Data Loading and 3D Visualization

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Following this tutorial, you will be able to load and visualize volumes within Slicer4, and to interact in 3D with structural images and models of the anatomy.
Slicer is a freely available open-source platform for segmentation, registration and 3D visualization of medical imaging data.

3DSlicer is a multi-institutional effort supported by the National Institute of Health.
3DSlicer

- An end-user application for image analysis

- An open-source environment for software development

- A software platform that is both easy to use for clinical researchers and easy to extend for programmers
3DSlicer version 4 is a multi-platform software running on Windows, Linux, and Mac OSX.

Disclaimer
It is the responsibility of the user of 3DSlicer to comply with both the terms of the license and with the applicable laws, regulations and rules. Slicer is a tool for research, and is not FDA approved.
3DSlicer History

• 1997: Slicer started as a research project between the Surgical Planning Lab (Harvard) and the CSAIL (MIT)

Image Courtesy of the CSAIL, MIT
3DSlicer History

• 1997: Slicer started as a research project between the Surgical Planning Lab (Harvard) and the CSAIL (MIT)

• 2012: Multi-institution effort to share the latest advances in image analysis with clinicians and scientists
Slicer is built every night on Windows, Mac and Linux platforms.
Slicer Training

- Hands-on training workshops at national and international venues
- >1,700 clinicians, clinical researchers and scientists trained since 2005
3DSlicer version 4.1
Tutorial Material

• Software: Slicer4.1 available at www.slicer.org

• Dataset: 3DVisualizationData.zip available in the Slicer 101 compendium at www.slicer.org
Welcome to Slicer4

Slicer is built upon a modular architecture. The Welcome to Slicer module is displayed by default at start-up. Click on Welcome to Slicer to display the 103 modules of Slicer in the Modules menu.
Welcome to Slicer4

Slicer4 contains more than 100 modules for image segmentation, registration and 3D visualization of medical imaging data.
PART 1: LOADING AN MR VOLUME
The DICOM 3.0 File Format

Most radiological imaging equipment produce images in DICOM file format (‘.dcm files’)
Data Representation

- The result of a volumetric acquisition is a 3D volume of data related to the patient.
- The 3D raster dataset is sampled on a discrete grid with elements called voxels which contain the signal intensity.
The tutorial dataset is an MR scan of the brain of a healthy subject.

The data in the **Nrrd** file format, part of the NA-MIC toolkit.

DICOM data can be converted in Nrrd using the module ‘**DICOM to NRRD Converter**’ in Slicer.
Click on Load Data in the Slicer Welcome module
Loading a volume

Click on Choose File(s) to Add
Loading a volume

Browse to the location where you copied the tutorial dataset, and select the file **MR-head.nrrd**
Click on OK to load the MR dataset into Slicer
The axial, sagittal and coronal views appear in the 2D viewers.
Loading a volume

Left-click on the Slicer layout icon
Loading a volume

Select Red slice only layout
Loading a volume

Position the mouse button at the top left corner of the window to display the slice menu.
Loading a volume

Click on the >> to expand the slice viewer menu
Loading a volume

Click on the Lightbox view icon in the slice menu, and select the 6x6 view option
Loading a volume

Slicer display 36 consecutives images of the dicom volume. Use the red slice slider to browse through the data.
Loading a volume

Left click on the red window icon, and select the Conventional layout
Loading a volume

Select the lightbox viewer in the red slice menu, and come back to 1x1 view
Loading a volume

Click on the links icon to link all three viewers, and on the eye icon to display the slices in the 3D Viewer.
Loading a volume

The three anatomical slices appear in the 3DViewer
Loading a DICOM volume

Use the left-mouse button to rotate the camera, and the right-mouse button to zoom in and out.
Close the scene

Select **File ➪ Close Scene** to close the Slicer Scene
Exit Slicer

Select **Slicer** → **Quit** to exit the software
Part 2:

3D visualization of surface models of the brain
3D Slicer Scene

• A Slicer scene is a MRML file which contains a list of elements loaded into Slicer (volumes, models, fiducials…)

• The tutorial scene contains an MR scan of the brain and 3D surface models of anatomical structures.

• The tutorial data are part of the SPL-PNL Brain Atlas developed by Thalos et al.
Loading a Scene

Select File → Load Scene from the main menu
Browse to the directory **3DHeadData**, located in the 3DVisualizationData directory, select the file **3DHeadScene.mrml** and click on **Open**
Loading the Slicer Scene

A 3D surface model of the head, and 2D anatomical slices appear in the Viewer.
3D Surface Models

- A **3D model** is a surface reconstruction of an anatomical structure.

- The model is a **triangular mesh** that approximates a surface from a 3D label map.

- The scalar values for surface models are integers which correspond to the **label** that had been assigned in the segmentation process.
Loading the Slicer Scene

Select the module **Models** from the Modules menu.
Models module

The list of 3D models appear in the Models panel

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3D Visualization

Position the mouse cursor over the red banner in the axial view. Click on the eye icon to display the slice in the 3D viewer.
Slice through the 3D model of the head using the axial slider.

Select the model ‘Skin.vtk’ in the list of models, and expand the tab ‘Material Properties’ under ‘Display’.
3D Visualization

Lower the opacity of the skin model using the Opacity slider
Select the skullBone.vtk model, and turn off its visibility.
3D Visualization

The 3D surface of the white matter appears in the 3D viewer.
Click on the eye icon in the green viewer to display the coronal slice in the 3D viewer.
Select the 3D model `hemispheric_white_matter.vtk`, and select the option **Clip** in the Display tab.
Select the tab Clipping, and set the **Green Slice Clipping** to **Negative Space**
The optic chiasm appears in the 3D viewer.
3D Visualization

Uncheck the option clipping and lower the opacity of the White Matter surface.
3D Visualization

Check the option ‘Slice intersection Visible’
The intersection of the white matter surface with the 2D anatomical slices appear in the 2D viewers.
Select Conventional Layout from the layout manager, and turn off the visibility of the coronal slice in the green viewer.
3D Visualization

Click on the top left corner of the 3D viewer to display the 3D control windows

Click on A (Anterior) to display an anterior view of the 3D models
3D Visualization
Part 3:

Saving a scene
Saving a Scene

Select **File ➔ Save** from the main menu
Saving a Scene

The **Save Scene and Unsaved Data** lists all the elements of the Slicer Scene.
Saving a Scene

Rename the scene **myNewScene.mrml** and click on **OK**
Saving a Scene

Click on Yes to replace the current Master Scene View with the new one.
Saving a Scene

Select **Slicer**→ **Quit** to exit Slicer
Scene Restore

Restart Slicer and select **File ➔ Load Scene** from the main menu.
Scene Restore

Browse to the directory where you copied the scene, select the file *myNewScene.mrml* and click on *Open*.
Scene Restore

The scene myNewScene.mrml appears in the viewer
Conclusion

This tutorial guided you through the basics of data loading and interactive 3D visualization of volumes and 3D surface models in Slicer4.
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Questions and Comments

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