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Visualizing Images

Visualization of image datasets is an important aspect of image analysis. Researchers must often visualize the orientation, locality, or progression (time) of structures in clinical and non-clinical datasets. This chapter explains how to use MIPAV to visualize medical images using views.

Views specify the way image datasets are displayed. Views indicate the number of images in a dataset that are displayed at one time and whether images in a dataset are manually or automatically advanced.

In the *default view*, one image is displayed at a time. If a dataset contains more than one image, you can manually advance through the image stack. The default view can also display 2D through 5D datasets. For image

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datasets with more than two dimensions, additional views are available: animate, cine (movie), lightbox, link to another image, surface plotter, surface render, triplanar, and triplanar-dual. The lightbox view displays two or more images, or slices, at once. Others—animate and cine—automatically advance the images and display them in succession, much like a cinema film.

To gain access to views other than the default view, you use the Image > Views menu (Figure 105) in the MIPAV window. Figure 1 lists the types of views and the number of images each view displays at one time and indicates whether images are manually or automatically advanced in the view and the number of dimensions an image must have to be displayed in the specified view. For example, you can view an image dataset that has three or more dimensions in cine view, which displays only one image at a time and advances images in the forward direction only.
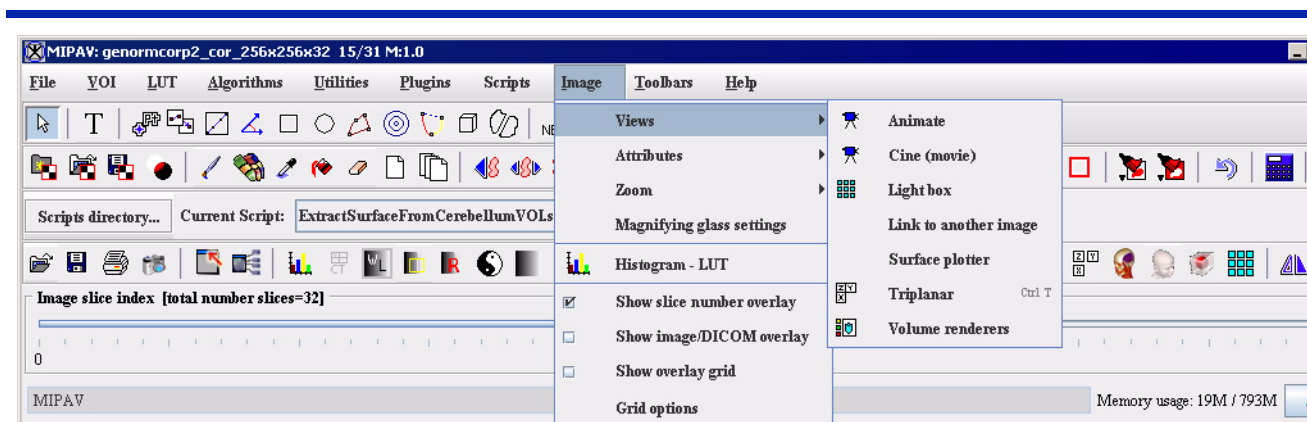
View	Number of images displayed	Manual or automatic image advancement	Dimensionality
Default	1	Manual	All (2D, 3D, 4D, 5D)
Animate	1	Automatic (forward, reverse, continuous looping)	Images with more than two dimensions (2D)*
Cine (Movie)	1	Automatic (forward)	Images with more than two dimensions

*MIPAV can display a 4D dataset that overlays a 3D dataset in the views indicated. If the 4D dataset has dimensions that differ from the 3D dataset, the 4D dataset is automatically resampled and interpolated into the same dimension space as the 3D dataset.

Figure 105. Types of views as shown on the Image > Views menu
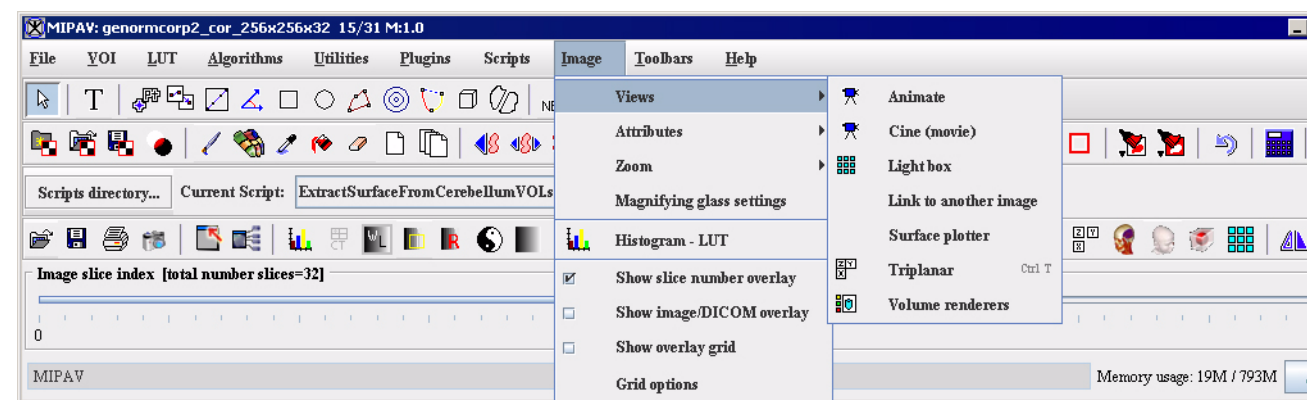
View	Number of images displayed	Manual or automatic image advancement	Dimensionality
Lightbox	All images in the dataset	Manual	Images with more than two dimensions*
Link to another image	2	Manual	Images with more than two dimensions*
Surface plotter	1	Automatic and Manual	Images with more than two dimensions*
Surface renderer	All images in the dataset	Manual	3D images*
Triplanar	2	Manual	3D and 4D images*
Triplanar-dual	2 images loaded together	Manual	3D and 4D images*
Volume render (shear)	In development		
Volume renderer	In development		

*MIPAV can display a 4D dataset that overlays a 3D dataset in the views indicated. If the 4D dataset has dimensions that differ from the 3D dataset, the 4D dataset is automatically resampled and interpolated into the same dimension space as the 3D dataset.

Figure 105. Types of views as shown on the Image > Views menu (continued)
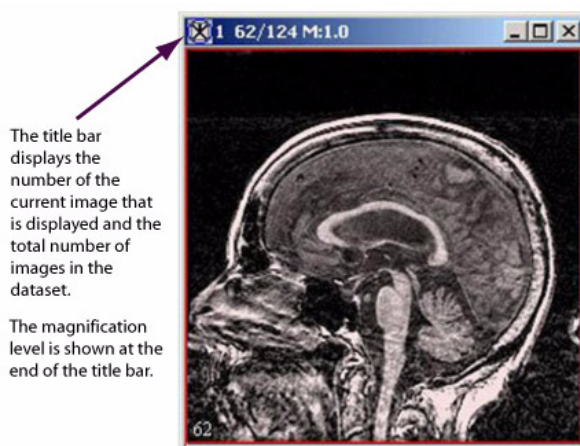
Tip: You can display different views of the same dataset on the desktop at the same time.

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Displaying images using the default view

When you initially open or load an image dataset, it appears in the image window showing the default view (Figure 2).

If you display a 2D image dataset, the title bar only displays the name of the file and the magnification level only. If you open an image dataset that has more than two dimensions, the title bar displays the name of the file, the position of the image in the dataset, the total number of images in the dataset, and the magnification level.

The title bar displays the number of the current image that is displayed and the total number of images in the dataset.

The magnification level is shown at the end of the title bar.

Figure 106. Image window showing the default view for a 2D image

Datasets with more than two dimensions typically contain many image slices. To manually advance through datasets that contain more than one image, you can use the image slice slider or ![icon], the Decrements image slice icon, or ![icon], the Increments image slice icons in the MIPAV window (Figure 4). You can also use the lightbox view to find and display a particular slice in the image dataset in the default view (refer to "Using the lightbox view to update the image slice displayed in the default view" on page 47).
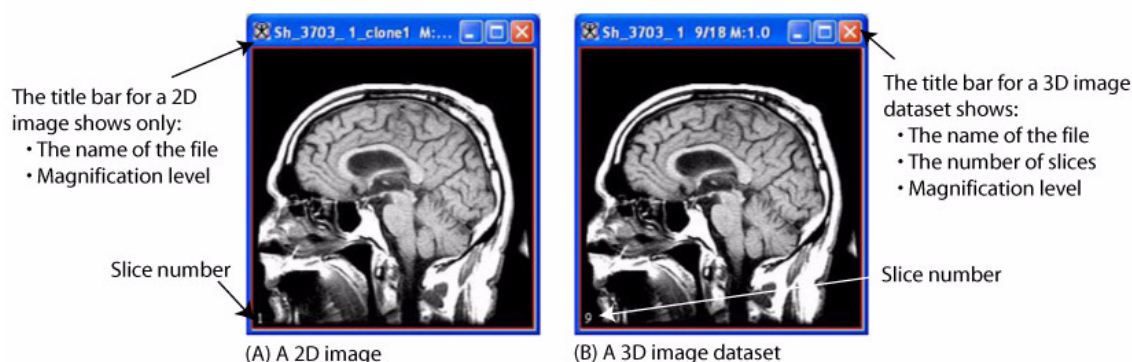
Figure 107. Image window showing (A) a 2D image, or slice, and (B) an image dataset that has more than two dimensions.

Magnifying and minifying images

In the default view you can magnify or minify, or reduce, displayed images. When you display an image, the magnification level is indicated on the title bar of the window. For example, M:4.0 indicates that the image was magnified by a factor of four times the original size. You can also use the magnifying glass to temporarily magnify or reduce a region of the image. You can magnify images to 32 times their original size, reduce them to one-fourth their original size, or restore them to their original size.
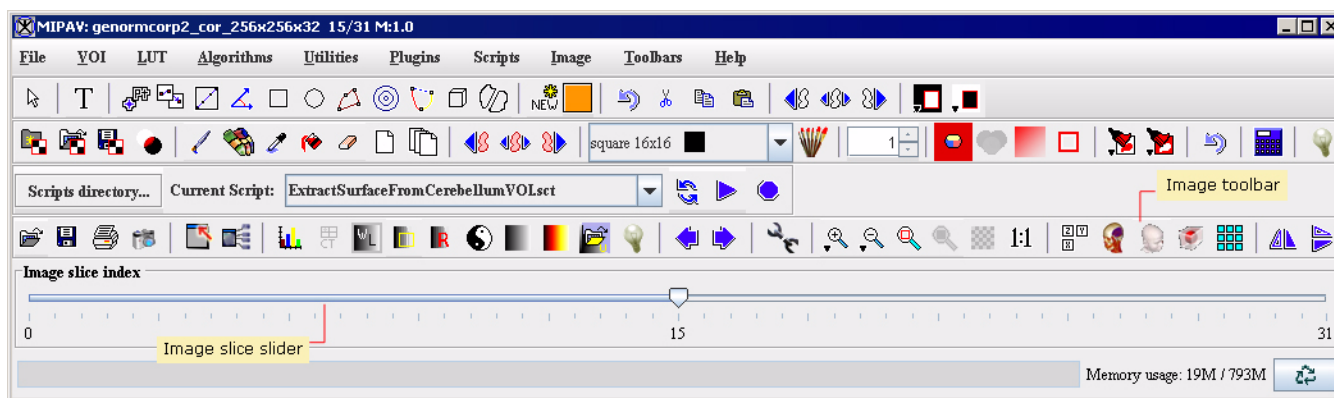
Figure 108. MIPAV window

In the MIPAV window, there are three methods for magnifying or minifying images:
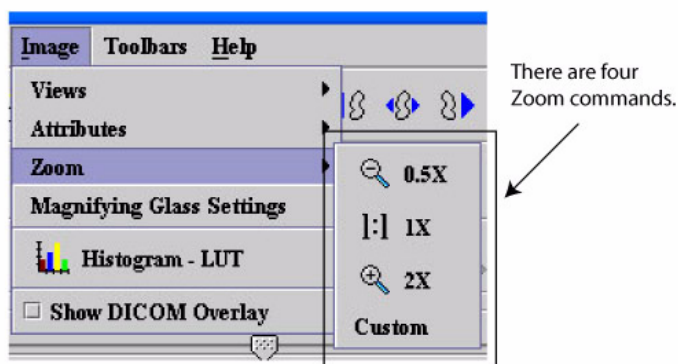
- Automatically using three preset commands on the Image > Zoom menu

- Manually using the Custom command on the Image > Zoom menu, which allows you to create other magnification levels

- Automatically using the icons on the image toolbar

To set the magnification level automatically using the preset commands

1 Open an image.

2 Select Image > Zoom.

3 Select one of the following commands on the Zoom menu:

- *0.5X*—To reduce the image by one-half of its current size

- *1X*—To restore the image to its original size

- *2X*—To enlarge the image by twice its original size

The software immediately changes the magnification level of the image.

Figure 109. Zoom commands on the Image menu

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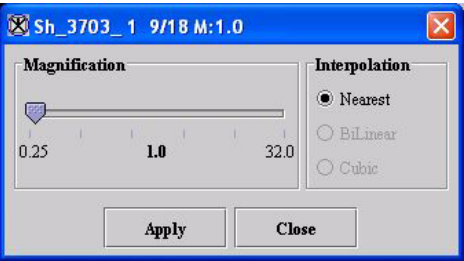## To set the magnification manually using the Custom command

To manually adjust the magnification level to a specific level that is not available through the preset commands or the icons on the image toolbar, do the following:

1 Open an image.

2 Select Image > Zoom > Custom. The Custom Magnification dialog box (Figure 6) opens.

3 Slide the marker in the Magnification slider to the specific level of magnification that you want to apply.

4 Select the interpolation method if desired.

Interpolation is the addition of one or more voxels between two other voxels. The interpolation mode is particularly important when an image is magnified (and voxels are seen more easily). Three interpolation modes are available: nearest, bilinear, and cubic (refer to Figure 6 for more information).

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5 Click Apply. MIPAV applies the magnification level and interpolation mode to the image.

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Magnification	Slide the marker left to decrease the magnification or right to increase the magnification. You can reduce the image to one fourth of its current size or enlarge it up to 32 times its current size. Notice that the number below the center of the slider changes as you slide the marker to indicate the magnification level.

Interpolation	Select one of the following methods: **Nearest**—Short for *nearest neighbor.* The replicated voxel is assigned the color of the closest voxel. This mode yields more accurate results because other modes because the original values are retained. However, if applied, the image may have a choppy "stair-step" effect. It is also possible that some data may be lost or duplicated. **Bilinear**—In this mode, the average of the four nearest voxels (to the newly interpolated voxel) is weighted. The interpolated voxel is then assigned the resulting color. If this mode is applied, the "stair-step" effect is reduced. However, because the view of the data is altered, it is not as accurate as the nearest neighbor mode. **Cubic**—Short for *cubic convolution.* This mode is similar to the bilinear mode, except that the weighted average of the nearest sixteen voxels is used instead of the nearest four. If this mode is applied, the stair-step effect is greatly reduced. However, because the view of the data is altered, it is not as accurate as the nearest neighbor or bilinear modes.
Apply	Applies the magnification and interpolation you specified.
Cancel	Disregards any changes that you made in this dialog box and closes this dialog box.
Help	Displays online help for this dialog box.

Figure 110. Custom Magnification dialog box

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To set the magnification automatically using icons on the image toolbar

The three magnification icons on the image toolbar work the same way as the three preset commands on the Image > Zoom menu do. Do one or more of these tasks:

- To magnify an image, click ⊕, the Magnify image 2.0x icon. Each time you click Magnify, the image doubles in size. As the magnification level increases, it may be necessary to manually adjust the size of the window so you can see the entire image at one time. Scroll bars appear if the image is too big for the window.

- To minify an image, click ⊖, the Magnify image 0.5x icon. Each time you click this icon the image is reduced to half size.

- To return the image to the original level of magnification, click 1:1, the Magnify image 1.0x icon.

Tip: These icons appear on other windows beside the MIPAV window, and they work in the same way on each window.
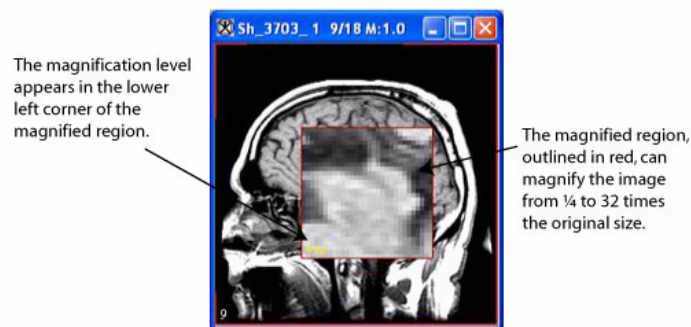

WORKING WITH THE MAGNIFYING GLASS

The magnifying glass is much like a traditional, real-world magnifying glass. It allows you to view a portion of the image at a specific magnification level. You can select the magnification level, which can be anywhere from 1 to 32 times the original image size. For example, an image may be the original size; however, to examine a specific area more closely, you may want to set the magnification level of the magnifying glass to 16 times the original size.

Conversely, if an image uses a high-level of magnification, you may want set the magnifying glass to a lower magnification level so that you can gain perspective on where a section fits with the whole image.

To use the magnifying glass

1 Open an image.

2 Click ![Magnify Region icon], the Magnify Region icon, on the Image toolbar in the MIPAV window.

3 Move the cursor to the image. The cursor shape changes to the magnifying glass shape, a box outlined in red with the level of magnification in the lower left corner (Figure 7). The area inside the box is magnified.
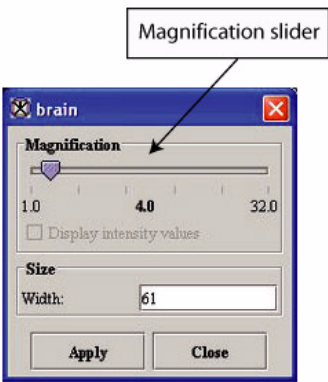

Figure 111. Magnified region

You can move the magnifying glass to different places on the image. This allows different regions to be magnified without affecting magnification level of the entire image. When you want to return to normal magnification, click the Default Mode icon.

To adjust magnifying glass settings

1 Do either of the following:

- Select Image > Magnifying Glass Settings.

- Right-click on the image.

The Magnification Settings dialog box (Figure 8) appears.

Magnification	Specifies the level of magnification in the magnified region. You can select a magnification from 1 to 32 times the original size of the image.	
Display intensity values	Shows the intensity values of the voxels in four areas in the magnified region. This check box is only available for magnifications 21 to 32.	
Width	Indicates the size of the magnified region in voxels; in other words, of the magnifying glass.	
Apply	Applies the parameters in this dialog box to the magnifying glass.	
Close	Disregards any changes that you made in this dialog box and closes this dialog box.	
Help	Displays online help for this dialog box.	

Figure 112. Magnification Settings dialog box

2 Move the Magnification slider to select the level of magnification. The number in bold in the middle of the slider indicates the current level of magnification.

3 Specify the size of the magnifying region (box) in the Width text box. (The width and the length are the same.) Values are in voxels.

4 Select Display intensity values if you want to see the intensity values of the voxels in the magnifying glass (Figure 9).

5 Click Apply. The new settings are applied to the magnifying glass.

When you select Display Intensity values on the Magnification Settings dialog box, the magnified region shows the intensity values for four areas in the region.
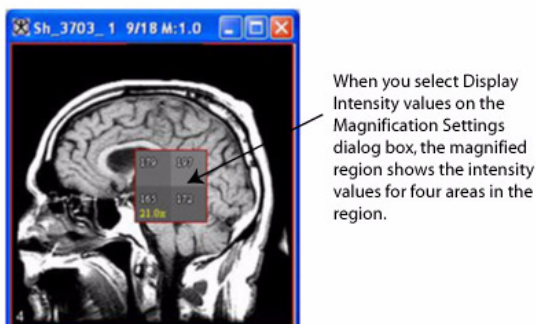
Figure 113. Magnified region showing intensities

Viewing two images together

When two separate image files are loaded into the same window (for directions on how to load an image, refer to Chapter 3, "Getting Started Quickly with MIPAV"), the window displays a blending of both images. MIPAV refers to the first image file as "Image A" and to the second image file as "Image B." By default, Image A is active and Image B is inactive. To change which image is active, simply select, as appropriate, the Image A or Image B radio button.

By default, Image A is active and Image B is inactive. Thus, even if two image files are loaded into the same image window, only Image A—which is the designation MIPAV assigns to the first image that was opened in the window—is displayed.

You can view the inactive image using one of the following methods:

- Adjust the alphablending value so that you can see the inactive and active images simultaneously

- View the part of Image B that is directly under that portion of Image A by using , the Window region of Image B icon.

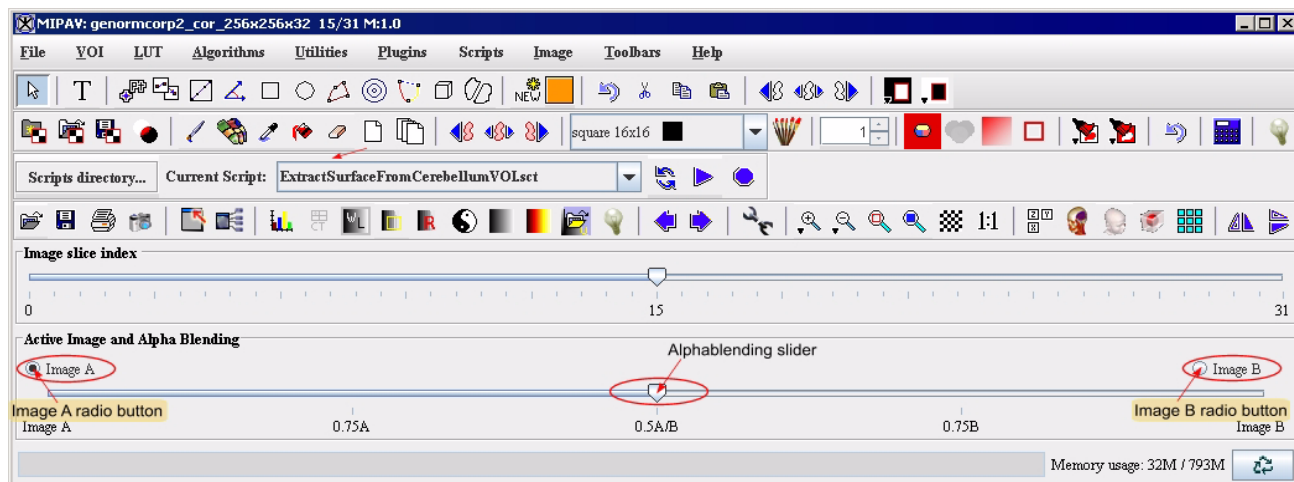- View portions of the image using the checkerboard tool

Figure 114. MIPAV window showing the Alphablending slider

COMPARING IMAGES USING ALPHABLENDING

Alphablending is a technique that adds transparency information to translucent objects. It is used to blend what is currently rendered on the display (i.e., Image A) with the contents of the frame buffer (i.e., Image B). Each colored voxel is assigned an alpha value, which represents transparency. The alpha value is used to blend the intensities, voxel by voxel. When two images share a window, you can adjust the alphablending settings so that you can see a blend of both images and can compare overlapping regions in two datasets. See Figure 114.

To use the alphablending tool and Window Region tool

1 Open two images.

2 Load the second image into the image window of the first image. The Active Image and Alphablending slider appears at the bottom of the MIPAV window (Figure 11).

The level of translucency for one image is inversely proportional to the other. Thus, if Image A is 75 percent transparent and 25 percent opaque; Image B is 75 percent opaque and 25 percent transparent ("Alphablending: An Example" on page 20).

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Note: In the MIPAV window, notice that an additional magnifying glass is now

available: [icon], the Window Region of Image B icon, which you use to view the portion of Image B that is directly under that portion of Image A.

3 Move the Active Image and Alphablending slider between the Image A and Image B radio buttons.

Alphablending: An Example

For a very clear example of how alphablending

works, open two images and then apply [icon], the Hot Metal LUT icon, to one of the images before you load them together. After the images are loaded, move the Active Image and Alphablending slider from the left to the right. The following images show what you see at five points of the slider:

(A) The image on the far left shows 100 percent of Image A. It does not display a blending of the images.

However, for any of the images below, you can

use the [icon], Window Region of Image B icon, to inspect the portion of Image B that lies underneath that same portion of Image A.

(B) The next image displays a blending of 75 percent Image A and 25 percent of Image B.

Again, use [icon] to see the portion of Image B beneath Image A.

(C) The middle image displays 50 percent blending of both Image A and Image B. You can
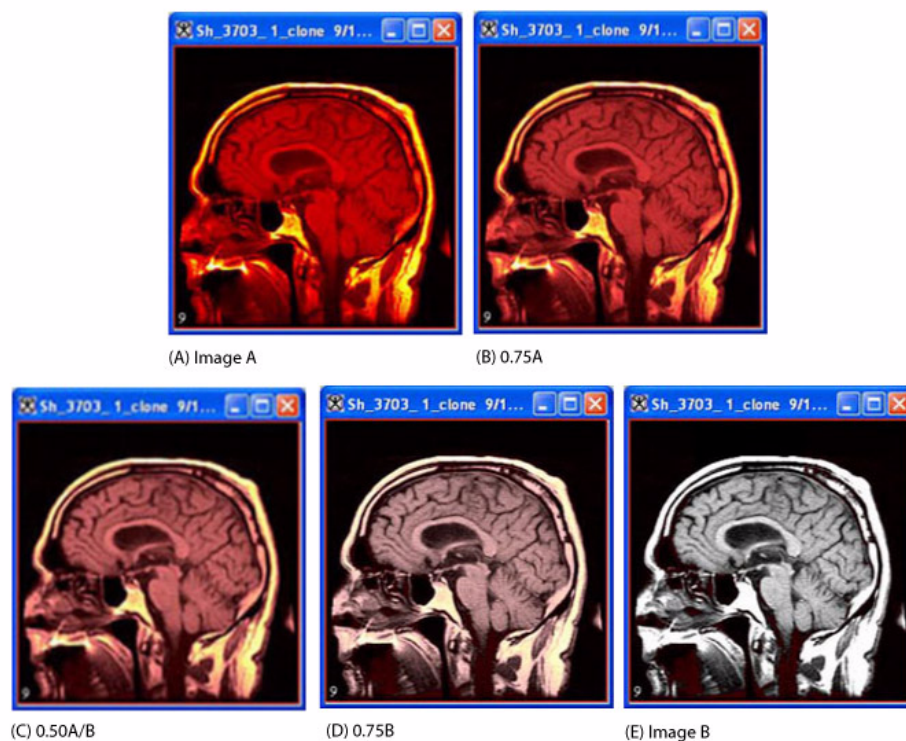
use [icon] to inspect Image B.

(D) The fourth image displays 75 percent of Image B and only 25 percent of Image A. You

can use [icon] still to inspect Image B.

(E) The final image on the right displays 100 percent of Image B. Since all of Image B is

shown, you no longer have a need to use [icon].

This figure is best viewed in the PDF version of this chapter.

(A) Image A

(B) 0.75A

(C) 0.50A/B

(D) 0.75B

(E) Image B

Depending on the direction in which you are moving the slider (that is, toward Image A or toward Image B), one image becomes more visible. To examine each image in more detail, you can use the magnifying glasses.

As you move the slider, the images in the image window are updated instantly. If not, release the mouse button to update the image.

Move the slider all the way to the right or to the left depending on which image you want to see. For example, to see Image B, move the slider to the far right. To see Image A, move the slider (Figure 10) to the far left. The closer the slider is to the middle, the more blended are the images.
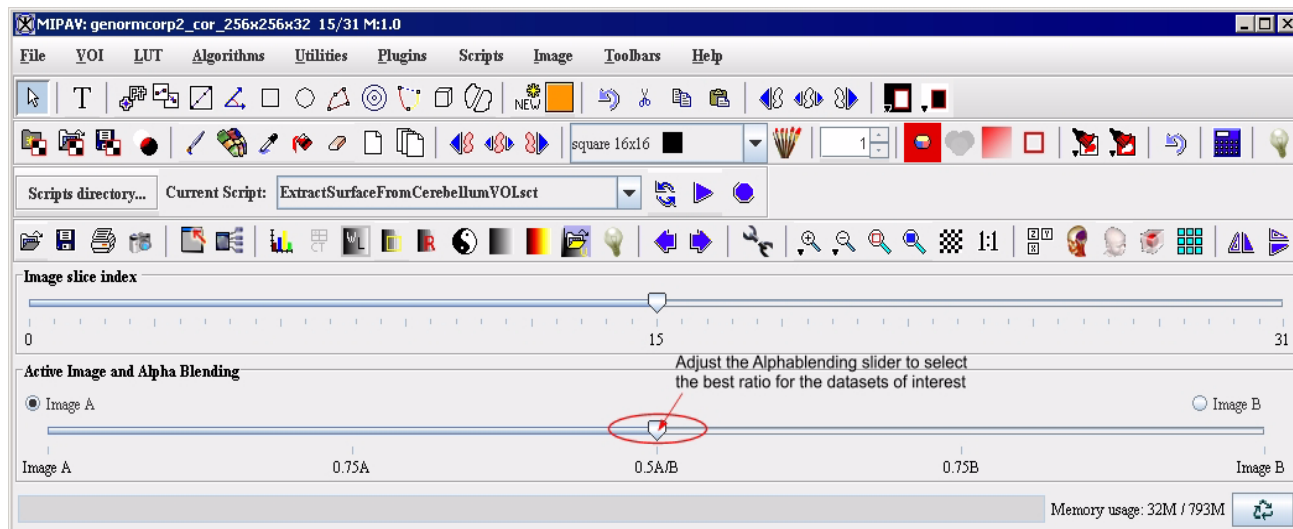
Figure 115. MIPAV window

To make images active or inactive

1 Open two images.

2 Load the second image into the first image window. The MIPAV window expands to include the Active Image and Alphablending slider (Figure 115).

3 Notice that Image A is currently the active image.

4 Select Image B in the Active Image and Alphablending slider to make Image B the active image.

5 Move the slider to the far right. As you are moving the slider, more of Image B appears in the image window. When the slider reaches the far right, all of Image B appears in the image window.

6 Click , the Default Mode icon.

If you want to take an action on one of the images—for example, adjusting the contrast or running an algorithm—make sure that it is the active image. If the inactive image is Image B, you also have the option of using the Image B region tool to view portions of the Image B. If the active image is currently Image A and you want to view Image B, simply select the Image B radio button. To make Image A the active image, select the Image A radio button.

VIEWING PORTIONS OF IMAGES USING THE CHECKERBOARD

The checkerboard tool displays both portions of both images in an alternating fashion, much like the squares on a checkerboard. A traditional checkerboard has a grid of alternating dark-colored and light-colored squares. Portions of Image A appear where the light-colored squares would appear on the checkerboard; portions of Image B appear in place of the dark-colored squares. You can adjust the number of rows and columns displayed.
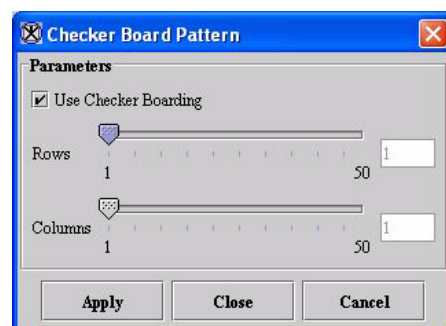
To use the checkerboard tool

1 Open two images.

2 Load the second image into the first image window. The MIPAV window expands to include the Active Image and Alphablending slider.Click

[icon]. The Checkerboard Pattern dialog box (Figure 12) appears.

Use checkerboarding	Specifies to use checkerboarding.
Rows	Indicates the number of rows you want to display in the checkerboard. You can display from 1 to 50 rows.
Columns	Indicates the number of columns you want to display in the checkerboard. You can display from 1 to 50 columns.
Apply	Applies the parameters that you specified to the images.
Close	Closes this dialog box.
Cancel	Disregards any changes you made in this dialog box, closes the dialog box, and does not apply checker boarding.
Help	Displays online help for this dialog box.

Figure 116. Checkerboard Pattern dialog box

3 Select Use checkerboarding if it is not already selected.

4 Adjust the Rows slider to indicate the number of rows that should be in the checkerboard pattern.

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5 Click Apply when finished. The checkerboard pattern appears in the image window (Figure 13).

When the rows and columns intersect, a grid is created. Adjacent squares in the grid alternatively display the active and inactive images.

6 Click Close to close the Checkerboard Pattern dialog box.

Note: If you select another image—that is, an image that is not loaded into the same window as Image A and Image B, the Active Image and Alphablending slider disappears from the MIPAV window. The slider only appears when the selected image window contains two images.

To remove the checkerboard from the image

1 Click ⊞. The Checkerboard Pattern dialog box (Figure 12 on page 22) appears.

2 Clear Use checkerboarding.

3 Click Apply. MIPAV removes the checkerboard from the image.

4 Click Close.
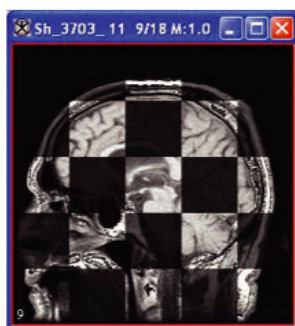
(A) Example of 5 rows and 5 columns
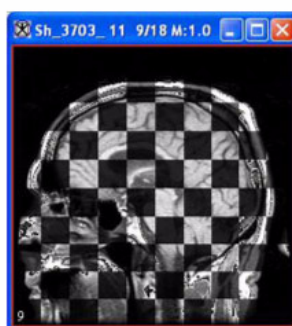
(B) Example of 10 rows and 10 columns

Figure 117. Examples of the checkerboard pattern

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Changing image brightness and contrast using LUTs

Generally, computer systems have brightness display values written in the display hardware. These values are known as the *physical color map;* they are hard coded in your monitor. When you open an image, the image file contains data that indicates the intensity of each voxel in the image. These data are passed to the physical color map and displayed on the monitor. Additionally, MIPAV provides a logical color map, which allows you to remap the original intensities to other intensities. Although technically the term *look-up table* (LUT) can be used for the physical and logical color maps, in this guide look-up table refers to the logical color map only. You can apply predefined, pseudo color or inverse LUTs, or you can manually manipulate the transfer function used to map the image data to the LUT. The LUT then translates the remapped values so that they can be interpreted by the physical color map and displayed on your monitor.
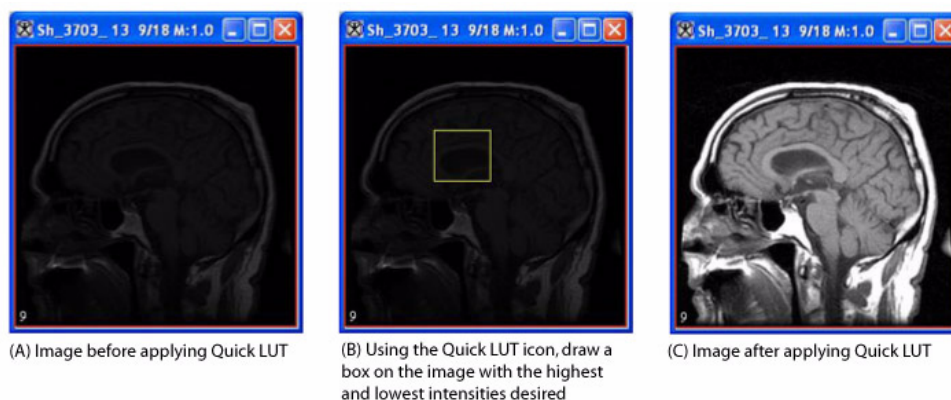
To adjust the look-up table using the Quick LUT

To adjust the LUT, you open the Look-up Table window to modify the LUT's values and transfer function. However, you can use the Quick LUT icon to modify the LUT without opening the Look-up Table window. Quick LUT allows you to easily choose the highest and lowest values for the intensity levels in a user- defined area.

To do this, complete the following steps:

1 Open an image.

2 Click ▣ (Quick LUT) in the MIPAV window.

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3 Move the cursor to the image window and draw a box around an area that has the highest and lowest intensities you want the image to display. These values are used to remap the image data to the LUT. The net effect is increased contrast in the area of interest (Figure 14).


(A) Image before applying Quick LUT

(B) Using the Quick LUT icon, draw a box on the image with the highest and lowest intensities desired

(C) Image after applying Quick LUT

Figure 118. An image before and after applying Quick LUT

To generate a histogram and look-up table

A *histogram* is a graphic representation of the intensity level distribution in an image or VOI region. It displays the number of voxels at each intensity level. The histogram and LUT appear in the Look-up Table window.

To generate a histogram, and view the LUT, complete the following steps:

1 Open an image. The image appears in an image window.

2 Create a VOI on the image (optional step).

3 Do either of the following:
- Click Look-up Table.
- Select LUT > Histogram –LUT.

If the image contains a VOI, the Histogram window appears (Figure 15). Go to the next step.
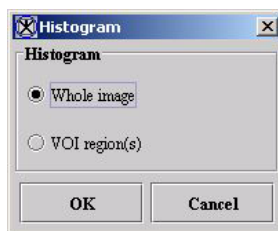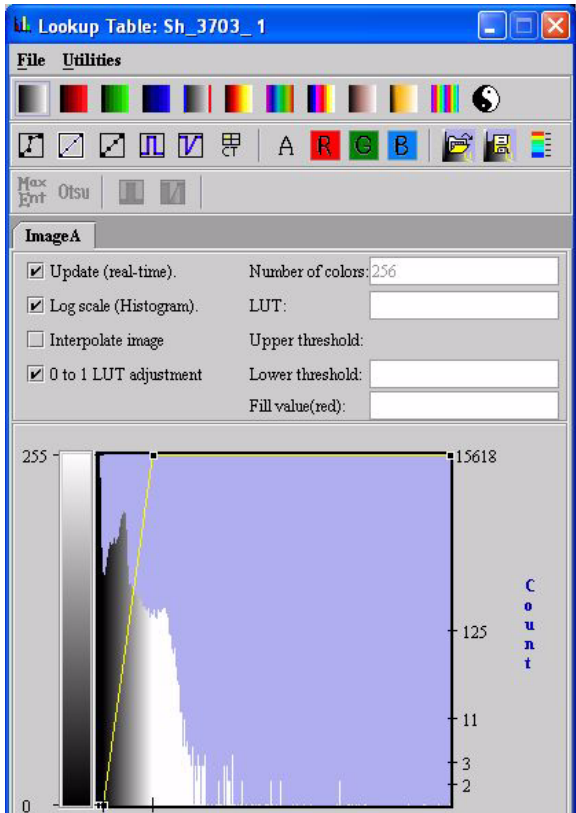
Figure 119. Histogram dialog box

If there are no VOIs on the image, the Look-up Table window (Figure 16) appears.

4 Choose one of the following:

- *Whole image*—To generate a histogram for the whole image

- *VOI region(s)*—To generate a histogram for the VOI region of the image

5 Click OK. A progress message appears briefly. After a few moments, the Look-up Table window appears (Figure 16).

File	*Open LUT*—Opens a previously saved LUT file. LUT files have a *.LUT* extension. *Save LUT*—Saves the LUT displayed in this window in a LUT file. *Open Transfer Functions*—Opens a previously saved transfer function. Transfer function files have a *.FUN* extension. *Save Transfer Functions*—Saves the transfer function displayed in this window to a file. *Close LUT*—Closes the LUT window.	
Utilities	*Change number of colors*—Allows you to change the number of colors displayed in the image. Valid values are 2 to 256.	
	CT function—Allows you to select a preset LUT that is appropriate for the image content. Values are abdomen, head, lung, mediastinum, spine, and vertebrae. *Invert LUT*—Creates a negative of the image. *Reset histogram and LUT A*—Returns image A to its original values. *Reset histogram and LUT B*—Returns image B to its original values. This command is only available if two images are open.	
LUT toolbar	Provides tools that allow you to manipulate the displayed image. Refer to Figure 19.	
Update (real-time)	Changes the image as you make changes to the LUT, which allows you to see the effect of your changes immediately on the image.	
Log scale (histogram)	Displays the image's histogram count in log scale along the *Y* axis.	
Interpolate image	Displays image using interpolation, which reduces pixilated image to appear more smooth. **Caution:** Depending on the memory resources of your workstation, interpolation can be very lengthy.	

Figure 120. Look-up Table window

Number of colors	Allows you to change the number of colors displayed in the image.
LUT	Displays the image intensities.

Figure 120. Look-up Table window (continued)

The Look-up Table window consists of three sections: a menu bar, a toolbar, and one or more pages containing histograms. A tab appears for each image that is opened in the image window. For example, if only one image is in the image window, then only the Image A tab appears. If you generated the histogram for an image window that contains two images, a tab for Image A and a tab for Image B appear. Each of these tabbed pages contain a histogram for the applicable image. If you generated the histogram for a VOI, the window does not display a tab and only the applicable icons and buttons in the toolbar appear.

The toolbar allows you to manipulate the displayed image. You can apply pseudocolor LUTs, adjust the image contrast with the transfer function, and apply preset window and level settings for CT slices. You can also edit the red, blue, green, and alpha channels of a LUT.

look-up table (LUT)—Indicates the intensity of each voxel in the image and, in MIPAV, allows you to remap the original intensities to other intensities.

transfer function—Reflects the relationship between the original image intensity values and how they are mapped into the LUT. The line in the LUT represents the transfer function.

Note: You can generate a histogram for two image datasets that are loaded together. In this case, the Look-up Table window (Figure 17) shows two tabs— one for Image A and one for Image B.
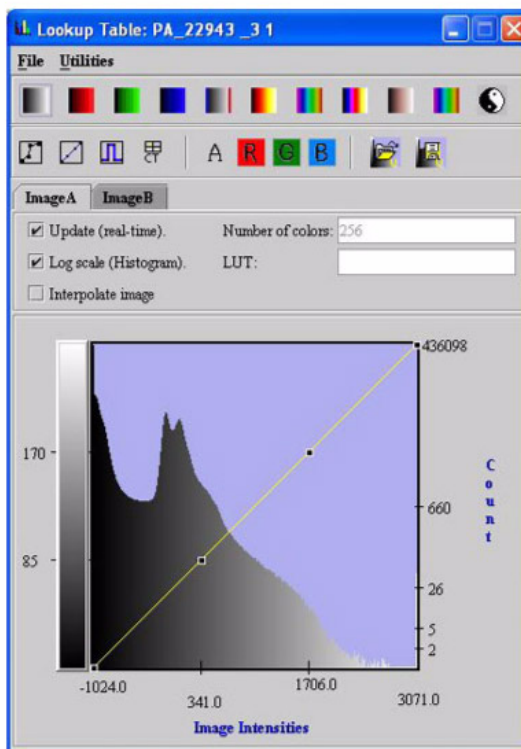
Figure 121. Look-up Table window showing Image A and B histograms

To update images in real time

When you modify the LUT, be sure to select the Update (real time) check box. The image in the image window is then updated in real time.

To change the number of intensities displayed in the LUT

You can change the number of intensities displayed in the LUT. To do this, do the following:

1 Select Utilities > Change Number of Colors in the LUT window. The Change Number of Colors dialog box opens.

Figure 122. Change Number of Colors dialog box

2 Type the number of colors you want in the Number of colors box. You can specify any whole number between 2 and 256.

3 Select Apply to apply the changes.

Notice that the Number of colors box in the LUT window now displays the number you specified and the histogram changes to display the new colors.

4 Click Close or Cancel to close the dialog box.

APPLYING PREDEFINED LUTS TO IMAGES

You can use MIPAV's predefined LUTs to apply pseudocolor, create a negative of the image, and apply preset CT window and level settings to an image.

To apply pseudocolor LUTs to images

As you examine an image, you may need to observe small changes in intensity values or identify the same intensity values in different portions of an image. This can be difficult if the image is rendered in grayscale because the human eye can only see about 100 shades of gray. However, because varied colors are often easier to distinguish, MIPAV allows you to use various pseudocolor maps to elucidate objects of interest. Thus, MIPAV provides a variety of pseudocolor LUTs. If you apply a pseudocolor LUT, the grayscale intensity values are remapped to color intensity values. Note that

the original image data is not changed; only the displayed image file (hence the term *pseudocolor*).

Figure 123. LUT toolbar

To apply a pseudocolor LUT, click one of the following icons:

- ■ Red LUT
- ■ Green LUT
- ■ Blue LUT
- ■ Gray blue/red LUT
- ■ Hot metal LUT
- ■ Spectrum LUT
- ■ Cool hot LUT
- ■ Striped LUT
- ◐ Invert LUT

The grayscale intensity values in the image dataset are remapped to color intensity values.

To invert intensities

To invert the intensities so that a negative of the dataset appears, click ◐, the Invert LUT icon. The Invert LUT icon is in both the Look-up Table window (Figure 16 on page 26) and the MIPAV window. Figure 19 on page 30 shows the location of this icon in the Look-up Table window.

To apply CT level presets to images

There are six CT window and level presets: abdomen, head, lung, mediastinum, spine, and vertebrae. To apply a preset level to the image,

complete the following steps:

1 Click [icon], the CT Preset icon, in the LUT window. The CT Presets dialog box appears (Figure 20).
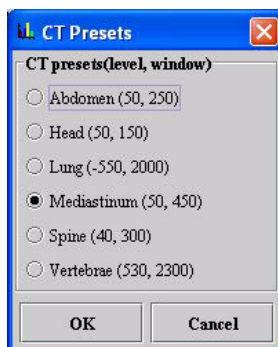
Figure 124. CT Presets dialog box

2 Select the desired CT preset. As you select the CT preset option, the colors in the image's histogram or LUT change, and, if you chose to update images in real time, the image changes.

3 Click OK to save the change.

ADJUSTING CONTRAST USING THE TRANSFER FUNCTION

The transfer function reflects the relationship between the original image intensity values and how they are mapped into the LUT. An example of how adjusting the transfer function affects the display of an image appears in Figure 16. In this example, the top image is generated by applying the linear transfer function (slope = 1) to produce display values that are evenly distributed over the range of the LUT (see Figure 125A). This results, in this case, in a low-contrast image (see Figure 125B). The contrast of the image can be improved by adjusting the transfer function in a manner shown in Figure 125A (e.g., changing a low-contrast image into a high-contrast image). The image scalar values between −175 and 275 are remapped as a function of the modified transfer function and distributed across the full

LUT range. The values above 275 are remapped to white and the values below −175 are remapped to black. The effect can be readily seen in Figure 125B.

To modify transfer functions

1 Open an image. The image appears in the default image window.

2 Click , the Displays Look-up Table (LUT) icon. The Look-up Table dialog box opens.

3 Click the transfer function. A new node may appear.

4 Drag the node to the new location.

You can also adjust the transfer function for the alpha, red, green, and blue channels in an image.

Example: You might want to use these icons to highlight certain intensities in a particular color.

To do this, click the appropriate one of the following icons:

- , the Edit Alpha icon

- , the Edit Red icon

- , the Edit Green icon

- , the Edit Blue icon

When you click on one of these icons, the transfer function for that channel appears on the histogram and a node appears on that transfer function. Drag the node to the desired position. To adjust another channel, you must click on the icon and drag the node to the appropriate position.
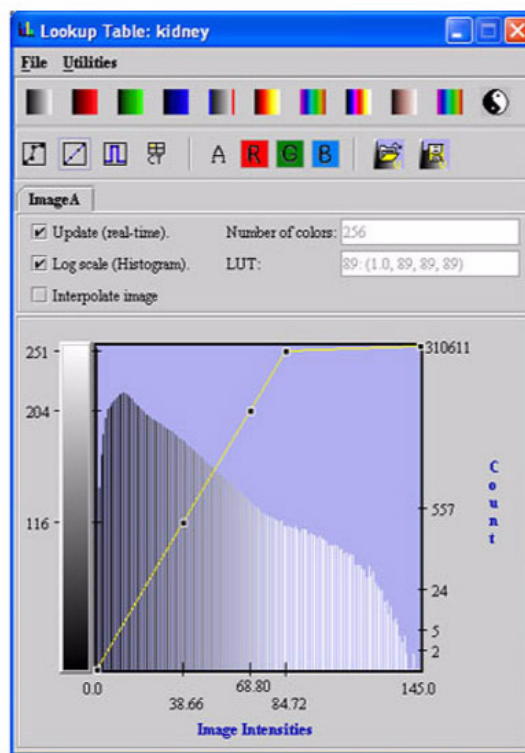
(A) The original image before changing the transfer function

(B) The image after changing the transfer function
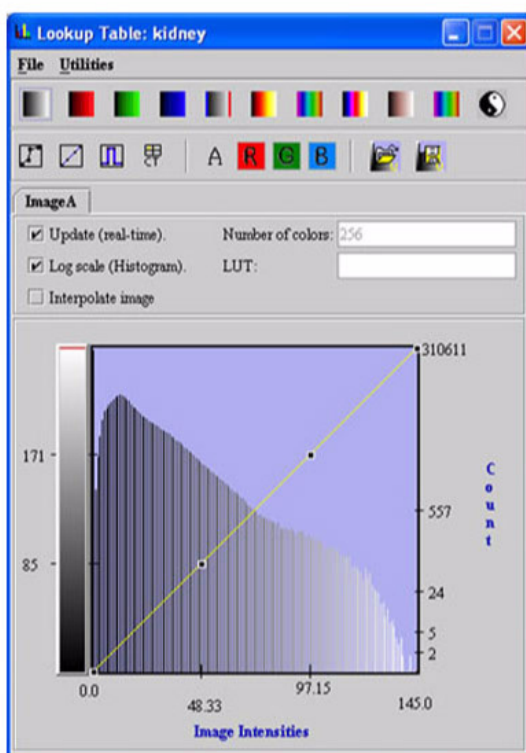
(C) The original transfer function

(D) The modified transfer function

Figure 125. An image before and after modifying the transfer function

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To save transfer functions

To save a transfer function to a file, complete the following steps:

1 In the Look-up Table dialog box, select File > Save Transfer Functions (Figure 126) or press Ctrl+S. The Save dialog box (Figure 127) appears.
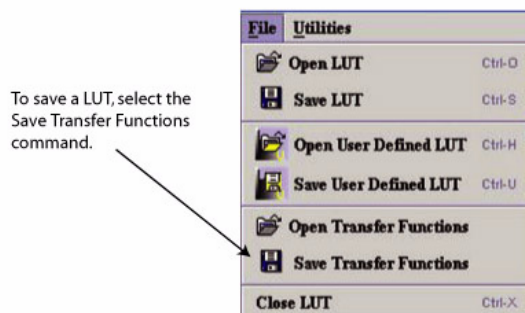
Figure 126. Open and Save commands in the File menu

2 Type a name to the transfer function in the File Name box. Be sure to add the .fun extension to the file name.
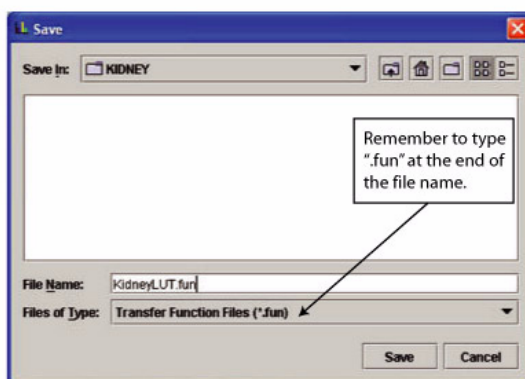
Figure 127. Save dialog box

3 Click Save. The program saves the transfer function under the name you specified.

To apply previously saved transfer functions

To open a transfer function file and apply it to an image, complete the following steps:

1 Select File > Open Transfer Functions in the Look-up Table window. The Open dialog box appears.

2 Select the desired file. LUT files have a `.fun` extension.

3 Click Open. The program applies the transfer functions file to the current image.

To save LUTs for later use

1 Select File > Save LUT in the Look-up Table window, or press Ctrl S. The Save dialog box (Figure 128) appears.
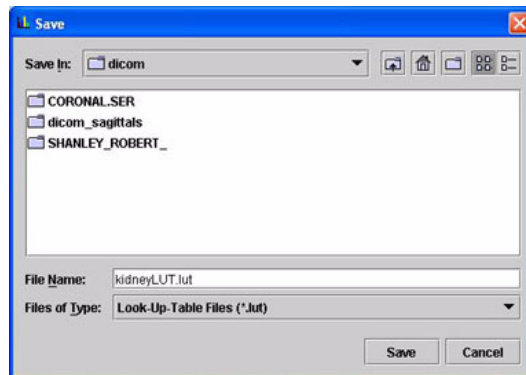
Figure 128. Save dialog box

2 Type a name for the LUT in the File Name box. Be sure to add the .lut extension to the file name.

3 Click Save. The program saves the LUT under the name you specified.

To open and apply previously saved LUTs to images

1 Select File > Open LUT in the Look-up Table window, or press Ctrl O. The Open dialog box (Figure 25) appears.

2 Select the desired file. LUT files have a .lut extension.

3 Click Open. The program applies the LUT settings from the LUT file you specified to the current image file.
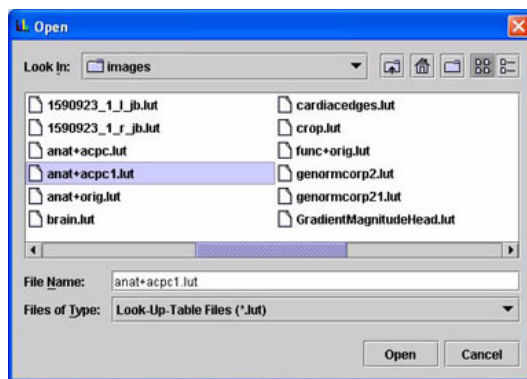
Figure 129. Open dialog box

To open, save, and apply frequently used LUTs

For a LUT that you defined and expect to use frequently, MIPAV provides a simple method for saving, opening, and applying it without needing to use the commands on the File menu. You use two icons on the toolbar in the Look-up Table window:

- , the Save User-Defined LUT icon, allows you to save the LUT.

- , the Open User-Defined LUT icon, provides a very quick way of opening and applying the user-defined LUT

Recommendation: Because these icons only apply to one user-defined LUT, it is recommended that you select the LUT that is used most frequently.

To reset original LUTs to images

Click , the Grayscale icon in the Look-up Table window (refer to

Figure 16 and Figure 19). Alternatively, you can click , the Reset LUT icon, in the MIPAV window.

To adjust the threshold

1 Open an image. The image appears in the default image window.

2 Click , the Displays Look-up Table (LUT) icon. The Look-up Table dialog box opens.

3 Click , the Dual threshold function icon. The Threshold icon becomes active and the transfer function of the histogram changes.

4 Select Algorithms > Threshold. The Threshold dialog box (Figure 26) opens.

|		
Set lower limits between (1.0–3774.0)	Threshold limit for the lowest image intensities.	
Set threshold between (1258.3334–3774.0)	Threshold limit for the highest image intensities.	
Produce binary image	Produces a binary image (Boolean).	
Set values outside of limits to	Specifies the intensity value to assign to values outside the threshold limits.	
New image	Shows the results of the algorithm in a new image window	
Replace image	Replaces the current active image with the results of the algorithm.	
Whole image	Applies the algorithm to the whole image.	
VOI regions	Applies the algorithm to the volumes (regions) delineated by the VOIs.	
OK	Applies the changes you made in this dialog box and closes the dialog box.	
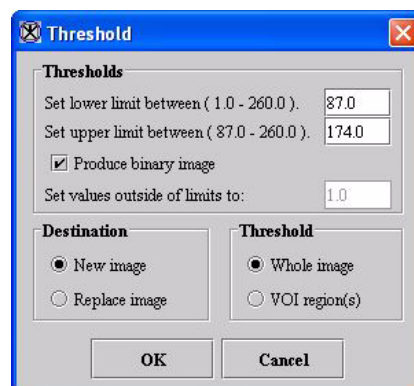
Figure 130. Threshold dialog box

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Cancel	Disregards any changes you made in this dialog box, closes the dialog box, and does not change the threshold.
Help	Displays online help for this dialog box.

Figure 130. Threshold dialog box (continued)

5 Complete the dialog box.

Note: You can choose to generate a binary image (Boolean) by selecting the Produce binary Image check box. Alternatively, you can clear the binary option and enter a threshold value. If you still want to generate a Boolean image, select the check box again. Note that, if you generate a Boolean image, MIPAV does not allow you to reapply the threshold or to generate either a histogram or LUT for a Boolean image.
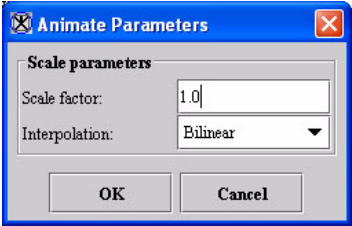
6 Click OK to apply the threshold.

Displaying images using the animate view

If you select the *animate* view, the software makes a copy of the image dataset and loads it into an image window showing the animate view. In animate view, like cine view, the software automatically advances through the entire image dataset. However, the animate view allows you to adjust the speed at which images are advanced. You can specify that images be displayed in forward or reverse order. You can also pause or stop the sequence.
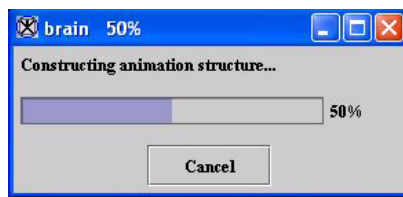
To view an image dataset in animate view

1 Select Image > Views > Animate in the MIPAV window. The Animate Parameters dialog box (Figure 27) appears.

2 Type the scale factor that you want to use in the Scale factor box.

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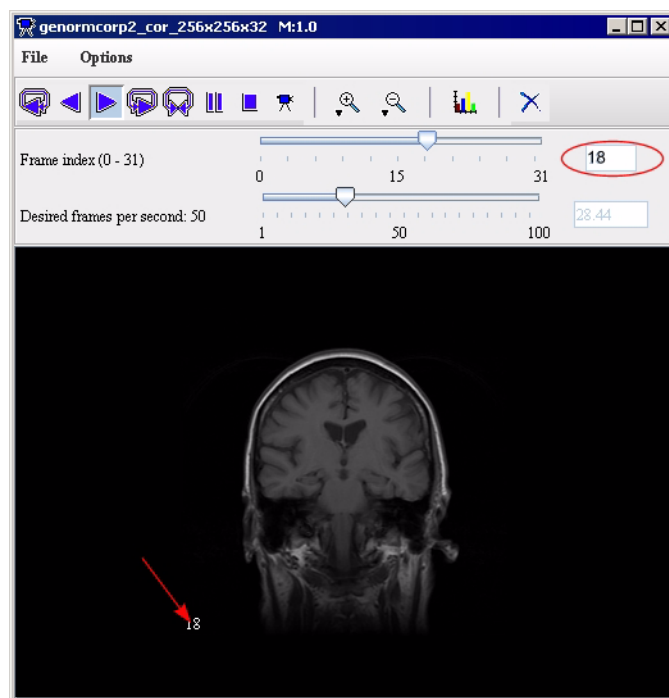|	
Scale factor	Changes the size of the dataset by the factor specified. Unlike magnification, the number of voxels used to replicate the image may change. For example, if you scale a dataset by a factor of 2, the image becomes twice the original size, and the number of voxels is squared.
Interpolation	Determines the intensity of the additional voxels using one of the three following methods: **Bilinear**—Weighs the average of the four nearest voxels (to the newly interpolated voxel). The interpolated voxel is assigned the resulting intensity. **Bspline 3rd order**—Weighs the average of the 27 nearest voxels (to the newly interpolated voxel). **Bspline 4th order**—Weighs the average of the 64 nearest voxels (to the newly interpolated voxel).
OK	Applies the scale factor and interpolation to the image dataset according to the specifications in this dialog box.
Cancel	Disregards any changes that you made in this dialog box and closes this dialog box.
Help	Displays online help for this dialog box.

Figure 131. Animate Parameters dialog box

> **3** Select one of the three interpolation methods.
>
> **4** Click OK.
>
> MIPAV transforms the dataset using the scale factor and interpolation method you indicated. A progress message (Figure 28) appears while the program constructs the animated file. It then loads a copy of the dataset in the Animate window.

Figure 132. Animate progress message

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File	**Save Image as .avi**—Saves the dataset as an AVI, or digital video, file.
	Close Animate—Closes the Animate window.
Options	**Show Z Slice Numbers**—Displays, if selected, the slice number, or the frame number, on the lower left side of the image.
Continuous reverse	Steps through all of the images in the dataset continuously in reverse without stopping at the speed specified in Desired frames per second.
Reverse	Steps through all of the images in the dataset once in reverse at the speed specified in Desired frames per second.
Forward	Steps through all of the images in the dataset once in sequence at the speed specified in Desired frames per second.
Continuous forward	Steps through all of the images in the dataset continuously without stopping at the speed specified in Desired Frames per second.
Backward and forward	Steps through all of the images in the dataset in sequence and then in reverse continuously without stopping at the speed specified in Desired Frames per second.

Figure 133. Image window shown in the Animate view

Pause	Pauses the animation at the frame currently shown.
Stop	Halts the animation and redisplays the first image in the dataset.
Magnify image 2.0X	Magnifies the image by 2.
Magnify image 0.5x	Magnifies the image by one-half.
Set brightness/ contrast	Specifies the brightness and contrast of the image. When you select this icon, the Brightness/Contrast dialog box opens. To change the brightness, slide the Brightness slider to the level desired and then click Apply. To change the contrast, slide the Contrast slider to the level desired and click Apply.
Delete current slice	Removes the slice currently shown in this window from the image dataset. **Caution:** The program does not allow you to undo slice deletion. Before you delete slices, you may want to have a backup of the complete image dataset to avoid losing images.
Frame number	Sets the first image slice shown to the frame, or slice, number that you specify. Notice that the frame number appears in the box to the right of the slider.
Desired frames per second	Specifies how many frames, or slices, should appear in 1 second. The read-only box to the right shows the *actual* number of frames per second your computer has achieved. The number of frames per second depends on the amount of memory accessible by the computer and CPU time.

**Figure 133. Image window shown in the Animate view (continued)**

ADJUSTING DATASET DISPLAY

You can magnify or reduce the display of your dataset using the magnification icons. Use   , the Magnify image 2.0x icon, to enlarge the image to twice its current size.

ADJUSTING THE BRIGHTNESS AND CONTRAST IN IMAGES

To adjust the brightness and contrast in the image, do the following:

1 Click ![icon], the Brightness/Contrast icon, in the Animate window. The Brightness/Contrast dialog box (Figure 30) opens.

2 Move the Brightness slider to the position you want. Notice that the level of brightness changes on the image as you move the slider.

3 Move the Contrast slider to the desired contrast level. The contrast in the image changes as you move the slider.

4 Click Apply when you are finished. The image in the Animate window reflects the changes in brightness and contrast that you made.

5 Click ![icon], the close button at the top right of the dialog box, to close the dialog box.

|		
Brightness	Specifies the level of brightness to apply to the image.	
Contrast	Specifies the level of contrast to apply to the image.	
Apply	Applies the brightness or contrast you specified to the image.	
Cancel	Disregards any changes that you made in this dialog box and closes this dialog box.	
Help	Displays online help for this dialog box.	

Figure 134. Brightness/Contrast dialog box

REMOVING SLICES FROM IMAGE DATASETS

In the Animate window, you can also remove slices from the dataset. First, you need to find the slice that you want to delete. To find a slice number, do either of the following:

- Select Options > Show *Z* Slice Numbers, which shows the slice number at the lower left of the image (refer to Figure 29 on page 40).

- Move the Frame Number slider to the slice that you want to delete. The number appears in the box on the right of the slider.
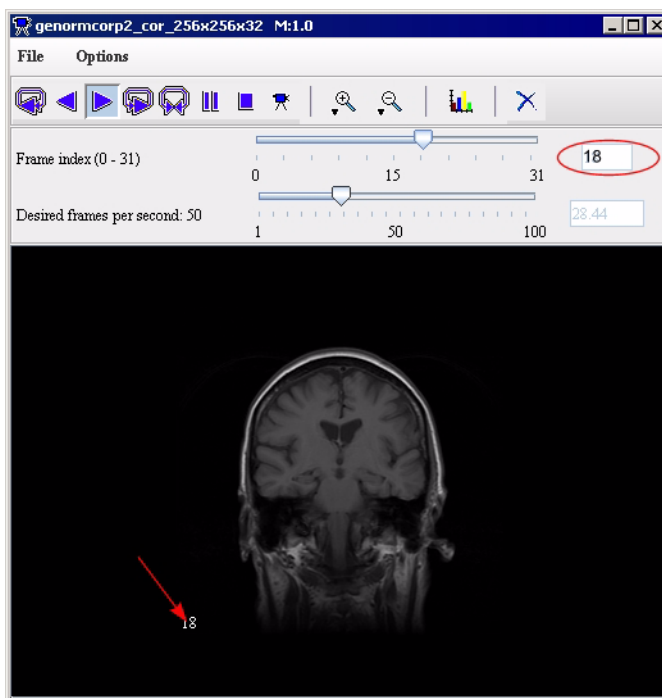
Figure 135. In the Animate dialog box, the slice number appears in the information box beside the Frame Number slider, and the Desired Frames per Second information box shows the actual number of slices per second.

Once you locate the slice that you want to remove, click $\times$, the Delete icon. The slice is removed from the dataset.

Caution: The program does not allow you to undo slice deletion. Before you delete slices, you may want to have a backup of the complete image dataset to avoid losing images.

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PLAYING A DATASET "FILM"

Using the icons and buttons on the toolbar in the Animate window (Figure 29 on page 40), you can produce and play a dataset "film." To do so, complete the following steps:

1 Move the Frame number slider to the slice that you want to see first.

2 Move the Desired frames per second slider to indicate the speed at which images should be advanced or reversed.

3 Click the following buttons as appropriate:

- Click ▶, the Forward icon, to advance the image dataset forward through all of the images one time (one loop).

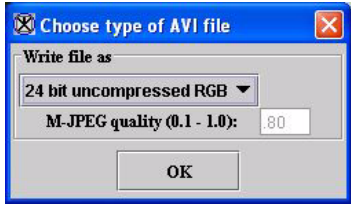- Click ◀, the Reverse icon, to advance the image dataset backward through all of the images one time (one loop).

- Click 🔁, the Continuous Forward icon, to advance the image dataset forward through all of the images multiple times. To stop image advancement, you must press ⏸, the Pause icon, or ⏹, the Stop icon.

- Click 🔁, the Continuous Reverse icon, to advance the image dataset backward through all of the images multiple times. You must press the press ⏸, the Pause icon, or ⏹, the Stop icon, to stop image reversal.

- Click ⏸, the Pause icon, to pause the image advancement or reversal.

- Click ⏹, the Stop icon, to stop the image advancement or reversal.

Note: As the images advance or reverse, you may notice that the desired frames per second and the actual frames per second differ. Although you can type any number in the desired frames per second, the actual speed at which the images advance depends primarily on your computer's processor speed.

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4 Save the animate viewer file by selecting File > Save Image as .avi (AVI, or audio video interleaved, is a Microsoft multimedia format). The Choose Type of AVI File dialog box (Figure 32) opens.

5 Select a type of file.

6 Click OK. The program runs the animation sequence that you created, closes this dialog box, and then displays the Save dialog box.

24-bit uncompressed RGB	An uncompressed RGB file, which uses 8 bits per color (red, green, blue).	
8-bit RLE compressed	A run length encoded (RLE) file that is converted to 8 bits and is compressed.	
Quicktime movie	An Apple format.	
Motion JPEG	A format that consists of motion JPEGs.	
MPEG-4 version 2	Another compression format.	
OK	Plays back the animated sequence that you created and then displays the Save dialog box for you to save the sequence.	
Cancel	Disregards any changes that you made in this dialog box and closes this dialog box.	
Help	Displays online help for this dialog box.	

Figure 136. Choose Type of AVI File dialog box

7 Specify a name for the animation sequence in the File Name box.

8 Click OK. The dialog box closes and the Choose File Type dialog box (Figure 33) opens.
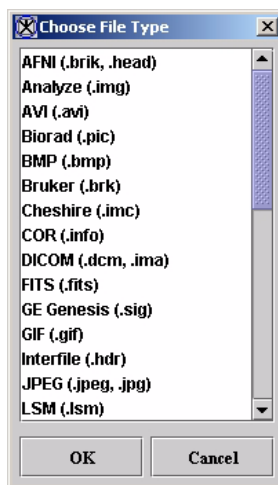
Figure 137. Choose File Type dialog box

 9 Select a file type.

 10 Click OK. The Save Range of Slices dialog box (Figure 34) opens.

 11 Close the Animate window by either selecting File > Close Animate or pressing Ctrl X. The Animate window closes.

Save image to separate files	Saves the animation to separate files. Selecting this check box makes the First file starting number text box and the File name number of digits text box become active.
First file starting number	Indicates which frame, or slice, to begin the first file saved. To make this box active, you must first select Save image to separate files.
File name number of digits	Specifies how may digits you want used for the file name. To make this box active, you must first select Save image to separate files.
First slice	Specifies the first slice that should appear in the animation file.
Last slice	Specifies the last slice that should appear in the animation file.
First time period	Specifies the time period of the images that should start the file. This box only applies to 4D images.
Last time period	Specifies the time period of the images that should end the file. This box only applies to 4D images.
Save with packed bits compression	Indicates that the file should be saved as compressed TIFF files. This check box only applies to 4D images.
OK	Saves the animation according to the specifications in this dialog box and closes the dialog box.
Cancel	Disregards any changes that you made in this dialog box and closes this dialog box.
Help	Displays online help for this dialog box.
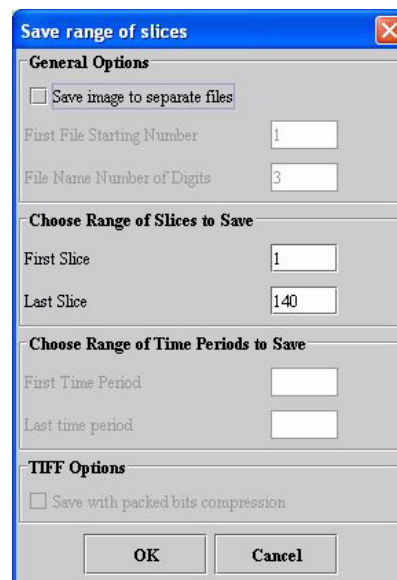
Figure 138. Save Range of Slices dialog box

Displaying images using the cine (movie) view

The *cine* view, like the default view, displays images one at a time in the default image window. However, in cine view, the software automatically advances the images.

To display a 3D or 4D dataset in this view, select Image > Views > Cine

(Movie). The images appear sequentially in the default image window. All images in the dataset are displayed only once. The cine view does not loop images, nor does it show images in reverse order.

Displaying images using the lightbox view

You can use the *lightbox* view to display datasets that have more than two dimensions (2D). Like its real-world counterpart, the lightbox view displays several images, or slices, in the dataset at one time in an image window. Through the lightbox settings, you can easily control the number of slices that appear.

To view an image dataset in lightbox view

1 Open an image dataset that has more than two dimensions. It appears in the image window in default view (Figure 35).

2 Select Image > Views > Lightbox in the MIPAV window. The image window for the lightbox view appears (Figure 35). The image number, or slice number, appears in the lower left corner of each image.

Notice that the image you originally opened in step 1 remains on your desktop. So you not only see the image dataset in the lightbox view, but you also see the image in the default view.

Using the lightbox view to update the image slice displayed in the default view
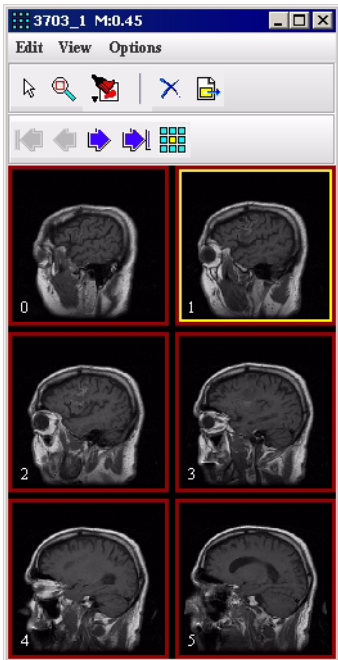
The MIPAV window allows you to step through all of the slices of an image dataset shown in the default view one at a time using the Image slice slider,

, the Decrements image slice icon, and , the Increments image slice icon. However, the default view only shows one slice at a time, but the lightbox view can show two or more slices at one time depending on the lightbox settings (that is, you can control the number of image slices that appear in lightbox view; refer to "Adjusting the lightbox view" on page 50).

Suppose it is easier for you to find a particular slice in the dataset by viewing several slices at the same time in order to compare them against each other. To do so, you would open an image dataset in default view and then display the dataset in lightbox view. The lightbox view displays the number of image slices that you had already specified.

At this point your desktop shows both the image dataset in default view and the dataset in lightbox view. The lightbox view allows you to quickly look through the entire dataset until you locate the correct slice. Once you find it, you may want to perform some actions, such as running algorithms, on that slice. To update the image in the default view to display the slice you located, first select and then right-click the image slice in the lightbox view. The default image window now shows the image slice you found.

Edit	**Select All**—selects all of the slices in the dataset. **Select None**—deselects all of the selected slices. **Invert Selections**— deselects selected slices and select those that were not selected. **Delete**—deletes the selected slices from the dataset. **Extract**—copies the selected slices to a separate image window, which you can save as a separate dataset.	
View	**First Page**—displays the first set* of slices in the dataset. **Previous Page**—displays the previous set* of slices in the dataset. **Next Page**—displays the next set* of slices in the dataset. **Last Page**—displays the last set* of slices in the dataset.	
Options	**Settings**—allows you to change settings for the number of rows and columns used to display images in the dataset, change the grid size and the size of the frame border, change the colors of the borders and frames, and the level of magnification. **Save Settings**—saves the settings currently set in the Lightbox Settings dialog box. **Continuous Update**—updates all of the displayed images when you make a change to one of the images.	
Default mode	Displays the images according to the standard settings used by MIPAV when it is initially installed.	
Magnify region	Magnifies a portion of the image from 1 to 32 times. To change the level of magnification or the size of the magnifier, right-click on the image, and the Magnification dialog box opens.	
Repaints images	Updates the images displayed in the lightbox reflecting the changes made to the lightbox settings and to the dataset.	

Figure 139. Image window showing the lightbox view

*The set of slices depends on the number of slices currently being displayed. For example, if four slices are currently displayed, then View > Previous Page shows the previous set of four slices. If seven slices are currently displayed, then View > Previous Page displays the previous seven slices in the dataset. View > Next Page works similarly. It displays the next set of slices in the dataset.

Delete selected slices	Removes the selected slices from the image dataset.
Extract selected slices to a new image	Makes a copy of the selected slices in the image dataset to a new image window.
First page	Displays the first set* of slices in the dataset.
Previous page	Displays the previous set* of slices in the dataset.
Next page	Displays the next set* of slices in the dataset.
Last page	Displays the last set* of slices in the dataset.
Go to active slice	Displays the currently selected slice.
Go to slice	Specifies which slice you want to display. Type a number in this box and then select Enter to display the slice. The slice then appears in the lightbox view.
Image window	Displays an individual slice in the dataset. To select a slice, click once on the slice. A thin red line appears around the slice inside the border.
Border	Outlines each slice.
Background	Provides the grid for the images in the window.

Figure 139. Image window showing the lightbox view (continued)

*The set of slices depends on the number of slices currently being displayed. For example, if four slices are currently displayed, then View > Previous Page shows the previous set of four slices. If seven slices are currently displayed, then View > Previous Page displays the previous seven slices in the dataset. View > Next Page works similarly. It displays the next set of slices in the dataset.
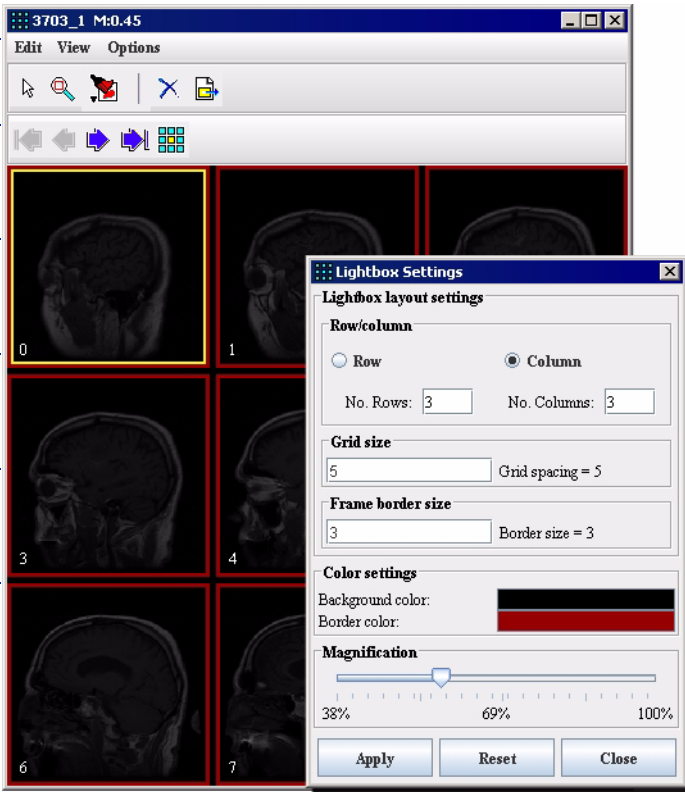
Adjusting the lightbox view

By default, the lightbox view shows only one column of images. Each image in the dataset is surrounded by frame borders and background (Figure 36). However, you can adjust the lightbox view so that you can see several

columns and rows of images at a time (Figure 36) in a grid. You can also adjust the borders and the default magnification level of the images.

To change the grid configuration

1 Select Options > Settings in the image window for the lightbox view. The Lightbox Settings dialog box (Figure 140) appears.

2 Select Row.

3 Type the number of rows you want to appear in No. rows.

4 Select Column.

5 Type the number of columns in No. columns.

Row	Selects the row settings.	
Column	Selects the column settings.	
No. rows	Specifies the number of rows that should exist in the lightbox view.	
No. columns	Specifies the number of columns that should exist in the lightbox view.	
Grid size	Indicates the spacing in pixels used for the grid size.	
Frame border slice	Indicates the spacing in pixels used in the grid.	
Background color	Allows you to choose the color of the background of the lightbox. When you select this icon, the Pick Background Color dialog box opens.	
Border color	Allows you to choose the color of the border that surrounds each image displayed in the lightbox. When you select this icon, the Pick Border Color dialog box opens.	
Magnification	Controls the level of magnification.	
Apply	Applies the parameters that you specified to the lightbox view.	

Figure 140. Lightbox Settings dialog box

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Reset	Returns all of the parameters to their default values.
Close	Closes this dialog box without making changes to the lightbox view. If you changed the parameters in this dialog box, you must first select Apply to put those changes into effect.
Help	Displays online help for this dialog box.

Figure 140. Lightbox Settings dialog box (continued)

6 Click Apply. Notice that the number of rows and columns in the lightbox view changed to the numbers you specified.

7 Continue to make changes to other lightbox settings.

8 Click Close to close the Lightbox Settings dialog box.

9 Click Options > Save Settings to save the settings as the default number of rows or columns for the next time you display the lightbox view.

To change the grid size

1 Select Options > Settings in the image window for the lightbox view. The Lightbox Settings dialog box (Figure 37) appears.

**2** Type a number from 0 to 20 in Grid size (Figure 38).

**Note:** On the right of the Grid size text box, Grid spacing shows the current grid size.

Figure 141. Grid size box

3 Click Apply. Notice that the grid size in the lightbox view changed to the size that you specified.

4 Continue to make changes to other lightbox settings, or click Close to close the Lightbox Settings dialog box. The image window for the lightbox view appears.

5 Click Options > Save Settings (Figure 39) to save the settings as the grid size for the next time you display the lightbox view.
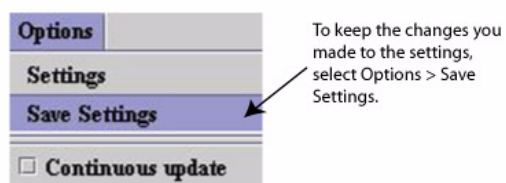
Figure 142. Save Settings command on the Options menu in the Lightbox Settings dialog box
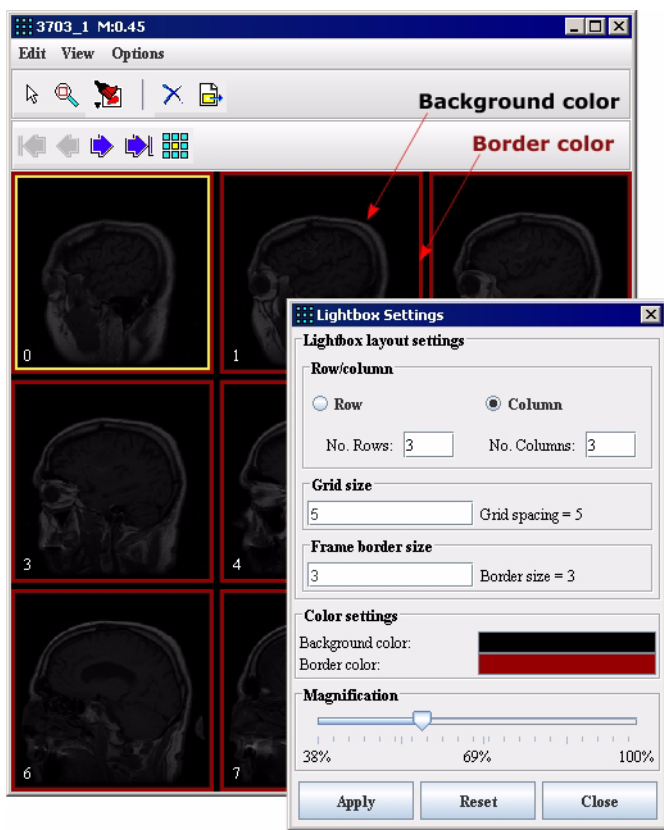
Figure 143. Grid and frame border

To change the border size

1 Select Options > Settings in the image window for the lightbox view. The Lightbox Settings dialog box (Figure 37 on page 51) appears.

2 Type a number from 0 to 10 in Frame border size (Figure 41). The unit of measurement for the number is in pixels.
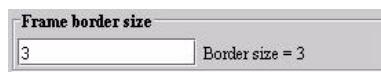

Figure 144. Frame border size box

3 Click Apply. On the right of Frame border size, Border size changed to the size you specified.

4 Continue to make changes to other lightbox settings, or click Close to close the Lightbox Settings dialog box.

5 Click Options > Save Settings to save the settings as the default border size for the next time you display the lightbox view.

To change background and border colors

1 Select Options > Settings in the image window containing the lightbox view. The Lightbox Settings dialog box (Figure 37 on page 51) appears.

Notice that Background color displays the color of the current grid border, and Border Color shows the color of the current frame border.

2 Click the background color bar (Figure 42).

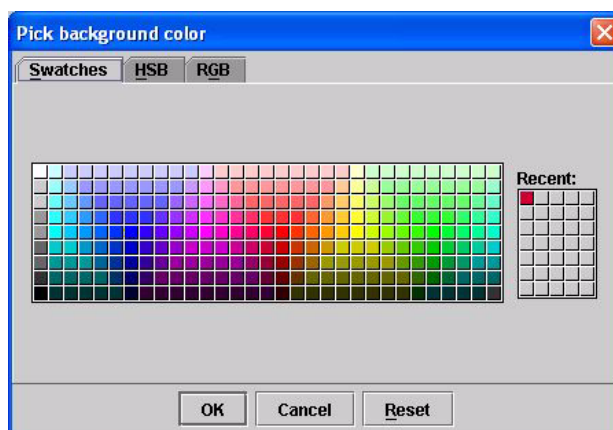The Pick Background Color dialog box (Figure 43) opens.
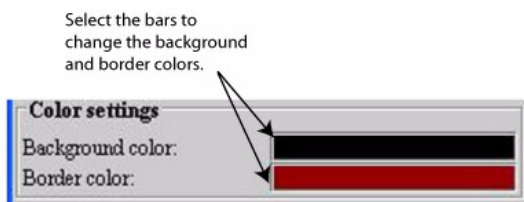
Figure 145. Background color and border color bars

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This dialog box includes three tabbed pages:

- Swatches page (Figure 43), which, by default, is always displayed first
- HSB page (Figure 43)
- RGB page (Figure 43)

You can change the color of the background on any of these pages

Figure 146. Swatches page in the Pick Background Color dialog box

3 Select a color from the Swatches, HSB, or RGB page. (For instructions on how to select colors, refer to "Manually creating a mask using paint" on page 332 in Chapter 6, "Segmenting Images Using Contours and Masks").
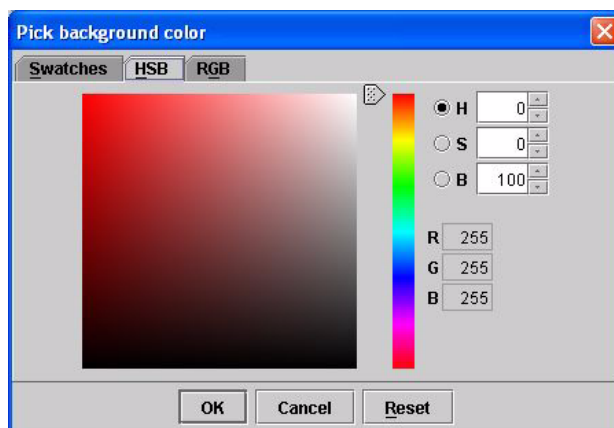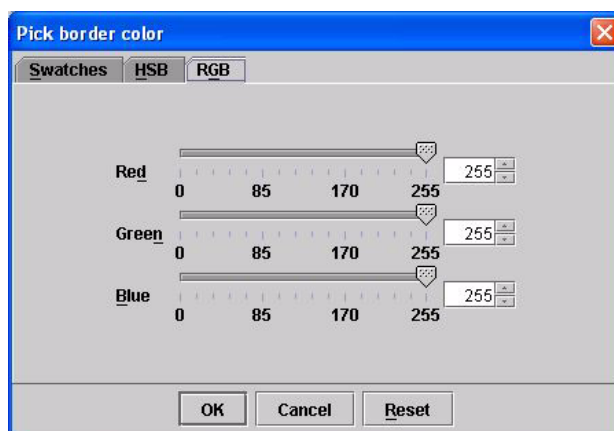
Figure 147. HSB page in the Pick Background Color dialog box

4 Click OK to apply the color to the background or border.

The Pick a Background Color dialog box closes, and the Lightbox Settings dialog box appears.

5 Click Apply.

Notice that the color of the background or border colors in the lightbox view changed to the colors you specified.
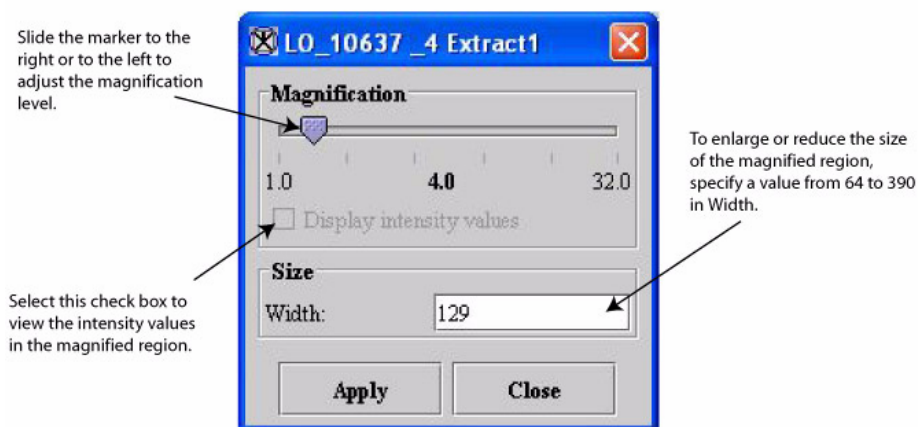

Figure 148. RGB page in the Pick Background Color dialog box

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6 Continue to make changes to other lightbox settings, or click Close to close the Lightbox Settings dialog box.

7 Click Options > Save Settings in the lightbox view to save the settings as the default background and border colors for the next time you display the lightbox view.

To change the default magnification level for one slice in the dataset

1 Click 🔍.

2 Right-click on the image. The Magnification dialog box (Figure 46) opens.

3 Change the magnification level by sliding the marker on the Magnification slider to the level you want.

4 Select Display intensity values if you would prefer to see the intensity values in the magnified region rather than the magnified image.

Slide the marker to the right or to the left to adjust the magnification level.

To enlarge or reduce the size of the magnified region, specify a value from 64 to 390 in Width.

Select this check box to view the intensity values in the magnified region.

Figure 149. Magnification dialog box

5 Type a number from 64 to 390 to enlarge or reduce the size of the magnified region.

6 Click Apply. The settings specified in the Magnification dialog box take effect immediately and only for that one image, or slice.

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To enlarge or reduce the size of all images

1 Select Options > Settings in the image window containing the lightbox view. The Lightbox Settings dialog box opens (Figure 37 on page 51).

2 Select the level of magnification by moving the slider right or left to the appropriate value.

3 Click Apply. Notice that the image magnification changed to the magnification you specified.

4 Continue to make changes to other lightbox settings, or click Close to close the Lightbox Settings dialog box.

5 Click Options > Save Settings in the lightbox view to save the settings as the default magnification for the next time you display the lightbox view.

Tip: To return to the original settings for the lightbox view, click Reset in the Lightbox Settings dialog box.

In the example shown in Figure 47, the researcher changed the original lightbox view (Figure 47A) in several ways. The number of rows was increased from two to four and the number of images in each row from two to three. The frame border color was changed from yellow to gray and the grid color from blue to black. Also the magnification level of the images was reduced to 38 percent of the original image size. Figure 47B shows the final lightbox view.

Repainting (updating) the lightbox

You can simultaneously display the same dataset in different views on your desktop. For example, you can display the dataset in default view and in lightbox view. If you perform an action on the dataset that is visualized in default view, such as contour a structure, you can update the dataset display so that the contours also appear in lightbox view. You can do this automatically or manually.

To automatically update the dataset in the image window

Select Options > Continuous Update in the lightbox view. The dataset is refreshed whenever a change occurs in the default image window.

Caution: Although this option is convenient, it may slow software response time if you are working with a large dataset.

To manually update the dataset in the image window

Click [icon], the Repaint icon, from the toolbar in the lightbox view.

To close the Lightbox window

Click [X] in the upper right corner of the Lightbox window. A confirmation message (Figure 48) appears. To close the window, click Yes and the Lightbox window closes. If you change your mind about leaving the lightbox view, click No.
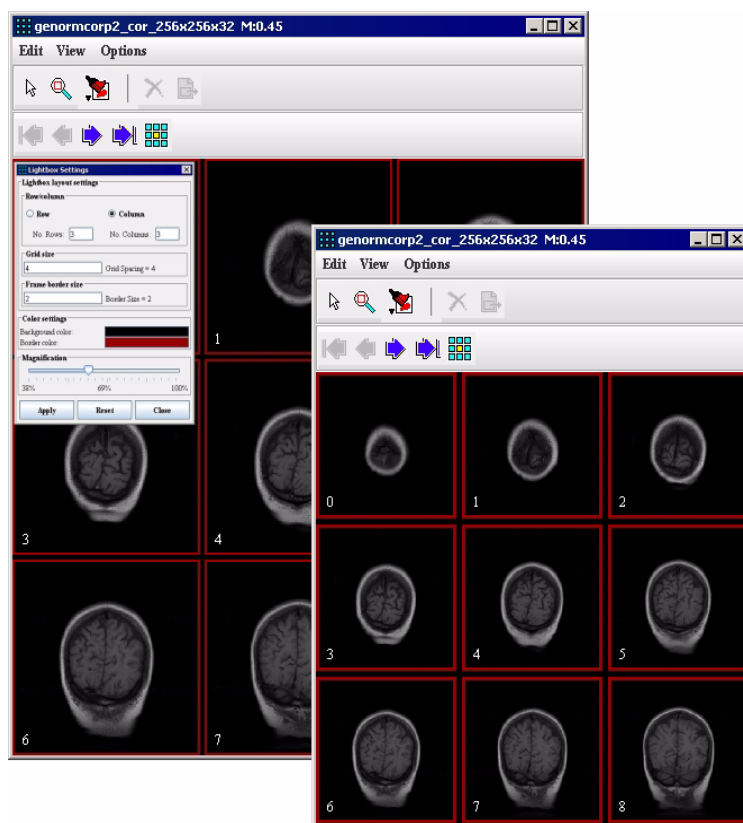
(A) original lightbox view (image on the left) and (B) changed lightbox view (image on the right)

Figure 150. Some of the display options available in lightbox view:

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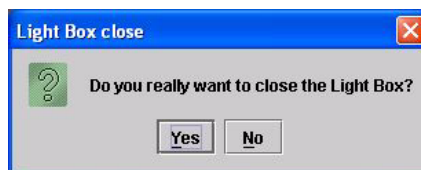
Figure 151. Lightbox Close message

Displaying images using the link to another image view

At times you may want to compare two images slice by slice side by side. Linking one image to another allows you to make this type of detailed comparison.

To compare images side by side

1 Open the two images you want to compare.

2 Select one of the images. This image becomes known as Image A, and the second image becomes known as Image B.

3 Select Image > Views > Link to Another Image. The Image Frame Linker dialog box opens.

4 Select the name of the second image, or Image B, in the Image B box.

5 Click Link. MIPAV immediately connects the images.

6 Move the Image slice slider in the MIPAV window. Notice that the image slices change on both images so that Image B shows the exact same slice as shown on Image A.

Tip: Select Image B, and move the Image slice slider. Although the slices change in Image B, they do **not** change in Image A. The reason is that only Image A controls the simultaneous movement of slices for both images. Therefore, when you select an image to be Image A, make sure that the image is the one you want to control the movement of both images.

Image A	Indicates the name of the Image A file. This field is a read-only field.	
Image B	Allows you to choose the open image that you want to use as Image B.	
Link	Links the two image files.	
Cancel	Disregards any changes you made in this dialog box, closes the dialog box, and does not link the images.	
Help	Displays online help for this dialog box.	
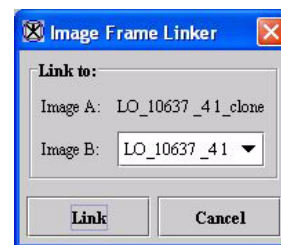
Figure 152. Image Frame Linker dialog box

Displaying images using the triplanar view

The *triplanar* view allows you to see three orthogonal planes of 3D or 4D datasets. The three orthogonal views enhance the visualization of important aspects of the anatomy and, in some cases, aids some manual segmentation processes.

Displaying image datasets in triplanar view

To view an image dataset in triplanar view, open an image and then select Image > View > Triplanar in the MIPAV window. The triplanar view (Figure 50 on page 62) appears in an image window.
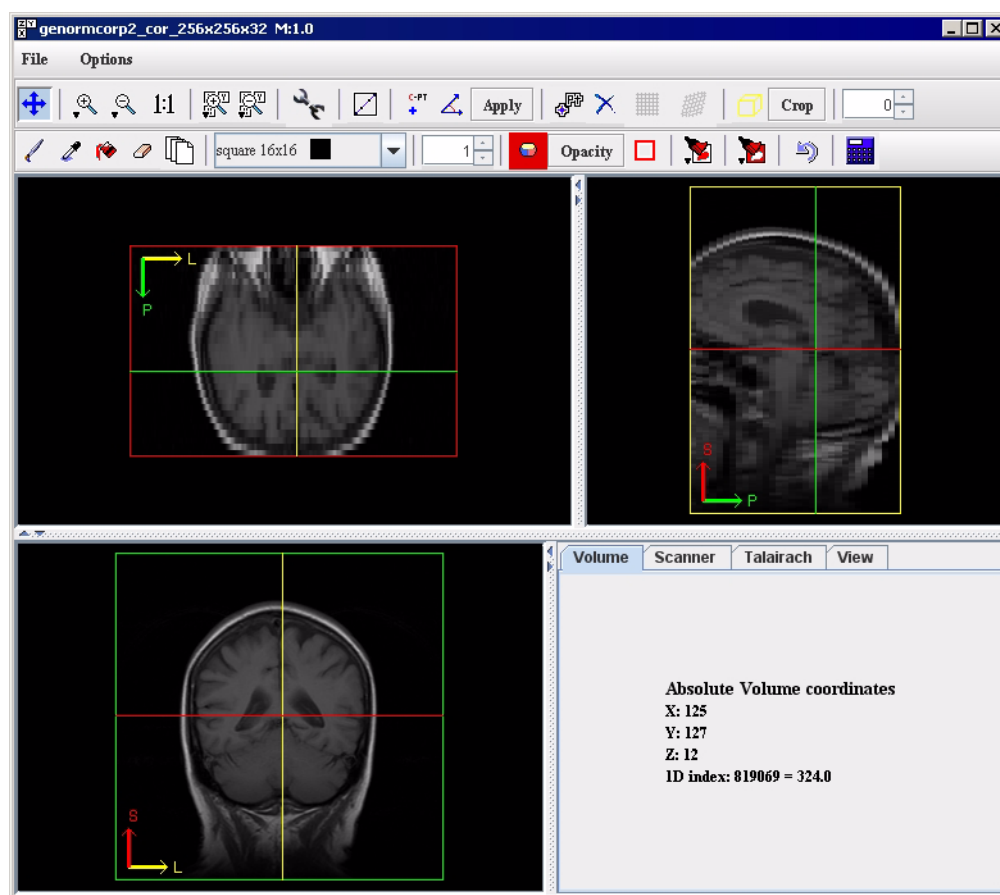
The image window for the triplanar view includes a File menu, an Options menu, a toolbar, and three views of the dataset. The bottom right corner of the window displays the currently selected coordinate. Two guidelines (cross hairs) also intersect at the selected point. Additionally, the axis appears in the upper left corner in each view of the dataset.

You can use icons and buttons on the toolbar to change the magnification level, draw a point or line, apply paint, and apply a new intensity values to selected voxels in the image.

Designating new center points for image datasets

You can designate a new center point for the dataset. To do this, complete the following steps:

1 Click [icon], the Volume Center icon, to display the center of a volume. The cross hairs intersect where the center of the volume has been calculated.

2 Drag the cross hairs to the point that you want to designate as the new center.

3 Release the mouse button.

4 Click Apply. The Apply Transformation Matrix dialog box (Figure 51 on page 65) opens.

5 Complete the dialog box.

Figure 153. Image window showing the triplanar view

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File	Close frame—Closes this window.
Options	Show Axes—Displays the *XY* (top left), *ZY* (top right), and *ZX* (bottom left) axes on the images.
	Show Cross Hairs—Displays cross-hair lines on the images. When you move these lines on one image, it also moves to the corresponding points on the other two images. Notice that the Absolute and Position values at the bottom right of the screen also change when you move the cross hairs.
	Show Talairach Grid—Displays a Talairach (stereo tactic) grid on the images.
	Show Talairach Position—Lists the Talairach position.
	Link to Another TriImage—Links this image to another image in triplanar view.
⊕ Traverse image	Aligns two images.
⊕ Magnify	Magnifies the image. It might be necessary to manually resize the window and use scroll bars to view all of the image.
⊖ Minify	Minifies the image (reduces the magnification level).
1:1 Original magnification	Displays image at the original magnification level.
C-PT Volume center	Reassigns a new center to the dataset. The location that you select appears in the center of the image window.
∠ Alignment tool	Allows you to apply a transformation matrix to an image dataset.
Apply	Applies the rotations and translations made to the image.
PT Point	Draws a point on an image.
NEW New Contour	Assigns the subsequently drawn contour to a new group. If this icon is not selected, all subsequent contours are assigned to the existing group.

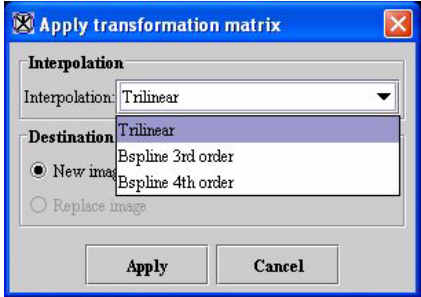**Figure 153. Image window showing the triplanar view (continued)**

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Delete	Deletes a single contour or a group of contours. **Caution:** When you select this icon, the contour is not copied to the clipboard. It is permanently deleted.
Crop Volume	Indicates the volume that should be cropped.
Crop	Crops the specified volume.
Paint Brush	Selects paint brush tool. You can use the paint brush to fill specific voxels with color.
Eyedropper	Changes the default intensity to the one sampled by the eyedropper. Click this icon, then move the pointer to the image. The sampled intensity becomes the default intensity.
Paint Grow	Applies the paint grow segmentation method. This method uses voxel aggregation to group voxels into larger regions. The effect is much like a fill operation; when you click a voxel, this algorithm is used to determine whether adjacent voxels should be filled with the default color or intensity.
Erase	Deletes painted sections of the image. To delete, click the icon and move the pointer on painted areas of the image.
Global Erase	Deletes all paint from the image.
Small Tip	Used with the paint brush and erase icons. Click this icon to indicate the size of the eraser or the paint brush tip. Click this icon to paint or erase one voxel each time the mouse button is clicked.
Medium Tip	Used with the paint brush and erase icons. Click this icon to indicate the size of the eraser or the paint brush tip. Click this icon to paint or erase 16 voxels (4 x 4 square) each time the mouse button is clicked.
Large Tip	Used with the paint brush and erase icons. Click this icon to indicate the size of the eraser or the paint brush tip. Click this icon to paint or erase 100 voxels (10 x 10 square) each time the mouse button is clicked.
Paint Intensity	Indicates the intensity value.
Change Paint Color	Changes the color of the paint used. This icon is often used in conjunction with the Paint Brush and Paint Grow icons. Click this icon and select the desired color from the window that appears.

Figure 153. Image window showing the triplanar view (continued)

Opacity **Opacity**	Indicates the opacity level of the paint. When this icon is clicked, a window appears that allows you to indicate the opacity of the paint: 0 is transparent, 1 is opaque. By default the paint is translucent (0.3), which allows you to see the original image under the paint.
Commit **Commit**	Permanently applies intensity level to the image.

Figure 153. Image window showing the triplanar view (continued)

6 Click Apply. A progress message appears as the image is transformed. In a few moments, the new image either appears in a new window or replaces the image in the current window depending on your choice.

7 Select [C-PT] again. Notice that the image center was moved to the center you designated.

|	
Interpolation	Determines the intensity of the additional voxels using one of the three following methods: **Bilinear—**Weighs the average of the four nearest voxels (to the newly interpolated voxel). The interpolated voxel is assigned the resulting intensity. **Bspline 3rd order—**Weighs the average of the 27 nearest voxels (to the newly interpolated voxel). **Bspline 4th order—**Weighs the average of the 64 nearest voxels (to the newly interpolated voxel).
New image	Indicates where the results of the transformation appear. If you select this option, the transformed image appears in a new image window.
Replace image	Indicates where the results of the transformation appear. If you select this option, the transformed image replaces the current active image.
Apply	Applies the transformation to the image dataset according to the specifications in this dialog box.
Cancel	Disregards any changes that you made in this dialog box and closes this dialog box.
Help	Displays online help for this dialog box.

Figure 154. Apply Transformation dialog box showing choices in the Interpolation list

Aligning image datasets

You can use $\angle$, the Alignment Tool icon, to create a new transformation matrix for the dataset (refer to Figure 52).

The following instructions explain how to use the alignment tool:

1 Click $\angle$. A closed angle, which looks like a line that is slightly thicker on one end, appears on each of the three images displayed in triplanar view.

2 Click the angle. Arrows appear at the end of each ray. The measurement of the angle appears beneath the angle.
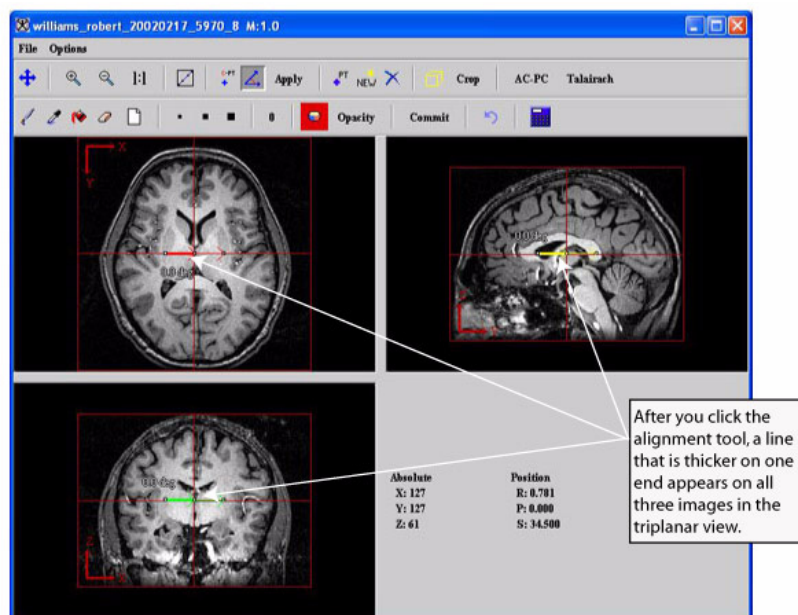
Figure 155. Using the alignment tool in triplanar view

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3 Open the angle. The angle degree indicates the direction and distance to rotate the image. You can open the angle with or without constraints. (If an angle is opened with constraints, it only opens in 90-degree increments.) Do the following:

- *To open the angle in 90-degree increments:* Position the pointer over the shorter ray of the angle. The pointer changes to a cross-hair shape. (The cross-hair pointer looks much like a plus sign.) Drag the shorter ray to the desired location. The new angle measurement appears below the angle.

- *To open an angle without constraints:* Position the pointer over the longer ray of the angle. The pointer changes to a cross-hair shape. The cross-hair pointer looks much like a plus sign. Drag the longer ray to the desired location. The new angle measurement appears below the angle.

4 Click Apply. The Apply Transformation Matrix dialog box (Figure 51 on page 65) appears.

5 Complete the dialog box.

6 Click Apply.

A progress message appears as the image is transformed. In a few moments, depending on your choice in the dialog box, the new image either appears in a new window or replaces the image in the current window.

7 Click ⊕, the Traverse Image icon, to return the cursor to normal mode.

Creating, modifying, and deleting point VOIs

You can create, modify, and delete a point VOI. For more information on how to do this, see Chapter 7.

Cropping images

To crop an image, complete the following steps:

1 In an image window that is displaying the image dataset in triplanar

view, click [icon], the Crop Volume tool.

2 Draw a rectangle around the area of the image that you want to remain. The area outside of the rectangle will be cropped.

3 Click **Crop**. A confirmation box appears.

4 Click Apply. The cropped area appears in a separate window.

Changing the intensity

For information on how to change the intensity of a portion of the image, refer to "To change the number of intensities displayed in the LUT" on page 29 and "To invert intensities" on page 31. In addition, refer to "Generating masks" on page 196.

Displaying images using the triplanar-dual view

The *triplanar-dual view* displays two image datasets (referred to as Image A and Image B) and a blended version of both Image A and Image B from three orthogonal planes.

To view image datasets using this view

1 Open two 3D or 4D images, which become known as Image A and Image B.

2 Load Image B into Image A.

3 Select Image > Views > Triplanar-Dual. The triplanar-dual view appears in an image window.
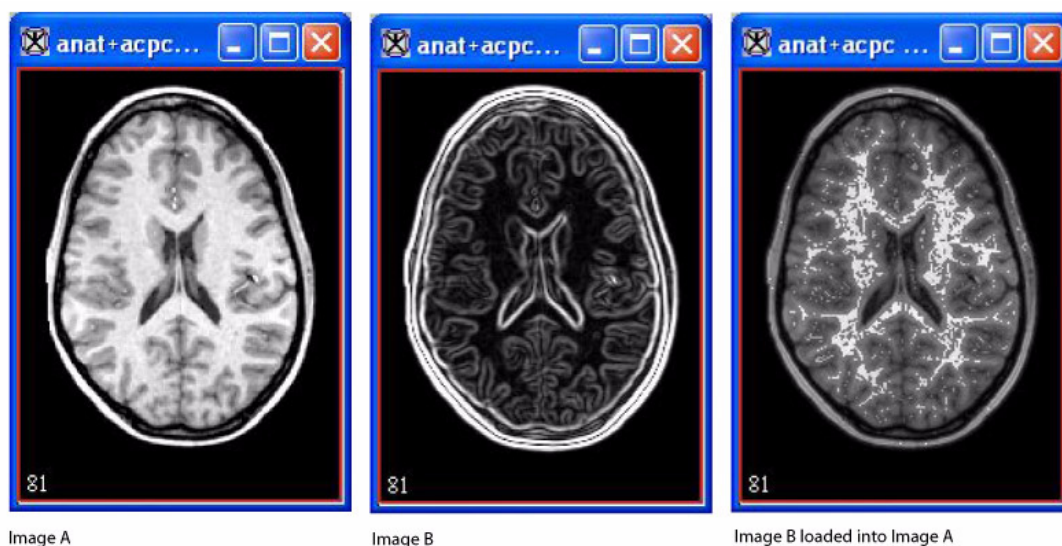
Figure 156. Image A, Image B, and Image B loaded into Image A

The image window for the triplanar-dual view is quite similar to the image window for the triplanar view. The File and Options menus contain the same commands except for one command—the Options menu for the triplanar view contains the command Link to Another TriImage. Since the triplanar-dual view shows two datasets in the image window and allows you to manipulate them together, linking to another image is not necessary. Most of the icons and buttons on the toolbars for both views are the same with one primary difference: The triplanar-dual view allows you to create VOIs on the images; the triplanar view does not.

Like the triplanar view, you can use the icons and buttons on the toolbar to change magnification, draw, change colors, change opacity, and apply a new intensity to selected voxels in the images.

Showing and hiding axes, cross hairs, and Talairach grid

By default, the triplanar-dual view automatically shows the axes and cross hairs on Image A, Image B, and the blended dataset.

To show or hide axes on images

To hide the axes, select Options > Show Axes (Figure 54). The check mark disappears from the check box in front of the command on the menu, and the axes disappear from all of the images.

Figure 157. Show Axes command on the Options menu in the Triplanar-Dual window

To display the axes on the images again, simply select Options > Show Axes. The check mark reappears in the check box in front of the command.

To show or hide cross hairs

Showing or hiding cross hairs works just as showing or hiding axes. To hide the cross hairs, select Options > Show Cross Hairs. To show them, select Options > Show Cross Hairs again.

To show or hide the Talairach grid

By default, the Talairach grid does not automatically display on the images unless you specifically select it to do so. To show the grid, select Options > Show Talairach Grid. The grid appears on all of the images shown in the triplanar-dual view. When you want to hide the grid, select Options > Show Talairach Grid again.

Creating VOIs on images

You can create point or line VOIs on the images.

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To create point VOIs

1 Click ⬚.

2 Click in the image where you want to create a point.

3 Repeat steps 1 and 2 for all other desired points.

To draw line VOIs

1 Click ⬚.

2 Click in the image where the line should begin and drag the line to where it should end.

The numbers beneath the line indicate the length of the line in millimeters.

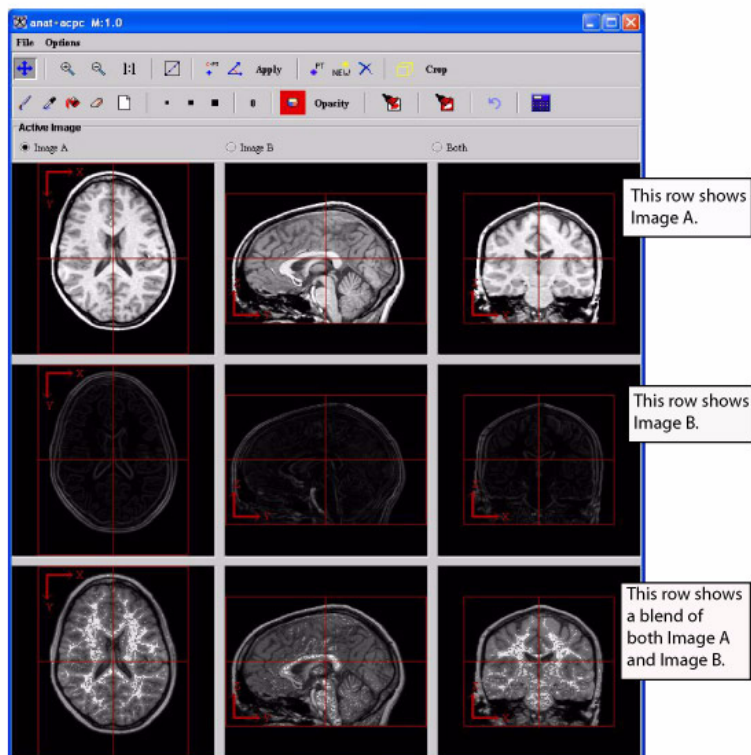To change the line VOI, simply click on the VOI and then drag it to another position in the image.

Note: You can only create one line VOI per orthogonal plane, although you can create a line VOI in each one of the three orthogonal planes.

To delete line VOIs

You cannot delete a line VOI. However, you can remove the display of the

line VOI on the image. To do so, click ⬚. The line VOI disappears.
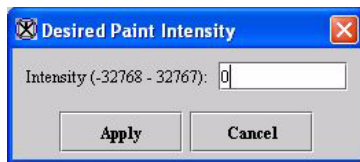
File	**Close Frame**—Closes this window.
Options	**Show Axes**—Displays the *XY* (top left), *ZY* (top right), and *ZX* (bottom left) axes on the images.
	Show Cross Hairs—Displays the cross-hair lines on the images. When you move these lines on one image, it also moves to the corresponding points all of the other images.
	Show Talairach Grid—Displays a Talairach (stereo tactic) grid on the images.
Traverse image	Aligns two images.
Magnify image 2.0x	Enlarges the images to twice their current size. It might be necessary to manually resize the window and use scroll bars to view all of the images.

Figure 158. Triplanar-Dual window
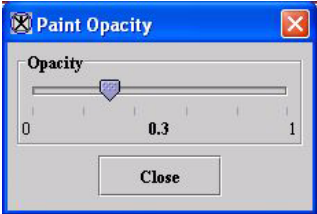
Magnify image 0.5x	Reduces the images to half of their current size.
Magnify image 1.0x	Restores the images to their original size.
Draw line VOI	Draw a line VOI.
Identify center of volume	Reassigns a new center to each dataset. The location that you select appears in the center of each image.
Alignment tool	Allows you to apply a transformation matrix to an image dataset.
Applies rotations and translations	Applies the rotations and translations made to the images.
Add point	Draws a point on an image. This point is only on the image you select.
Initiate new VOI	Indicates that the next VOI is a new VOI rather than a change to the currently existing VOI.
Delete point VOI	Removes the point VOI from the image.
Identify crop volume	Displays the bounding box, which is outlined in red, on each image.
Crops image delineated by the bounding cube	Displays in a separate image window only the area enclosed by the bounding box. When you click this icon, the Crop Image dialog box opens.
Draw using a brush	Allows you to draw with a brush on the image.

Figure 158. Triplanar-Dual window (continued)

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Picks up a color from the image	Changes the color of the paint used to the color selected on the image.
Fills an area with desired color	Allows you to fill an area with color. When you select this icon, the Paint Grow dialog box opens.
Erases a portion of the image	Removes the paint from the specific spot that you select.
Erase all paint	Removes all paint from all of the images.
Draw using small size	Indicates the size of the paint brush tip. Click this icon to paint one voxel each time the mouse button is clicked.
Draw using medium size	Indicates the size of the paint brush tip. Click this icon to paint 16 voxels (4 x 4 square) each time the mouse button is clicked.
Draw using large size	Indicates the size of the paint brush tip. Click this icon to pain 100 voxels (10 x 10 square) each time the mouse button is clicked.
Change intensity level of paint	Allows you to change the intensity value of the paint. When you click this icon, the Desired Paint Intensity dialog box opens. You can specify an intensity between -32,768 and 32,767. After you type an intensity level, the icon displays the level you entered.
Change paint color	Changes the color of the paint used. This icon is often used in conjunction with the Draw icons. When you click this icon, the Pick Paint Color dialog box opens. After you change the color, this icon displays the color.

Figure 158. Triplanar-Dual window (continued)

Opacity Opacity	Allows you to change the opacity of the paint. When you click this icon, the Paint Opacity dialog box opens.
Commit Changes image where painted	Permanently applies the intensity level to the images.
↺ Undo last region paint	Removes paint from the last area to which it was applied.
🖩 Calculate volume of paint	Determines the volume, or number of pixels, in the painted area of the image.
⦿ Image A Image A	Performs the action only on Image A.
◯ Image B Image B	Performs the action only on Image B.
◯ Both Both	Performs the action on both Image A and Image B.

Figure 158. Triplanar-Dual window (continued)

To delete point VOIs

1 Click the first point on the image aligning the middle of the cursor with the center of the point.

2 Click ✕ . The point disappears.

3 Repeat the first two steps for every point you want to delete.

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Aligning the datasets

The Alignment Tool icon, ⊿, allows you to create a new transformation matrix for the dataset.

1 Click ⊿.

A closed angle appears on each of the images in the triplanar-dual view. On Image A, the angle is red; on Image B, it's yellow; on the blended image, the angle is green.

2 Move the cursor to the arrow on the thin line to the right, and align the cursor with the end of the arrow. At this time, the cursor should be a red cross.

Arrows at the end of the two lines in the closed angle.

Degrees of the angle appear under the left side of the angle.

0.0 deg
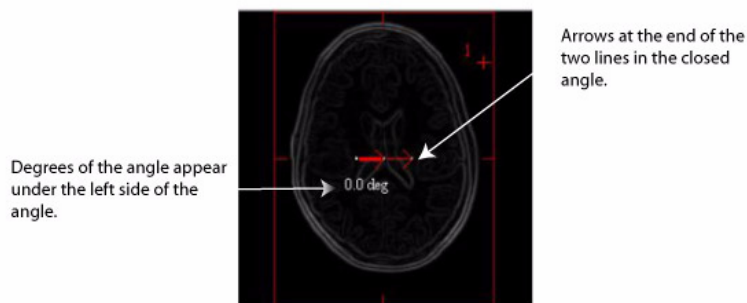
Figure 159. Closed angle that appears on each of the images

3 Change the size of the angle by dragging the arrow on the thin line up or down depending on the type of angle you want to create. The exact number of degrees appear on the left below the angle.

4 Release the mouse button when you reach the desired number of degrees.

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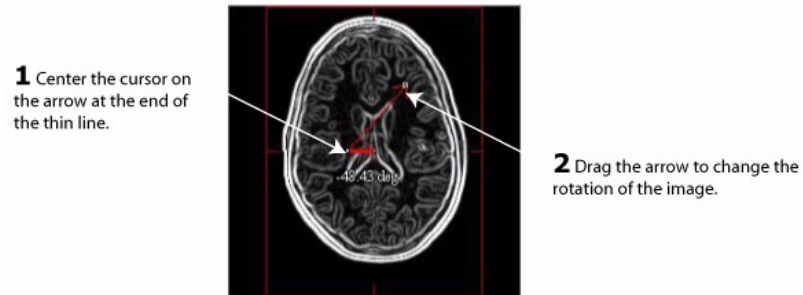
Figure 160. Changing the angle by dragging the arrow on the thin line

5 Click on the image or on any other area of the triplanar-dual view. The arrows disappear from the angle.

6 Click on the angle again to be able to change the angle again. The arrows reappear and you can repeat the previous steps.

Finding the center of image datasets

To find the center of the dataset, click . The center of each image dataset, shown as , appears in each image in the triplanar-dual view.

Erasing part or all of drawings

If you used the paint brush to draw on the image, you may at times find a need to erase a part of the drawing or the entire drawing.

Caution: Make sure that you want to erase a part of the drawing or the entire drawing. There is no undo.

To erase a part of the drawing

1 Select the image that contains the drawing you want to erase. In other words, select Image A, Image B, or Both.

2 Click .

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3 Click on the part of the drawing that you want to erase.

4 Repeat step 3 for as long as needed.

To erase all of the drawing

1 Select the image that contains the drawing you want to erase. Specifically, select Image A, Image B, or Both.

2 Click [ ]. MIPAV removes all of the paint from the image.

Cropping images

MIPAV allows you to extract the crop volume as a separate image, which is helpful if you need to work with or use only that portion of the image. The first step in cropping images is to identify what portion of the image is in the crop volume. Then you need to use the bounding cube for cropping the image.

To select the crop volume

1 Click [ ]. A red box appears on each image in the triplanar-dual view.

2 Align the cursor with one of the corner points of the box, and enlarge or reduce the size of the box.

3 Repeat the previous step on each corner point as required to enclose the portion of the image you want to be included in the cropped image.

The numbers on the sides of the box indicate the length and width of the box in millimeters.

Note: The size of the box changes proportionally on all of the images shown in the triplanar-dual view.

4 Release the mouse button when you are finished making changes to the box.

To crop images

1 Select one of the following:

- Image A if you want only the cropped area in Image A

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- Image B if you want only the cropped area in Image B

- Both if you want both the cropped area in Image A and the cropped area in Image B

2 Click [Crop] . The Crop Image dialog box appears.

Apply	Applies the transformation to the image dataset according to the specifications in this dialog box.	
Cancel	Disregards any changes that you made in this dialog box and closes this dialog box.	
Help	Displays online help for this dialog box.	

Figure 161. Crop Image dialog box

3 Click Apply.

The cropped area in the image you selected appears in a separate image window. So, if you selected Image A only or Image B only, one image appears. If you selected Both, two image windows appear: one for Image A and one for Image B.

If you selected . . .	Then . . .
Image A	The cropped area appears in a separate window.
Image B	The cropped area appears in a separate window.
Both	Two small windows—one displaying the cropped area of Image A and the other displaying the cropped area of Image B—appear.

After you generate the cropped images, you can run algorithms on the images, apply a quick LUT on the images, or use any other image processing that's available in the MIPAV window on them.

Magnifying or minifying images

Like the image toolbar on the MIPAV window, the Triplanar-Dual window includes the following magnification icons:

- , **the Magnify image 2.0x icon**—To magnify images to twice their current size

- , **the Magnify image 0.5x icon**—To reduce images to half their current size

- , **the Magnify image 1.0x** —To restore their original size

For information on how to use these icons, refer to "magnify or reduce a region of the image. You can magnify images to 32 times their original size, reduce them to one-fourth their original size, or restore them to their original size." on page 13.

Drawing on images

You draw on images in the triplanar-dual view in the same way as you do in the MIPAV window. However, any of the changes you make on the triplanar-dual view are also made on the original images.

For example, if you highlight a particular area in the image in the triplanar-dual view, the same change is made on all of the images in the triplanar-dual view, but also on the images in the default view.

To change the paint color

Click , the Change Paint Color icon. The Pick Paint Color dialog box (Figure 43 on page 54) opens. For instructions on how to use this dialog box to change the paint color, refer to "To change background and border colors" on page 54.
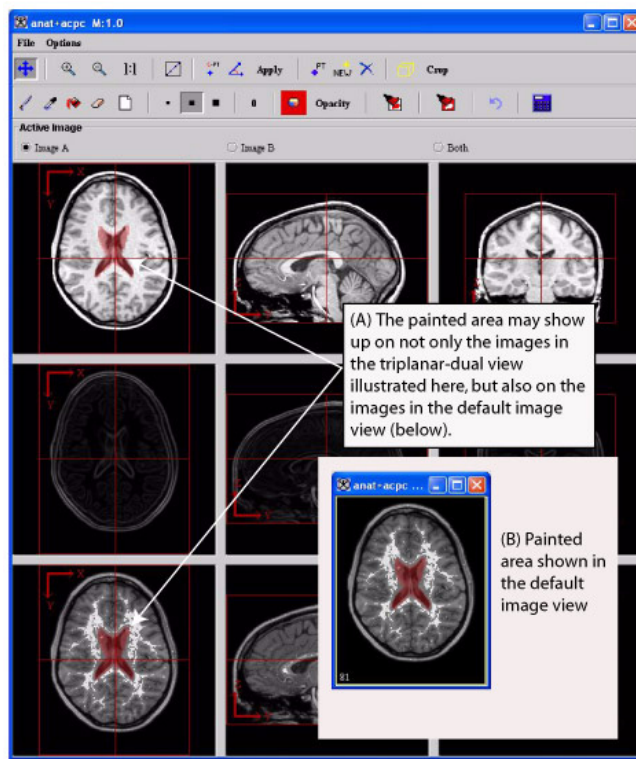
Painting an area on images in the triplanar-dual view affects images in the default image view

Figure 162. Painting an area on images in the triplanar-dual view

To change paint opacity

1 Click [Opacity]. The Paint Opacity dialog box opens.

2 Move the Opacity slider to the level of opaqueness you want. For example, to make the paint color more opaque, or solid, move the slider to the right. To make the paint color more transparent, move the slider to the left.

3 Click Close when you have finished. The Paint Opacity dialog box (Figure 60) closes.

Opacity	Indicates the opacity of the paint. The further right you move the slider, the more opaque the paint color. The further left you move the slider, the more transparent the paint color.	
Close	Closes this dialog box.	
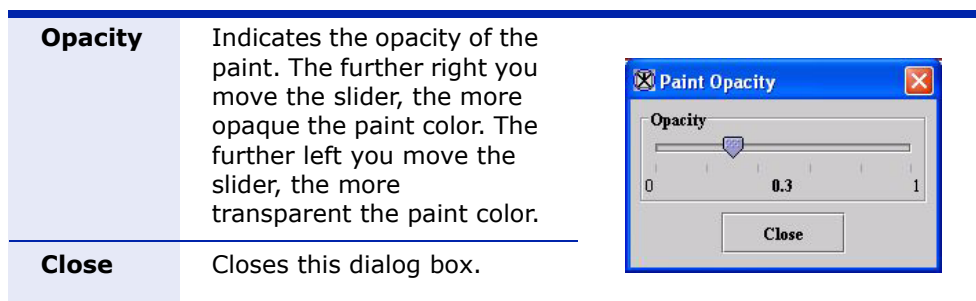
Figure 163. Paint Opacity dialog box

To calculate the volume of paint

The software can calculate the volume of a painted area in the number of pixels. To do so, do the following:

1 Paint the area of the image in which you are interested.

2 Click [icon] to discover the volume of paint. The software lists the number of pixels in each image and the volume in millimeters on the Data page of the Output window.

3 Amend and save, as an option, the information on the Data page.
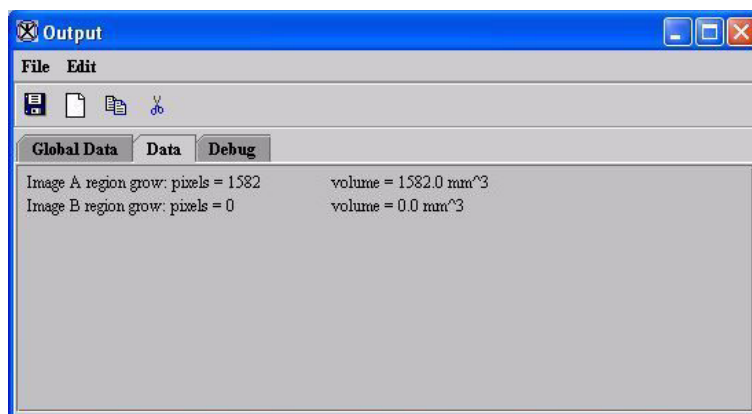
Figure 164. Output window after calculating the volume of paint

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To fill an area with color

1 Click [icon]. The Paint Grow dialog box opens.

2 Complete the dialog box.

3 Click Close.

|		
Cursor position and voxel intensity	Indicates the location of the cursor and the intensity value at that point	
Delta above selected voxel intensity	Indicates the range of paint beyond	
Delta below selected voxel intensity	Indicates the range of paint	
Unrestricted size	Limits the total volume in 3D or 4D images or area in 2D images	
Maximum size (null)	In development.	
Unrestricted distance	Limits the distance from the seed point	
Maximum size (null)	In development.	
Fuzzy connectedness	Applies the fuzzy algorithm	
Initial variance from selected VOI	In development.	
Display fuzzy image	In development.	
Fuzzy threshold	In development.	
Close	Applies the parameters you specified	
Cancel	Disregards any changes that you made in this dialog box and closes the dialog box	
Help	Displays online help for this dialog box	
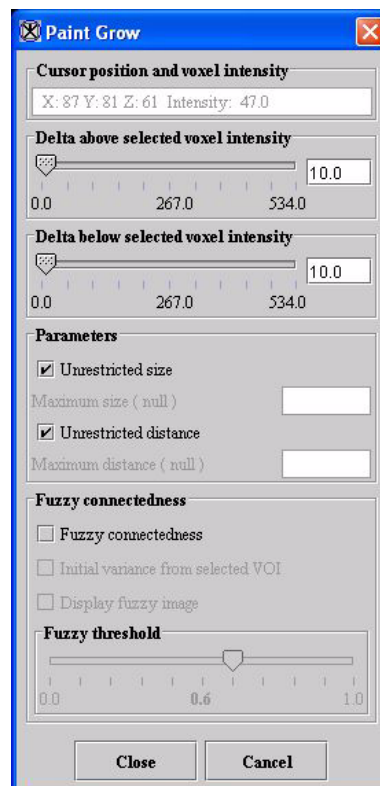
Figure 165. Paint Grow dialog box

To erase an area of paint from images

1 Click [icon].

2 Click the area of the paint that you want to remove.

3 Repeat the previous step for each area of paint to be removed.

4 Click ⬦ when done to return the cursor to the default state.

To erase all painting from images

Click ▯. MIPAV removes all of the paint from all of the images.

Displaying images using the surface plotter view

The *surface plotter* view visualizes the intensity levels for a chosen image using the height of the image surface. The surface plotter takes a 2D image and renders it into a 3D object that is similar to a raised-relief map. Higher intensities are peaks and lower intensities are valleys. The colors that the surface plotter used are the same as those used in the LUT, and when the LUT for the image is updated, so is the LUT for the plotted surface. The image itself is also a part of the scene, and it can be slid along, so that the peaks of the intensity levels match the image.
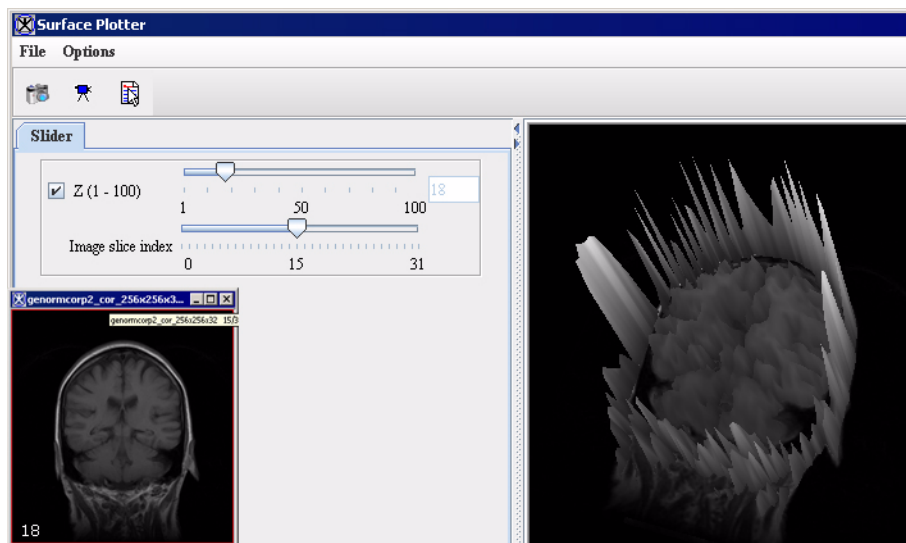
Figure 166. An image open in MIPAV and in the MIPAV Surface Plotter default view. At each point of the surface, the height indicates the intensity value for that point.

- The Z slider can be used as a cut off for pixel intensities. The read-only box on the right indicates the actual height of the cutoff.

- The image slice slider allows to select the image slice.

Surface Plotter window

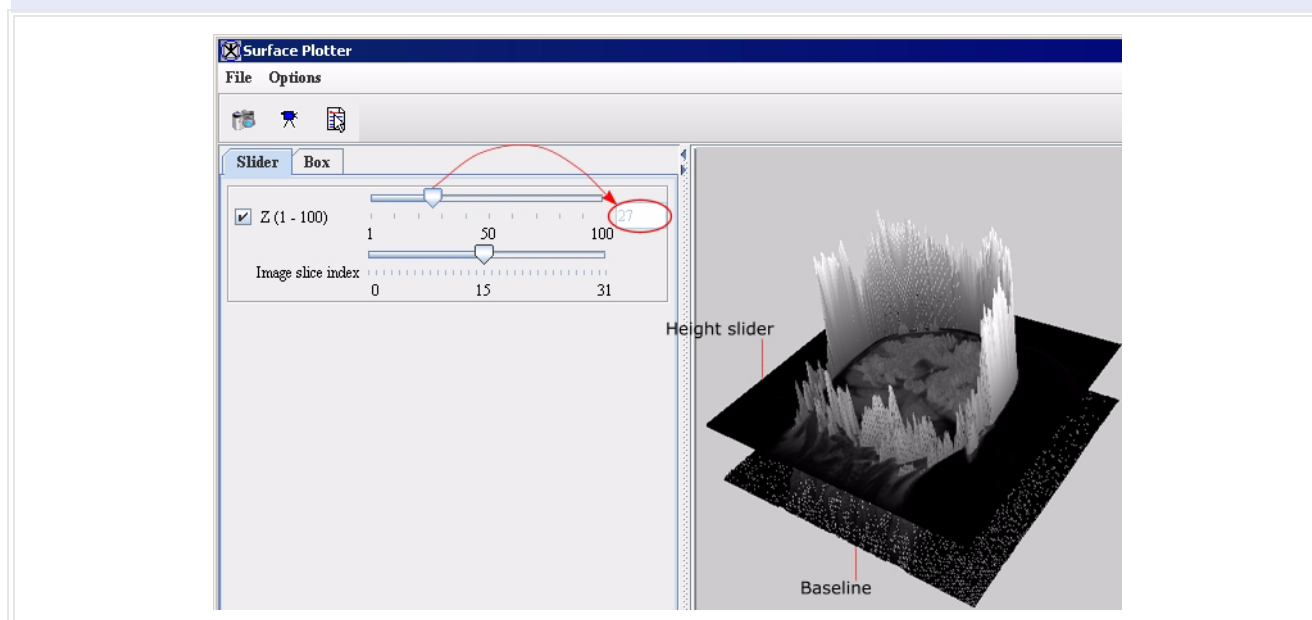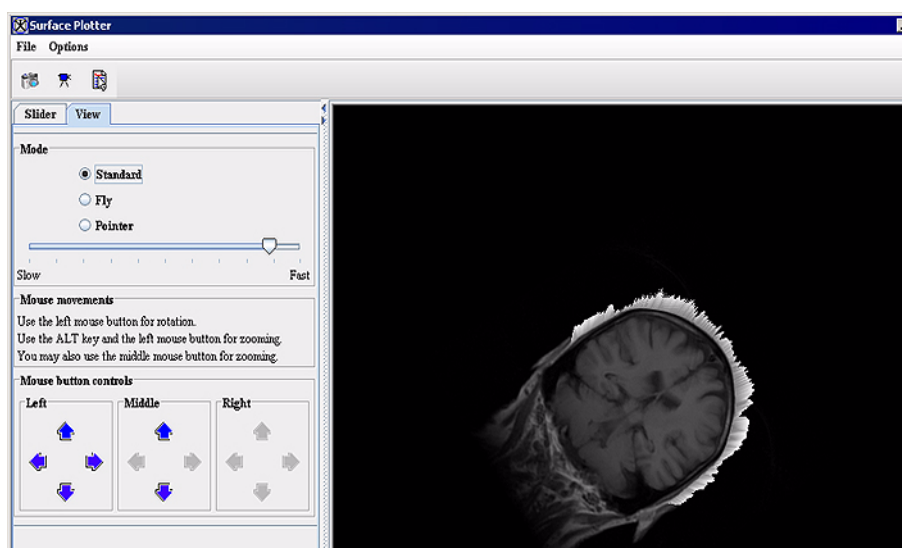| Menu		
File	**Exit**—closes the Surface Plotter window.	
Options	**View Mode**— opens the View tab, see "View tab" **Mouse Recorder**— opens the Mouse tab, see "Mouse tab" **Line Mode**—displays the surface plotter image as lines. **Resample**— improves the speed of animating of the image by resampling and forming the image with fewer triangles. **Display Options**—allows you to add a bounding box, change colors of the bounding box and background, show an orientation cube, and choose the projection type: perspective or orthographic. See also "Box tab" below.	
Help	Displays help for this dialog box.	
Toolbar	– opens the Camera tab, see "Camera tab" – opens the Mouse tab, see "Mouse tab" – opens the Box tab, see "Box tab"	
Image area	Displays the plotted image.	
Slider tab		

Figure 167. Surface Plotter window

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Z(1-100)	Turns on the ability to visualize the pixel intensities. When this box is selected, the height slider is available. It shows the height of the intensities in the image. Move the slider to the left to show the wider range of intensities: from the lower level to the higher level. Move the slider to the right to set up the cutoff and show only the higher level intensities. The read-only box on the right indicates the actual height of the cutoff.
Image Slice slider	Allows to select a particular slice and visualize the pixel intensities for that slice.

View tab	

Mode	Different view modes offer different opportunities for using the mouse controls.
	In Standard mode, you can use left mouse button controls for rotation and the ALT+ left mouse button controls combination of keys for zooming, you can also use middle mouse button controls for zooming.
	In Fly mode, left, middle and right mouse button controls are available for zooming, rotation, and also pitch and roll rotation of the image.
	In Pointer mode, you can use the mouse pointer for rotation, translation and zooming.
	See also "Viewing an image dataset in animate view" on page 298
Slow-fast slider	use this slider to adjust the speed of the mouse actions.

Mouse tab	
See also: "Recording and playing mouse actions" on page 301, "Saving as AVI" on page 305.	

Figure 167. Surface Plotter window (continued)
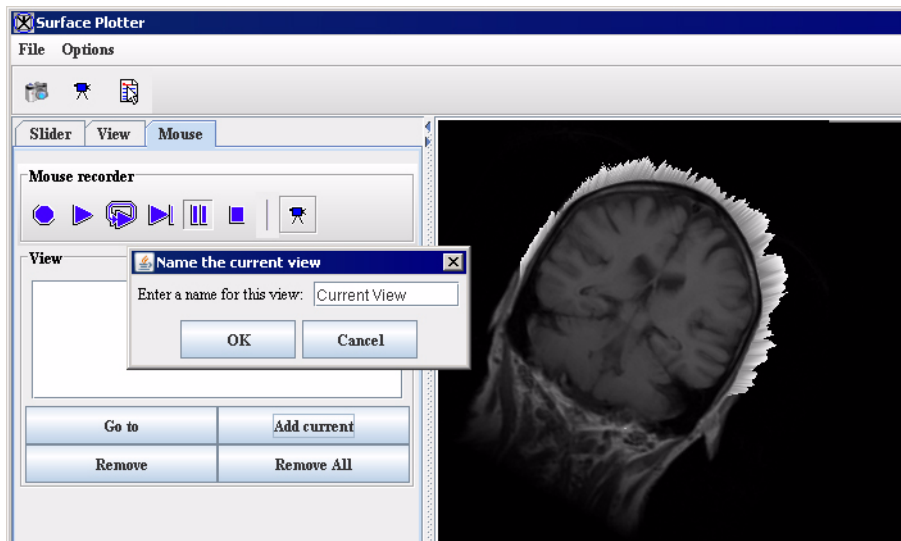
Mouse recorder controls	
View	This box displays a list of recorded mouse actions. You can select any of mouse actions from the list as a starting point and start playing the movie from that point.
Go to	– directs the viewer to the selected view.
Add current	– adds a current view to the sequence of views shown in the View box.
Remove	– removes selected view.
Remove All	– removes all views.
Camera tab	
See also: "Capturing snapshots" on page 303, "Saving as AVI" on page 305.	
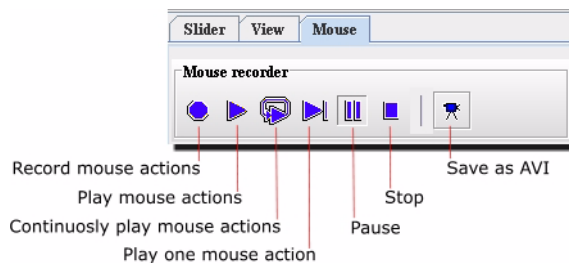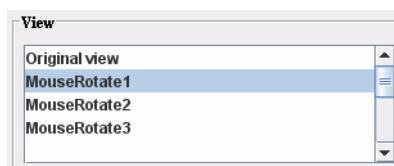
Figure 167. Surface Plotter window (continued)

![Surface Plotter window showing the Camera tab with Mode (Auto/Manual), Capture, Rotation Axis, Rotation Alpha, and Mouse button controls options, alongside a brain MRI image and a Screen capture window.](image)
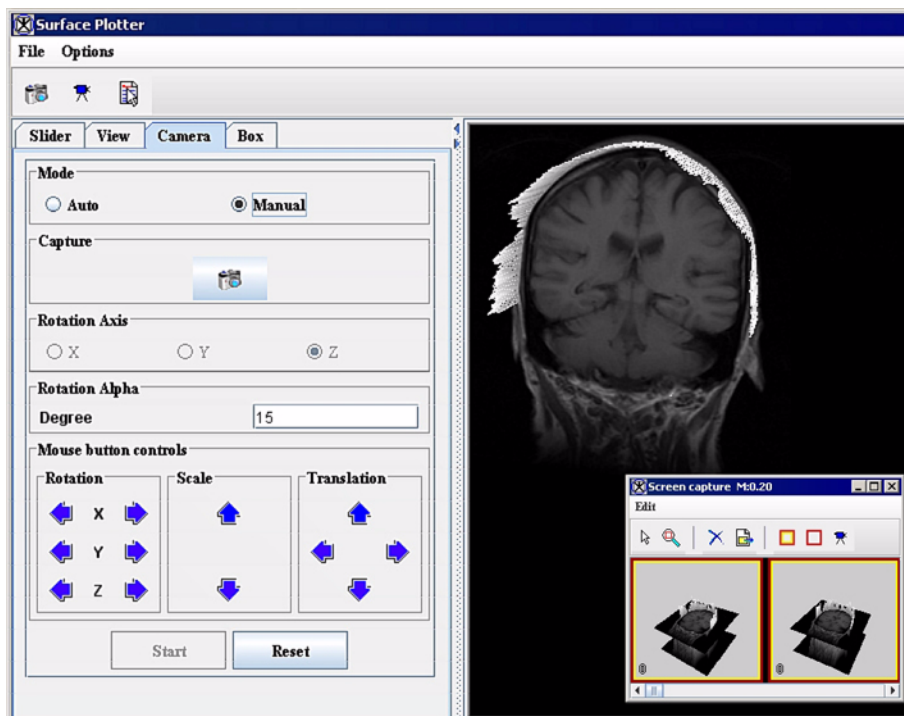
Mode	Auto mode allows the automatic rotation and capturing of the image.
	Manual mode allows the manual rotation and capturing of the image.
Capture	Press the Camera button to capture the current image view. This option is only available if Manual mode is activated.
Rotation Axis	Use the X, Y, or Z radio buttons to select the rotation axis. This option is only available if Auto mode is activated.
Rotation Alpha Degree	Enter a value for the rotation angle. By default, it is set to 15 degrees. This option is available in both Auto and Manual modes.
Mouse button controls	Use the mouse button controls to rotate, scale and translate the surface plotter view. The mouse button controls are only available in Manual mode.
Start	– starts capturing. Only available in Auto mode.
Reset	– resets the Surface Plotter view.
Box tab	

Figure 167. Surface Plotter window (continued)

Bounding box and Background	Use these options to change the background and bounding box colors and also to display the bounding box frame.
Projection type	Use the radio buttons to switch between Perspective and Orthographic view.
Texture type	TBD.
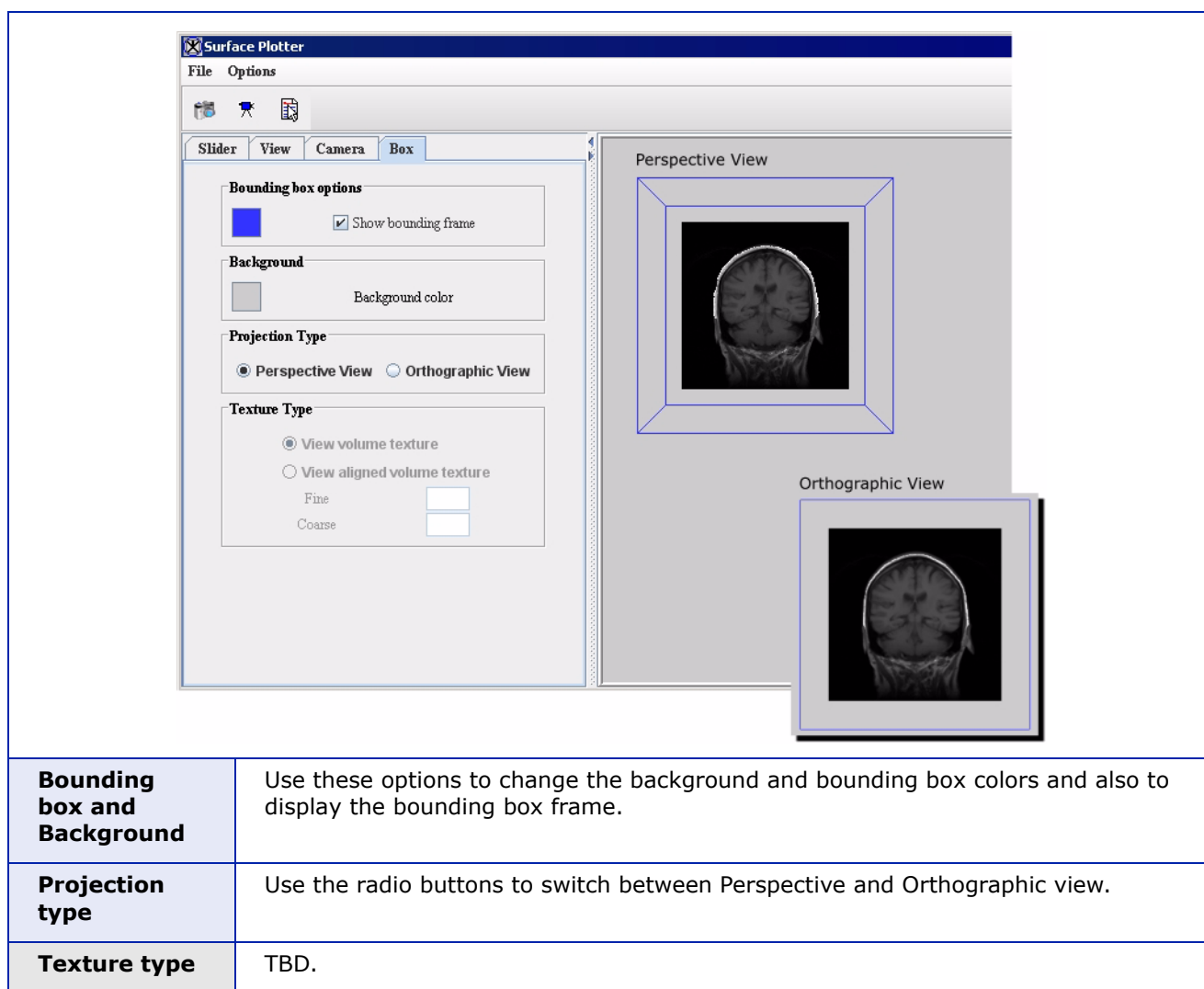
Figure 167. Surface Plotter window (continued)

Viewing an image dataset in animate view

In animate view, like cine view, the software automatically advances through the image dataset. However, animate view allows you to adjust the speed at which images are advanced using the Slow-Fast slider.

To view an image dataset in Standard mode

1 Select Image > Views > Surface Plotter in the MIPAV window. The Surface Plotter window opens.

2 In the Surface Plotter window, call Options > View Mode to open the View tab.

3 Select Standard mode, and then adjust the mouse action speed slider.

4 Use either the mouse controls, or hold down the left mouse button and drag the mouse to the left, right, top, and bottom. This allows you to move the image in all directions.

5 If you release the left mouse button, and then hold it down again while you move the mouse, you can turn the image upside down.

6 Hold down the middle mouse button (or use the mouse controls) and push the mouse forward. This makes the image smaller as if it has been seen from a distance.

7 Hold down the middle button and push the mouse toward you. This enlarges the image so that you can examine it closely.

You can also use the controls for the middle mouse button.

8 Return to the Slider tab and slide the height slider to determine the highest intensity in the image.

Example: One way of determining the highest intensity in the image is to use the mouse to drag the image to its side, enlarge it using the middle mouse button and pushing the mouse toward you, and then sliding the height marker to the top of the tallest intensity peak. The level of the intensity appears in the box to the right of the height slider.

To view an image dataset in Fly mode

1 Select Image > Views > Surface Plotter in the MIPAV window. The Surface Plotter window opens.

2 In the Surface Plotter window, call Options > View Mode to open the View tab.

3 Select Fly mode, and then adjust the mouse action speed slider. See Figure 168.

4 Use the left mouse button controls (upper and lower) to drag the image up and down.

5 Use the left mouse button controls (right and left) to rotate the image along the x axis.

6 Use the middle mouse button controls (upper and lower) to rotate the image along the y axis.

7 Use the middle mouse button controls (right and left) to rotate the image along the z axis.

8 Use the right mouse button controls (right and left) to zoom in or zoom out the image.

9 Use the right mouse button controls (upper and lower) to translate the image.

You can also use the mouse buttons instead of the mouse button controls.
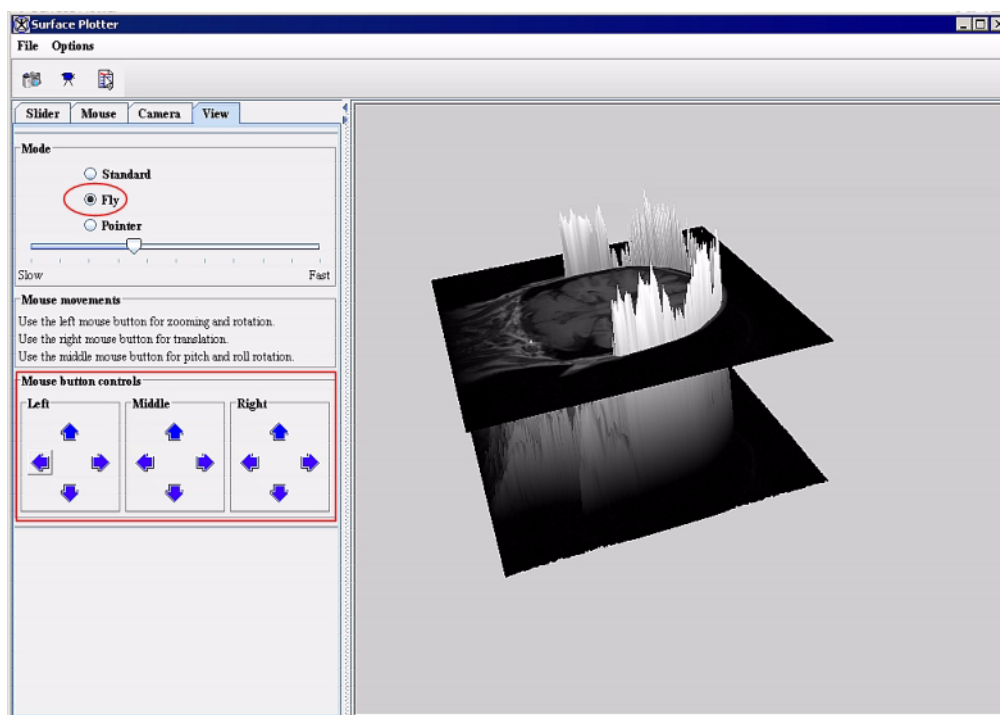
Manipulating of the plotted image in the Surface Plotter window in Fly mode

Figure 168.   Surface Plotter window – Fly mode

Recording and playing mouse actions

Surface plotter allows you to record mouse actions (e.g., rotations, translations, and zooming) you performed on the image and create a movie from them. This is available via the Mouse tab. When you record mouse actions, the software makes a copy of the image dataset and loads it in the animate image window. Before starting recording, you can adjust the speed at which images are advanced (the View tab). After recording is completed, you can specify that images be displayed in forward or reverse order, and you can also pause or loop the sequence.

To record the mouse actions:

1 In the Surface Plotter window, go to the Slider tab and adjust the intensity height slider.

2 Then call Options > View mode and choose Pointer mode. Use the Slow-Fast slider to adjust the speed of the mouse actions.

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3 Open the Mouse tab (use Options > Mouse Recorder).

4 In the Mouse tab, press the Start Mouse Recording button to start recording the mouse actions. The list of actions appears in the View box.

5 To pause recording, press Pause.

6 To stop recording, press Stop.

7 To save the recorded movie as an AVI file, press Save as AVI. See Figure 169. See also "Saving as AVI" on page 305.
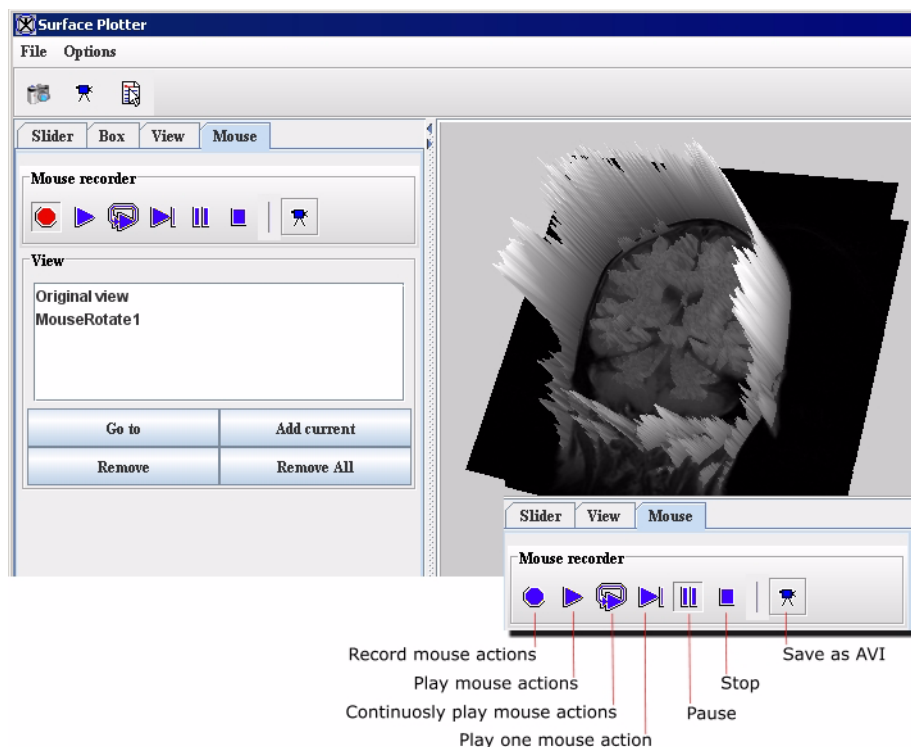
Figure 169. Recording and playing the mouse actions

To play recorded mouse actions:

1 In the Mouse tab, press the Continuously Play Mouse Actions button. This starts playing the recorded actions.

2 To stop playing, press Stop.

3 To start playing the movie from a particular mouse action, select that action in the View box, and then press the Continuously Play Mouse Actions button. The recorded mouse actions will play starting from that action. See Figure 169.

To edit recorded mouse actions:

1 In the Mouse tab, select the mouse action(s), and then press Remove. this will remove the selected action(s) from the list of recorded actions.

2 To remove all recorded actions and clean up the View box, press Remove All. See Figure 169.

See also: "Saving as AVI" on page 305.

Capturing snapshots

Surface Plotter dialog also offers the additional Auto Snapshot tool for automatic and manual capturing snapshots, which allows the user to reproduce the movements of the image. These snapshots can be worked on afterwards as slides or the video can be compiled in AVI format. See "Saving as AVI" on page 305.

To run the Auto Snapshot tool, click the Auto Snapshot Screen button on the Surface Plotter toolbar. This opens the Camera tab where you can set up the tool options and run the tool. For more information, refer to "Auto Snapshot tool" .

AUTO SNAPSHOT TOOL

The Auto Snapshot tool can be run in Auto and Manual modes.

- In Auto mode, the surface plotter image is rotated along the chosen axis (X, Y, or Z) using the user defined rotation angle step, and the snapshot is taken at each rotation step. The snapshots are displayed in the Screen Capture window. See also "To take snapshots in Auto mode"

- In Manual mode, the surface plotter image is rotated manually (using the mouse button controls) using the user defined rotation angle step, and the snapshots are also taken manually at each rotation step which is interesting for the user. The snapshots are then displayed in the

Screen Capture window. See also "To take snapshots in Manual mode" on page 304.

To take snapshots in Auto mode

1 In the Surface Plotter window, go to the Slider tab and adjust the intensity height slider.

2 Open the Camera tab (use the Auto Snapshot Screen button on the Surface Plotter toolbar).

3 In the Camera tab, select Auto mode. This is the default mode for capturing snapshots.

4 Then, choose the rotation axis and define the rotation angle. The default value for the rotation angle is set to 15 degrees.

5 Press the Start.

The image starts rotating and the snapshots appear in the Screen Capture window. After completing the whole 360 degrees rotating circle, the image stops rotating. See also Figure 167.

For more information refer to "Displaying images using the animate view" on page 246.

To take snapshots in Manual mode

1 In the Surface Plotter window, go to the Slider tab and adjust the intensity height slider.

2 Open the Camera tab (use the Auto Snapshot Screen button on the Surface Plotter toolbar).

3 In the Camera tab, select Manual mode.

4 The mouse button controls and Capture Screen icon become active.

5 Then, define the rotation angle. By default, the value for the rotation angle is set to 15 degrees.

6 Use the mouse button controls to rotate the image. Note that you can rotate the image in any direction.

7 Press the Capture Screen icon each time you want to take a snapshot.

The snapshots appear one by one in the Screen Capture window.

You can stop capturing the snapshots at any time by pressing the Reset button. See also Figure 167.

SCREEN CAPTURE WINDOW

After you've completed capturing snapshots, they appear in the Screen Capture window. This window provides you with the tools for further editing of the snapshot sequence and saving it as an AVI file. The following options are available:

⬚	– Default mode	⬚	– Select all
⬚	– Magnify region	⬚	– Unselect all
⬚	–Delete selected slices	⬚	– Capture to AVI
⬚	Extract selected slices to a new image		

SAVING AS AVI

The Save as AVI or Capture as AVI option saves the sequence of recorded mouse actions or captured snapshots as an AVI file. To call the Save as AVI option, click the corresponding icon on the Mouse tab. To call the Capture as AVI option, click the icon on the Screen Capture window toolbar. The follow the steps provided by the dialogs.

1 Click the Capture to AVI or Save to AVI icon.

2 In the Choose Type of AVI File dialog, specify the AVI type and JPEG quality, press OK.

3 In the Save Range of Slices dialog that appears next, press OK, then enter the file name.

4 The saved AVI file appears in the MIPAV AVI player.

Displaying images using the surface renderer view

In development.

Displaying images using the volume shear view

In development.

Displaying images using the volume renderer view

In development.