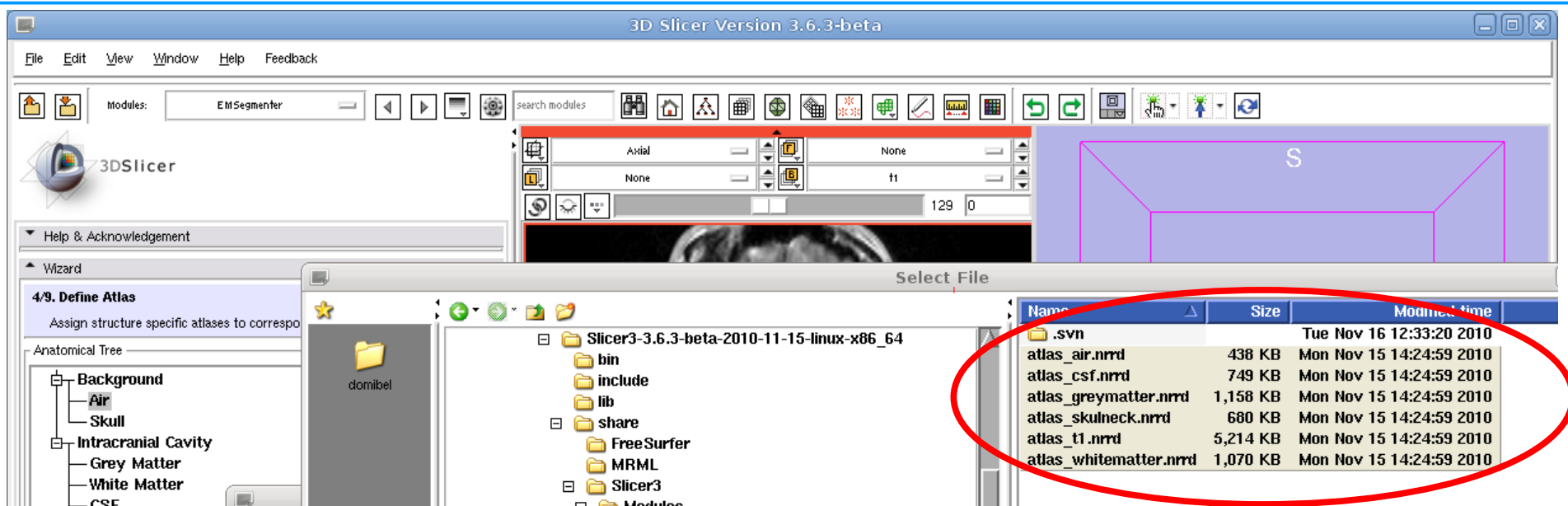
3DSlicer

Load Atlas Data





Load Atlas Data



Click on **Add File(s)**

Browse to your Slicer3 install directory and from there to
./share/Slicer3/Modules/EMSegment/Tasks/MRI-Human-Brain-Parcellation/

Select the six atlas data files and click **Apply**





3DSlicer

Load Atlas Data

Click on **Label None** to uncheck all **LabelMap** checkboxes
Click **Apply**

The screenshot shows the 3DSlicer interface with the 'Add Data' dialog box open. The dialog has several tabs: 'Label', 'Label None', 'Centered All', 'Centered None', 'FiberBundle All', and 'FiberBundle None'. The 'Label None' tab is selected and circled in red. Below the tabs is a table with columns: 'Select', 'File', 'Type', 'Name', 'LabelMap', 'Centered', and 'FiberBundle'. The 'LabelMap' column contains checkboxes, all of which are currently unchecked. The 'Apply' button at the bottom right of the dialog is also circled in red. A blue callout box with a red border contains the text: 'Click on Label None to uncheck all LabelMap checkboxes' and 'Click Apply'. Red arrows point from the callout box to the 'Label None' tab and the 'Apply' button.

Select	File	Type	Name	LabelMap	Centered	FiberBundle
<input checked="" type="checkbox"/>	/projects/sandbox/Slicer3/private-release-trunk/Sli...	Volume	atlas_air	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	/projects/sandbox/Slicer3/private-release-trunk/Sli...	Volume	atlas_csf	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	/projects/sandbox/Slicer3/private-release-trunk/Sli...	Volume	atlas_greymatter	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	/projects/sandbox/Slicer3/private-release-trunk/Sli...	Volume	atlas_skulneck	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	/projects/sandbox/Slicer3/private-release-trunk/Sli...	Volume	atlas_t1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	/projects/sandbox/Slicer3/private-release-trunk/Sli...	Volume	atlas_whitematte	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



Load Atlas Data

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

search modules

3DSlicer

Help & Acknowledgement

Wizard

4/9. Define Atlas

Assign structure specific atlases to corresponding anatomy in the tree.

Anatomical Tree

- Background
 - Air
 - Skull
- Intracranial Cavity
 - Grey Matter
 - White Matter
 - CSF

Probability Map

Class: Air

Select Volume:

Manipulate Slice Views

Manipulate 3D View

Feedback

The loaded atlas data appear in the viewer.



3DSlicer

Define Atlas

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EMSegmenter

search modules

3DSlicer

Help & Acknowledgement

Wizard

4/9. Define Atlas
Assign structure specific atlases to corresponding anatomy in the tree.

Anatomical Tree

- Background
 - Air**
 - Skull
- Intracranial Cavity
 - Grey Matter
 - White Matter
 - CSF

Probability Map

Class: Air

Select Volume: atlas_air

< Back Next > Segment

Manipulate Slice Views

Manipulate 3D View

File

Select **Air** in the anatomical tree.

Left-click on **Select Volume** and assign the probabilistic atlas **atlas_air** to the **Air** structure.



Define Atlas

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

search modules

3DSlicer

Help & Acknowledgement

Wizard

4/9. Define Atlas
Assign structure specific atlases to corresponding anatomy in the tree.

Anatomical Tree

- Background
 - Air
 - Skull**
- Intracranial Cavity
 - Grey Matter
 - White Matter
 - CSF

Probability Map

Class: Skull

Select Volume: atlas_skullneck

< Back Next > Segment

Manipulate Slice Views

Manipulate 3D View

P S
R L
I A

Select **Skull** in the anatomical tree.

Left-click on **Select Volume** and assign the probabilistic atlas **atlas_skullneck** to the **Skull** structure.



Define Atlas

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

search modules

3DSlicer

Help & Acknowledgement

Wizard

4/9. Define Atlas
Assign structure specific atlases to corresponding anatomy in the tree.

Anatomical Tree

- Background
 - Air
 - Skull
- Intracranial Cavity
 - Grey Matter**
 - White Matter
 - CSF

Probability Map

Class: Grey Matter

Select Volume: atlas_greymatter

< Back Next > Segment

Manipulate Slice Views

Manipulate 3D View

atlas_greymatter

Select **Grey Matter** in the anatomical tree.

Left-click on **Select Volume** and assign the probabilistic atlas **atlas_greymatter** to the **Grey Matter** structure.



Define Atlas

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

search modules

3DSlicer

Help & Acknowledgement

Wizard

4/9. Define Atlas
Assign structure specific atlases to corresponding anatomy in the tree.

Anatomical Tree

- Background
 - Air
 - Skull
- Intracranial Cavity
 - Grey Matter
 - White Matter**
 - CSF

Probability Map

Class: White Matter

Select Volume: atlas_whitematter

< Back Next > Segment

Manipulate Slice Views

Manipulate 3D View

File

Select **White Matter** in the anatomical tree.

Left-click on **Select Volume** and assign the probabilistic atlas **atlas_whitematter** to the **White Matter** structure.



Define Atlas

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EMSegmenter

search modules

3DSlicer

Help & Acknowledgement

Wizard

4/9. Define Atlas
Assign structure specific atlases to corresponding anatomy in the tree.

Anatomical Tree

- Background
 - Air
 - Skull
- Intracranial Cavity
 - Grey Matter
 - White Matter
 - CSF**

Probability Map

Class: CSF

Select Volume: atlas_csf

< Back **Next >** Segment

Manipulate Slice Views

Manipulate 3D View

atlas_csf

Select CSF in the anatomical tree.

Left-click on Select Volume and assign the probabilistic atlas atlas_csf to the CSF structure.

Click on Next



Edit Registration Parameters

Step 5



Edit Registration Parameters

The screenshot shows the 3D Slicer software interface. The title bar reads "3D Slicer Version 3.6.3-beta". The menu bar includes "File", "Edit", "View", "Window", "Help", and "Feedback". The main toolbar contains various icons for navigation and manipulation. On the left, the "Help & Acknowledgement" panel is expanded to "Wizard", and the "5/9. Edit Registration Parameters" wizard is active. The "Atlas-to-Input Registration Parameters" section is highlighted, and the "T1" input channel is set to "atlas_t1", which is circled in red. Below this, the "Affine Registration" is set to "None", "Deformable Registration" is set to "None", and "Interpolation" is set to "Linear". The "Manipulate Slice Views" and "Manipulate 3D View" panels are also visible. The main workspace displays three orthogonal views of a brain MRI scan: Axial (top), Coronal (bottom right), and Sagittal (bottom left). A blue callout box with a red border is overlaid on the interface, containing the text: "Select atlas_t1 to assign the atlas to the input channel T1".

Select atlas_t1
to assign the atlas
to the input channel T1



3DSlicer

Edit Registration Parameters

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

3DSlicer

Help & Acknowledgement

Wizard

5/9. Edit Registration Parameters
Specify atlas-to-input scans registration parameters.

Atlas-to-Input Registration Parameters

T1 atlas_t1

Affine Registration: **Accurate**

Deformable Registration: **Accurate**

Interpolation:

< Back **Next >** Segment

Manipulate Slice Views

Manipulate 3D View

View

Select **Accurate** for the **Affine Registration** and the **Deformable Registration**.

Click on **Next**



Define Preprocessing

Step 6

In order to get a better segmentation result, the original subject data set can be used to extract additional information and to prepare (e.g. skull stripping, noise correction) the data set for the subsequent application of the segmentation algorithm.

This process is called pre-processing.



Define Preprocessing

We note, that in this tutorial the subject data set is image inhomogeneity corrected and pre-registered to the atlas. Thus, the 'registration flag' and the 'inhomogeneity correction flag' are not checked. Please do not check for this tutorial as pre-processing can be time consuming.

The screenshot shows the 3DSlicer interface during the '6/9. Define Preprocessing' step. The 'Check List' section contains the following items:

- This task only applies to non-skull stripped scans!
- Should the EMSegmenter
 - register the atlas to the input scan ?
 - perform image inhomogeneity correction on input scan ?

The 'Next >' button is circled in red, and a blue callout box with the text 'Click on Next' is overlaid on the interface. The main window displays a 3D view of a brain scan and two 2D slice views (Sagittal and Coronal).



3DSlicer

Define Preprocessing

The screenshot shows the 3D Slicer Version 3.6.3-beta interface. The 'EM Segmenter' module is selected in the 'Modules' panel. A wizard window titled '6/9. Define Preprocessing' is open, with a 'Check List' section containing the following text: 'This task only applies to non-skull stripped scans!', 'Should the EMSegmenter', '- register the atlas to the input scan ? ', and '- perform image inhomogeneity correction on input scan ? '. A dialog box titled 'Start Preprocessing of images?' is overlaid on the interface, asking 'Preprocessing of images might take a while. Do you want to proceed?' with 'Yes' and 'No' buttons. The 'Yes' button is highlighted by a mouse cursor. The main interface shows a 3D view of a brain slice and two 2D slice views (axial and coronal).

The EMSegmenter will perform some standard pre-processing.

Click on **Yes** to confirm.



Define Preprocessing

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EMSegmenter

search modules

3DSlicer

Help & Acknowledgement

Wizard

6/9. Define Preprocessing

Answer questions for preprocessing of input images

Check List

This task only applies to non-skull stripped scans!

Should the EMSegmenter

- register the atlas to the input scan ?
- perform image inhomogeneity correction on input scan ?

< Back Next > Segment

Manipulate Slice Views

Manipulate 3D View

3D Slicer Version 3.6.3-be X

Please wait until pre-processing has been finished.

View



Specify Intensity Distribution

Step 7

In this step the intensity distributions for each class can be refined.

This step can be skipped for the tutorial, because the intensity distributions have been calculated during the pre-processing.



Specify Intensity Distribution

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

search modules

3DSlicer

Help & Acknowledgement

Wizard

7/9. Specify Intensity Distributions
Define intensity distribution for each anatomical structure.

Anatomical Tree

- Root
 - Background
 - Air
 - Skull
 - Intracranial Cavity
 - Grey Matter
 - White Matter

Intensity Distribution | Manual Sampling

Class: Air

Specification: Manual

Mean: 1.612

Log Covariance: 0.6825

Reset Distribution

Plot Distributions

< Back | **Next >** | Segment

Manipulate Slice Views

Manipulate 3D View

Click on Next



Edit Node-based Parameters

Step 8

Define EM algorithm specific parameters, e.g. class weights, atlas weights, and input channel weights.



3DSlicer

Edit Node-based Parameters

The screenshot shows the 3D Slicer software interface, version 3.6.3-beta. The main window displays the EM Segmenter module. On the left, the 'Anatomical Tree' shows a hierarchy of nodes: Root, Background (Air, Skull), and Intracranial Cavity (Grey Matter, White Matter). Below this, the 'Basic' tab is active, showing 'Class Weight' and 'Atlas Weight' settings. A blue text box is overlaid on the center of the interface, containing the text: "Per default all the EM Input Parameters are unspecified." The main view area shows three orthogonal slice views of a brain MRI: Axial (top), Sagittal (bottom left), and Coronal (bottom right). The Axial view is highlighted with a purple border and labeled with 'S' (Superior), 'I' (Inferior), 'R' (Right), and 'L' (Left). The Coronal view is labeled with 'A' (Anterior) and 'P' (Posterior). The interface includes a menu bar (File, Edit, View, Window, Help, Feedback), a toolbar, and a status bar at the bottom.



3DSlicer

Edit Node-based Parameters

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

search modules

3DSlicer

Help & Acknowledgements

Wizard

8/9. Edit Node-based Parameters

Specify node-based segmentation parameters.

Anatomical Tree

- Background
- Air
- Skull
- Intracranial Cavity
 - Grey Matter
 - White Matter
 - CSF

Basic | Stopping Conditions | Print | Advanced

Class: Background

Class Weight: 0.15 | Input Channel Weights

Atlas Weight: 1 | T1: 1

Alpha: 0.99

Overview Of Class Weights

Background	0.15
Intracranial Cavity	0

< Back Next > Segment

Manipulate Slice Views

Manipulate 3D View

Help

Left click on **Background** and Enter the following parameters:

- Class Weight 0.15
- Atlas Weight 1
- Input Channel Weights:
T1: 1.0



3DSlicer

Edit Node-based Parameters

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

search modules

3DSlicer

Wizard

8/9. Edit Node-based Parameters

Specify node-based segmentation parameters.

Anatomical Tree

- Background
 - Air
 - Skull
 - Intracranial Cavity**
 - Grey Matter
 - White Matter
 - CSF

Basic | Stopping Conditions | Print | Advanced

Class: Intracranial Cavity

Class Weight: 0.85 | Input Channel Weights

Atlas Weight: 1 | T1: 1

Alpha: 0.99

Overview Of Class Weights

Background	0.15
Intracranial Cavity	0.85

< Back Next > Segment

Manipulate Slice Views

Manipulate 3D View

Help

Left click on **Intracranial Cavity**
And enter the following parameters:

- Class Weight 0.85
- Atlas Weight 1
- Input Channel Weights:
T1: 1.0



Edit Node-based Parameters

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

3DSlicer

Wizard

8/9. Edit Node-based Parameters

Specify node-based segmentation parameters.

Anatomical Tree

- Background
 - Air
 - Skull**
- Intracranial Cavity
 - Grey Matter
 - White Matter
 - CSF

Basic | Stopping Conditions | Print | Advanced

Class: Skull

Class Weight: 0.3 | Input Channel Weights

Atlas Weight: 1 | T1 1

Overview Of Class Weights

Air	0.7
Skull	0.3

< Back | Next > | Segment

Manipulate Slice Views

Manipulate 3D View

Help

1e-1

Enter the following parameters
for Air and Skull

Air: Class Weight: 0.7
Atlas Weight: 1.0
Input Channel Weight: 1.0

Skull: Class Weight: 0.3
Atlas Weight: 1.0
Input Channel Weight: 1.0



3DSlicer

Edit Node-based Parameters

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

3DSlicer

Wizard

8/9. Edit Node-based Parameters
Specify node-based segmentation parameters.

Anatomical Tree

- Background
 - Air
 - Skull
- Intracranial Cavity
 - Grey Matter
 - White Matter
 - CSF

Basic | Stopping Conditions | Print | Advanced

Class: Grey Matter

Class Weight: 0.45 | Input Channel Weights: T1

Atlas Weight: 0.01

Overview Of Class Weights

Grey Matter	0.45
White Matter	0.3
CSF	0.25

< Back | **Next >** | Segment

Manipulate Slice Views

Manipulate 3D View

Window

Click on Next

Enter the following parameters for GM, WM, and CSF

GM: Class Weight: 0.45
Atlas Weight: 0.01
Input Channel Weight: 1.0

WM: Class Weight: 0.3
Atlas Weight: 0.7
Input Channel Weight: 1.0

CSF: Class Weight: 0.25
Atlas Weight: 0.01
Input Channel Weight: 1.0



Run Segmentation

Step 9

This is the last step of the EMSegmenter wizard.

The Volume Of Interested (VOI) can be specified,
and the algorithm can be started.



Run Segmentation

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EMSegmenter

search modules

9/9. Define Miscellaneous Parameters

Define miscellaneous parameter for performing segmentation.

Define VDI

L-R Range: -119. 119.5

P-A Range: -92.2 92.25

I-S Range: -119. 119.5

Display clipping box Interactive Mode

Display VDI in 2D Viewer

Save

Create Template File:

Save Intermediate Results:

Select Intermediate Directory:

Misc.

Multi-threading Enabled:

< Back Next **Segment**

Manipulate Slice Views

Manipulate 3D View

Click on Segment



Run Segmentation

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

9/9. Define Miscellaneous Parameters

Define miscellaneous parameter for performing segmentation.

Define VDI

L-R Range: -119. 119.5

P-A Range: -92.2 92.25

I-S Range: -119. 119.5

Display clipping box Interactive Mode

Display VDI in 2D Viewer

Save

Create Template File:

Save Intermediate Results:

Select Intermediate Directory:

Misc.

Multi-threading Enabled:

< Back Next > Segment

Manipulate Slice Views

Manipulate 3D View

t1 RAS: (-0.9, -53.8, 122.8), Bg IJK: (127, -4, 26), Bg: Out of Frame

The EM algorithm is running
Please wait for a while.

3D Slicer Version 3.6.3-beta
Please wait until segmentation has been finished.



3DSlicer

Results: Run Segmentation

The screenshot displays the 3D Slicer interface with the EM Segmenter module active. The main window shows three orthogonal views of a brain scan: Axial (top), Sagittal (bottom left), and Coronal (bottom right). The EM segmentation results are overlaid on the T1 volume, showing different tissue classes in various colors (blue, yellow, red, green). The interface includes a menu bar, a toolbar, and a sidebar with the '9/9. Define Miscellaneous Parameters' panel. A red circle highlights a button in the 'Manipulate Slice Views' section. A blue text box on the right contains the text: 'The results of the EM Segmentation are overlaid on the T1 volume.'



Consecutive adjustment

The following slides illustrate

- how to specify a volume of interest and
- how to adjust segmentation parameters
the refine the segmentation result.



Volume Of Interest (VOI)

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

search modules

3DSlicer

9.9. Define Miscellaneous Parameters

Define miscellaneous parameter for performing segmentation

Define VOI

L-R Range: -41 62

P-A Range: -38 62

I-S Range: -14 46

Display clipping box Interactive Mode

Display VOI in 2D Viewer

Save

Create Template File:

Save Intermediate Results:

Select Intermediate Directory:

Misc.

Multi-threading Enabled:

< Back Next > **Segment**

Manipulate Slice Views

Manipulate 3D View

Feedback

To specify a smaller volume of interest, make it first visible by selecting the checkbox **Display VOI in 2D Viewer**, adjust the size of the VOI by moving the 'Range' slider, unselect the checkbox **Display VOI in 2D Viewer**, and click **Segment**.

Result: Volume Of Interest (VOI)

3DSlicer

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

search modules

3DSlicer

9/9. Define Miscellaneous Parameters

Define miscellaneous parameter for performing segmentation.

Define VOI

L-R Range: -41 62

P-A Range: -38 62

I-S Range: -14 46

Display clipping box Interactive Mode

Display VOI in 2D Viewer

Save

Create Template File:

Save Intermediate Results:

Select Intermediate Directory:

Misc.

Multi-threading Enabled:

< Back next > Segment

Manipulate Slice Views

Manipulate 3D View

Feedback

Only the VOI has been segmented.

Note that a smaller VOI leads to a faster segmentation.

For the next adjustment click on **Back**



Adjusting Parameters

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

3DSlicer

Wizard

8/9. Edit Node-based Parameters

Specify node-based segmentation parameters.

Anatomical Tree

- Background
 - Air
 - Skull
- Intracranial Cavity
 - Grey Matter
 - White Matter
 - CSF

Basic | Stopping Conditions | Print | Advanced

Class: CSF

Class Weight: 0.25 | Input Channel Weights

Atlas Weight: 0.01 | T1

Overview Of Class Weights

Grey Matter	0.23	<input type="checkbox"/>
White Matter	0.52	<input checked="" type="checkbox"/>
CSF	0.25	<input type="checkbox"/>

< Back Next > **Segment**

Manipulate Slice Views

Manipulate 3D View

Feedback

Step 8/9. Edit Node-based Parameters:

We want to change the class weight for grey matter and automatically update the class weight for white matter.

To do so,
select the checkbox next to white matter and
change the class weight for grey matter.

Click on **Segment**.



Result: Adjusting Parameters

3D Slicer Version 3.6.3-beta

File Edit View Window Help Feedback

Modules: EM Segmenter

search modules

3DSlicer

Help & Acknowledgement

Wizard

8/9. Edit Node-based Parameters

Specify node-based segmentation parameters.

Anatomical Tree

- Background
 - Air
 - Skull
- Intracranial Cavity
 - Grey Matter
 - White Matter
 - CSF

Basic | Stopping Conditions | Print | Advanced

Class: CSF

Class Weight: 0.25 | Input Channel Weights

Atlas Weight: 0.01 | T1

Overview Of Class Weights

Grey Matter	0.23
White Matter	0.52
CSF	0.25

Manipulate Slice Views

Manipulate 3D View

Help

The result of the new segmentation based on the changed parameters appears.

This process can be continued to get a better segmentation.



Further Info & Acknowledgments

EMSegmenter Wiki Page:

<http://www.slicer.org/slicerWiki/index.php/EMSegmenter-Overview>

The EMSegmenter technology behind was reported in:

K.M. Pohl et. A hierarchical algorithm for MR brain image parcellation. IEEE Transactions on Medical Imaging, 26(9), pp 1201-1212, 2007.

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