3D Interactive Visualization of DICOM images

Sonia Pujol, PhD
Brigham and Women’s Hospital
Harvard Medical School

Kitt Shaffer, MD, PhD
Boston University Medical Center
Harvard Medical School

Randy Gollub, MD, PhD
Massachusetts General Hospital
Harvard Medical School

Kathryn Hayes, MSE
Brigham and Women’s Hospital
Harvard Medical School

Ron Kikinis, MD
Brigham and Women’s Hospital
Harvard Medical School
- Part 2 -

3D Visualization

Sonia Pujol, Ph.D.

Leonardo da Vinci (1452-1519), Virgin and Child
Alte Pinakothek, München
Data

This course is built upon three datasets of a single healthy subject brain:

- MR DICOM
- MR Nrrd
- Pre-computed Label Map

GRASS
SPGR
Learning objective

Following this tutorial, you’ll be able to load and visualize volumes within Slicer3, and to interact in 3D with structural images and models.
Overview

- Loading and visualizing multiple volumes simultaneously
- Loading and visualizing segmented structures overlaid on grayscale images
- Loading and visualizing 3D models
- Loading and saving a scene
Launch Slicer3

To launch Slicer3 on Windows:

Select **Start → Programs → Slicer3 3.5.2009-11-06 → Slicer**

**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.*
The Graphical User Interface (GUI) of Slicer3.5 integrates 8 main components:

- the File Menu
- the Menu Toolbar
- the Module GUI Panel
- the 3D Viewer
- the Slice Viewer
- the Slice Controller
- the 3D View Controller

**Slicer3 GUI**

- **File Menu**
- **Menu Toolbar**
- **Module GUI Panel**
- **3DViewer**
- **Slice Controller**
- **Slice Viewer**
- **3DView Controller**
- **Progress and Error Log**
Part 1: Loading and visualizing multiple volumes simultaneously
The **SlicerWelcome** module is the module displayed by default in the GUI.
Left-click on the module selection menu to load the module **Volumes**
The panel of the module **Volumes** appears in the interface.
Loading Volumes

Click on **Select Volume File**
Loading Volumes

Browse to find the first image **001.dcm** of the dataset located in the directory

**C:/slicer_data/Slicer3VisualizationDataset/dicom**

and click on **Open**
Select **Image Origin: Centered**

Click on **Apply** to load the DICOM dataset
The DICOM images appear in the Background display of the 2DViewer.
Loading Volumes

Click on the tab **Info** to display the characteristics of the DICOM volume.
Viewing Volume Information

The information contained in the DICOM header appears in the interface:

- **Volume dimensions:**
  - 256 x 256 x 124

- **Volume Spacing:**
  - 0.9375x0.9375x1.3 mm

- **Scan Order:** LR

- **Scalar Type:** Short

- **Image Origin:** (-79.95, 119.53, 119.53)
Select the **red slice only layout** from the menu.
Exploring the data

The axial slices of the dicom volume appear in the 3D viewer.

Click on the icon to adjust the dimensions of the image to the size of the window.
Exploring the data

Slicer adjusts the dimensions of the image to the size of the window.
Exploring the data

Browse the images using the slider to display the ventricles (~slice 38)
Exploring the data

Click on the **conventional layout** icon to come back to the standard view.
Loading Volumes

Click on Select Volume File
Browse to find the header file of the volume `spgr.nhdr` located in the directory `c:/slicer_data/Slicer3VisualizationDataset/nrrd` and click on Open.
Select **Image Origin: Centered** and Click on **Apply**
The spgr images appear in the Background display of the 2DViewer.
Select the module **Data** from the Modules Menu.
The two datasets 001.dcm and spgr.nhdr are loaded in Slicer.
Overview

Loading and visualizing multiple volumes simultaneously

Loading and visualizing segmented structures overlaid on grayscale images

Loading and visualizing 3D models

Loading and saving a scene
Part 2: Loading and visualizing segmented structures overlaid on grayscale images
Label map

- Image segmentation is the extraction of structural information of particular interest from surrounding image.

- Each pixel is assigned a specific label value which corresponds to the anatomical structure that it belongs to.

- The three-dimensional result of the segmentation is a binary array called a label map.
Loading a label map

Come back to the module Volumes and click on Select Volume File
Loading a label map

Browse to find the header file `all.nhdr` of the label map dataset located in the directory `C:/slicer_data/Slicer3VisualizationDataset/nrrd` and click on **Open**
Visualizing a label map

Set Image Origin to **Centered**

Check the **Label Map** box and click on **Apply**
Visualizing a label map

Slicer displays the label map **all in the Label layer**.

Click on the **links** icon.
Visualizing a label map

Browse to display the segmented ventricles (~slice 41)
Visualizing Multiple Volumes

Foreground Viewer
Left click the drop-down menu to the right of the F icon and select the labelmap **all**

Label Viewer
Left click the drop-down menu to the right of the L icon and select **None**
Visualizing Multiple Volumes

Background Viewer

Left click on the drop-down menu to the right of the B icon and select the volume spgr
Visualizing Multiple Volumes

Select the tab **Manipulate Slice Views**

Use the slider to fade between the labelmap *all* (Foreground) and the *spgr* volume (Background).
Visualizing Multiple Volumes

Make sure the **links** icon is clicked.

Click on the **Slice Visibility** icon to display the slices in the 3D Viewer.
Visualizing Multiple Volumes

Slicer displays 2D anatomical slices in the 3D viewer
Position the mouse in the 3D Viewer, hold down the left mouse button and drag to rotate the volumes
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Part 3: Loading and visualizing 3D models
3D 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 a 3D model

Select the module **Models** from the main menu.
Loading a 3D model

Click on Add 3D model or a model directory
Loading a 3D model

Click on select **model directory**

and select the directory

C:/slicer_data/Slicer3VisualizationDataset/models/
Slicer loads the 3D models of the skin, the ventricles and the vessels.

Click on OK.
Click on the panel **Hierarchy & Display** to access the module’s display components.
Visualizing a 3D model

Select the model **Skin.vtk**

Click on the icon **Set Color** and choose a new color for the 3D model of the head.
Visualizing a 3D model

Use the slider to lower the opacity of the 3D model.
Visualizing a 3D model

The 3D models of the brain and vessels appear through the skin.
Visualizing a 3D model

Select the model **Vessels.vtk** and change the color of the vasculature
Visualizing a 3D model

Select the model **Brain.vtk** and change its color to white
Visualizing a 3D model

Click on the R letter (Right) in the control window
Manipulating a 3D model

The 3D Viewer shows the model from the right side of the patient.
Manipulating a 3D model

Position the mouse in the 3D Viewer, hold down the left mouse button and drag to rotate the model.
Manipulating a 3D model

Hold down the right mouse button, and move the mouse up and down to zoom out and in.
Manipulating a 3D model

Click on the **A** letter to display the standard Anterior View.

Click on the **Spin** icon
Manipulating a 3D model

The model starts spinning inside the Viewer Panel.
Manipulating a 3D model

Click on the **Slice Visibility** icon to display the slices in the 3D Viewer.

Click on the icon to link the 3 slices together.
Manipulating the images

Use the sliders to slice through the volume in all three directions
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Part 4: Loading and saving a Scene
Click on File and select Save
The list of elements currently loaded into Slicer3 appears.
Click on **Change Destination for All Selected** to browse to the location where the scene will be saved.

For this course, save the scene in C:/slicer_data/
Saving Data

Enter the name **MyScene.mrml**, and click on **Save Selected**.
Creating Scene Snapshots

Choose a 3D view of the scene and click on the capture snapshot icon.
Creating Scene Snapshots

Enter the Snapshot Name MySceneSnapshot1 and click on OK
Creating Scene Snapshots

Select a Superior view of the dataset, and click on the **capture snapshot** icon.
Creating Scene Snapshots

Enter the name **MySceneSnapshot2** and click on OK
Creating Scene Snapshots

Select File→Save and click on Save Selected to save the two scene snapshots in the saved scene.
Creating Scene Snapshots

Click on Yes to save the scene
Select **File → Close Scene** in the main menu and click on **OK**
Saving Data

The elements of the previous scene disappear from the Viewer.
Select **File ➔ Load Scene** from the main menu.
Select the file **myScene.mrml** and click on **Open**.
Loading a Scene

Slicer loads the elements from the scene **myScene.mrml**
Loading and visualizing multiple volumes simultaneously

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Loading and saving a scene