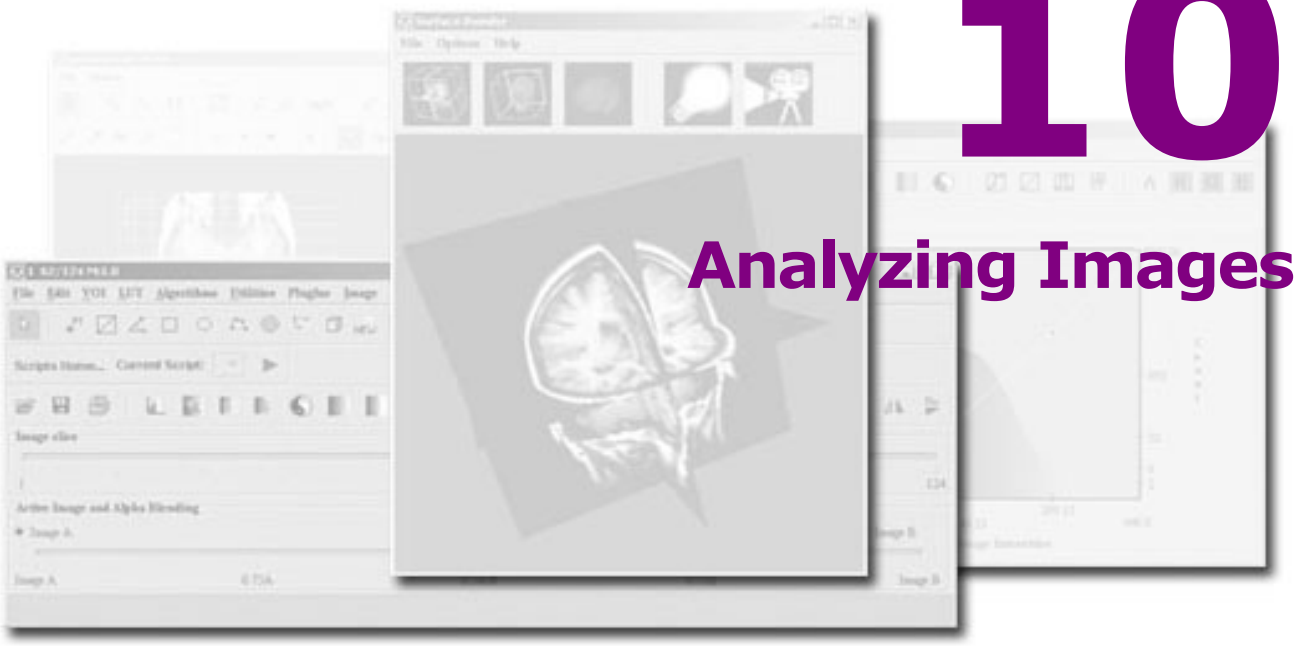


10 Analyzing Images

In this chapter . . .

You can use MIPAV to generate statistics on contoured volume of interest (VOI) regions and to calculate the volume of painted pixels and voxels. You can also use MIPAV's algorithms to perform more sophisticated image analysis. For information about algorithms, refer to Volume 2, *Algorithms*.

Calculating statistics for contoured VOIs

Once you have contoured structures, you can generate statistics on the VOI.

To select the type of statistics to calculate for a single VOI

1. Open an image.
2. Contour a VOI. An example of a contoured VOI is shown below (Figure 195).

3 Select the VOI.

4 Do one of the following:

- Select VOI > Properties.
- Right-click inside the VOI, which automatically selects it. Then select Properties on the menu (Figure 195).

The VOI Statistics dialog box (Figure 196) opens.

5 Choose the types of statistics that you want the program to calculate by selecting the appropriate check boxes in the Statistics to calculate group.

Refer to Figure 196 for information on each statistic you can select.

6 Click Calculate.

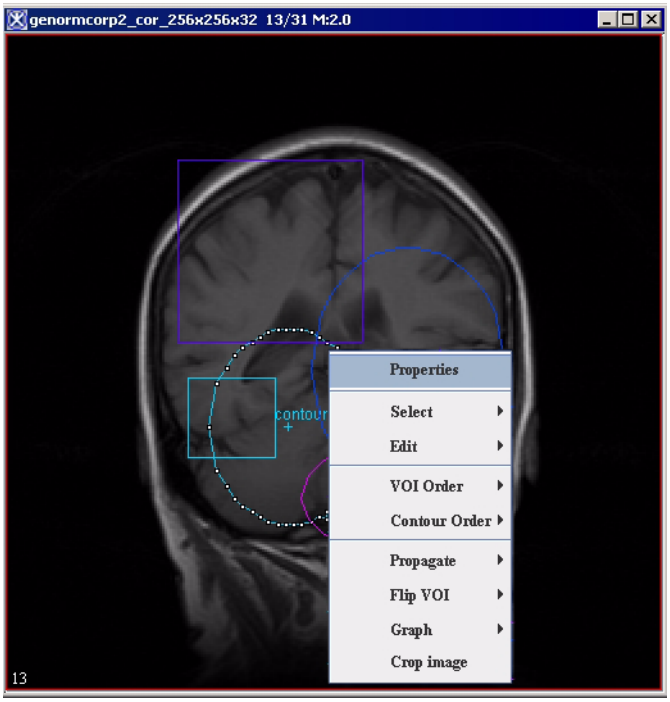


Figure 195. VOI properties context menu

Name of VOI	Indicates the color of the VOI outlines and the name of the VOI. To use this to group two contours, refer to Chapter 7 for more details.
Show bounding box	Indicates whether to show the bounding box. If this check box is selected, the bounding box appears around the VOI.
Use Additive polarity for VOI	TBD.
Include for processing	Indicates whether to include the VOI in the processing when running an algorithm. If selected, the VOI is included.
Boundary or blended	Indicates whether the contour is filled with color (blended) or transparent (only the boundary appears). If selected, the VOI is filled with color.
Opacity	Indicates whether a VOI that is filled with color is transparent, translucent, and opaque: 0 is transparent, and 1 is opaque.
Statistics to calculate	**# of voxels**—Indicates the number of voxels, including voxels that span frames in an image stack, that are enclosed in the VOI.

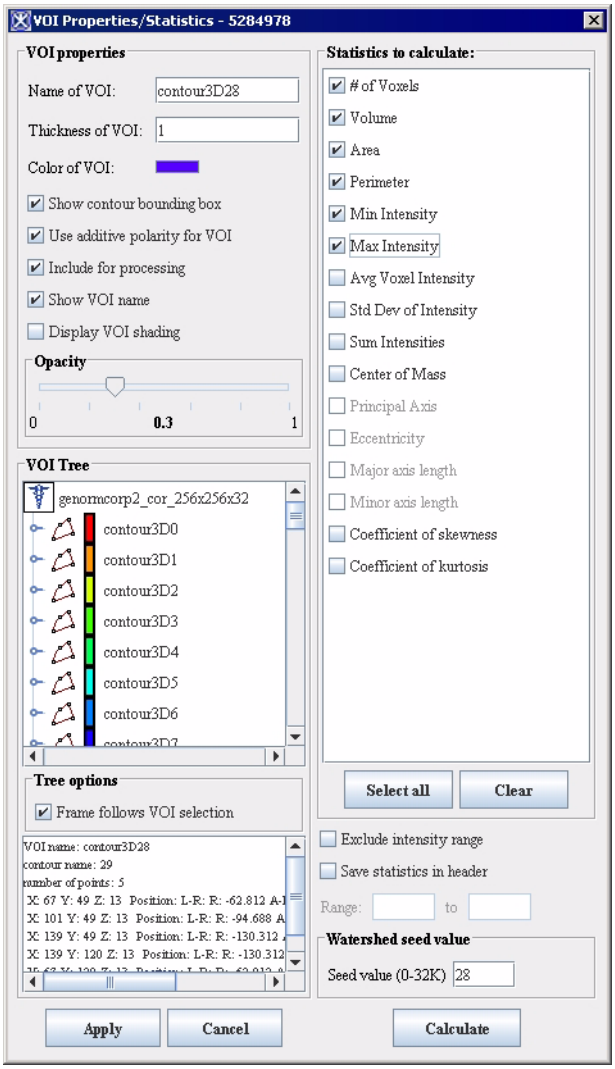


Figure 196. VOI Statistics dialog box

	Volume—Measures the amount of space occupied by a 3D VOI. To calculate the volume, the software multiplies the number of pixels by the resolution of each dimension. **Area**—Measures the surface of the VOI. To calculate the area, the software multiples the number of pixels by the resolutions of the *x* and *y* dimensions. **Perimeter** - measures a perimeter of VOI. **Min. Intensity** – shows the min voxel intestacy. **Max. Intensity** – shows the max voxel intensity. **Average voxel intensity**—Calculates the average intensity of the voxels in the VOI by adding the intensity of all voxels in the VOI and dividing the result by the sum of the voxels. **Std. dev. of voxel intensity**—Calculates the standard deviation of the intensity of the voxels in the VOI. **Center of mass**—Indicates the point at which the whole mass of the VOI is concentrated. It is calculated as the sum of all *x* coordinates divided by the number of points and the sum of all *y* coordinates divided by the number of points. **Principal axis (only 2D)**—Calculates the principal axis for 2D images only. **Eccentricity (only 2D)**—Describes the geometric shape of the VOI as an ellipse, with 0 indicating a circle and 1 indicating a straight line. **Major axis length** — calculates the length of the major axis for an elliptical VOI. **Minor axis length** — calculates the length of the minor axis for an elliptical VOI.
Select all	Selects all of the statistical measures in Statistics to calculate.
Clear	Clears all of the statistical measures in Statistics to calculate.
Exclude intensity range	Excludes a specific range of intensity values, which you specify in the Range boxes, in the calculation. When this check box is selected, the Range boxes become available.
Range	Specifies a particular range of intensities to exclude from the calculations. These boxes become available only when the Exclude intensity range check box is selected.
Watershed seed value (0-32K)	Indicates the watershed seed value.
Apply	Applies the changes you made to this dialog box.
Cancel	Disregards any changes you made in this dialog box and closes the dialog box.
Calculate	Runs all selected statistics according to the specifications in this dialog box.
Help	Displays online help for this dialog box.

Figure 196. VOI Statistics dialog box (continued)

To view the statistics for a single VOI

1. Select the Output window.
2. Select the Data tab on the Output window to view the information. The Data page of the Output window (Figure 197) appears showing the results of the calculations.

To save the statistics for a single VOI

1. Select File > Save Messages in the Output window.

   The Save dialog box opens.
2. Specify a name for the messages file and select a location for storing it.
3. Click Save. The software saves the file and places it in the specified location.

Tip: MIPAV provides you with the ability to type directly onto the Data page. So, for example, you could add a description of when the statistics were calculated or any other such meaningful information (Figure 197).

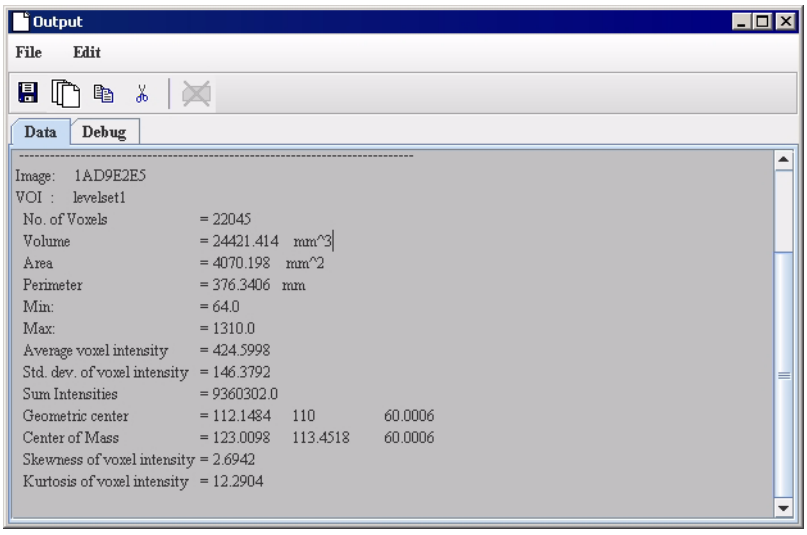


Figure 197. Data page in the Output window showing statistics

Calculating statistics on VOI groups

The Statistics Generator command on the VOI menu in the MIPAV window opens the Calculate Statistics on VOI Groups window, which allows you to obtain statistics on one VOI or on multiple grouped VOIs. You can save the statistics to a tab-delimited file, which can then be incorporated into a database.

The Calculate Statistics on VOI Groups dialog box includes three tabs:

- *VOI Selection page*—On this page you can select the VOIs on which to calculate the statistics. It also allows you to name and save the logging file at the path you choose.
- *Statistics Options page*—This page provides a choice of the types of statistics that may be calculated as well as the conditions under which they may be run.
- *Logging page*—This page provides the results of the statistics in a tabular form. Depending on the number of VOIs included in the calculation, the results may include one or more lines of text.

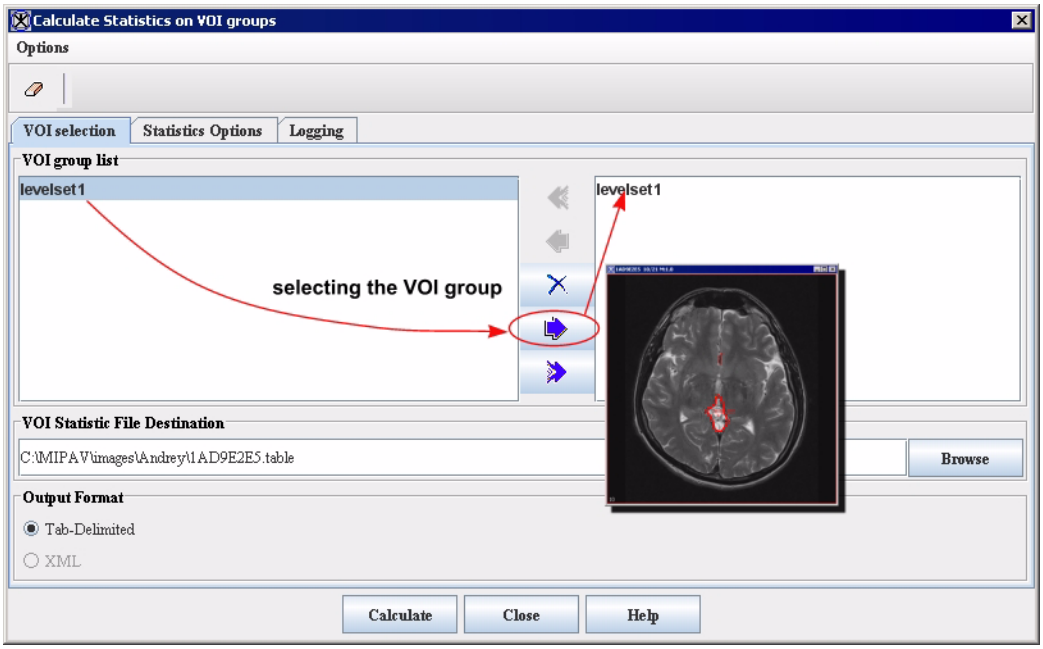


Figure 198. VOI Selection page in Calculate Statistics on VOI groups window

VOI groups list—left	Lists all of the VOIs found on the image.
VOI groups list—right	Lists the VOIs on which you plan to calculate statistics.
Send all left	Moves all of the VOIs that appear in the VOI groups list on the right to the VOI groups list on the left.
Send selection left	Moves the selected VOI that appears in the VOI groups list on the right to the VOI groups list on the left.
Delete selection	Deletes the selected VOI in either the VOI groups list on the left or the VOI groups list on the right.
Send selection right	Moves the selected VOI in the VOI groups list on the left to the VOI groups list on the right on which you plan to calculate statistics.
Send all right	Moves all of the VOIs, whether they are selected or not, in the VOI groups list on the left to the VOI groups list on the right on which you plan to calculate statistics.
VOI statistics file destination	Specifies the file path, file name, and file extension to which you want to save the file.
Browse	Allows you to navigate to the directory on your workstation or attached disks where you want to store the file.
Tab-delimited	Saves the statistics in a comma-separated tab-delimited file. The extension for this file is.TABLE.
XML	In development.
Calculate	Runs all statistics that are selected on the Statistics Options page according to the options specified.
Close	Closes this window.
Help	Displays online help for this window.

Figure 198. VOI Selection page in Calculate Statistics on VOI groups window

To calculate statistics on VOIs

1. Open an image.
2. Delineate one or more VOIs on the image (Figure 198).
3. Select one of the VOIs by clicking it.
4. Hold down the Shift key and select the next VOI.

5 Continue holding down the Shift key and selecting VOIs until all of the VOIs to be included in the calculation are selected.

6 Select VOI > Group VOIs.

7 Select VOI > Statistics Generator. The Calculate Statistics on VOI Groups window opens showing the VOI Selection page.

8 Select the VOI group, which appears in the left VOI groups list.

9 Click the Send selection right button. The group appears on the right VOI groups list (Figure 199).

10 Do one of the following:

- Accept the default path and file name for the logging file, where the statistics are stored, in VOI statistics file destination.
- Update the path and file name for the logging file.

11 Select the format of the logging file in Output format.

12 Select Statistics Options. The Statistics Options page (Figure 200) appears.

13 Select the statistics you want to include in the calculation in the Statistics to calculate list by doing one of the following:

- Click on the individual check boxes for each specific statistic.
- Click Select all to run all of the statistics.

Tip: If you, for example, clicked Select all and then decide that you don't want the software to calculate all of the statistics, it may be faster to click Clear to remove the check marks from *all* of the check boxes. You can then select only the statistics you want to calculate.

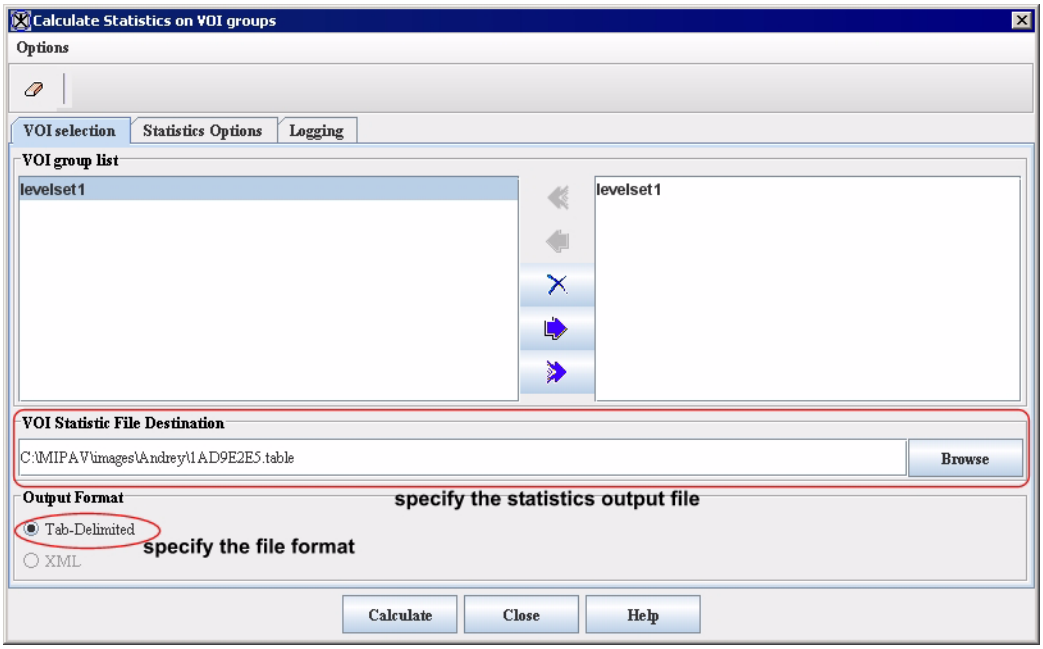


Figure 199. Specifying the output file

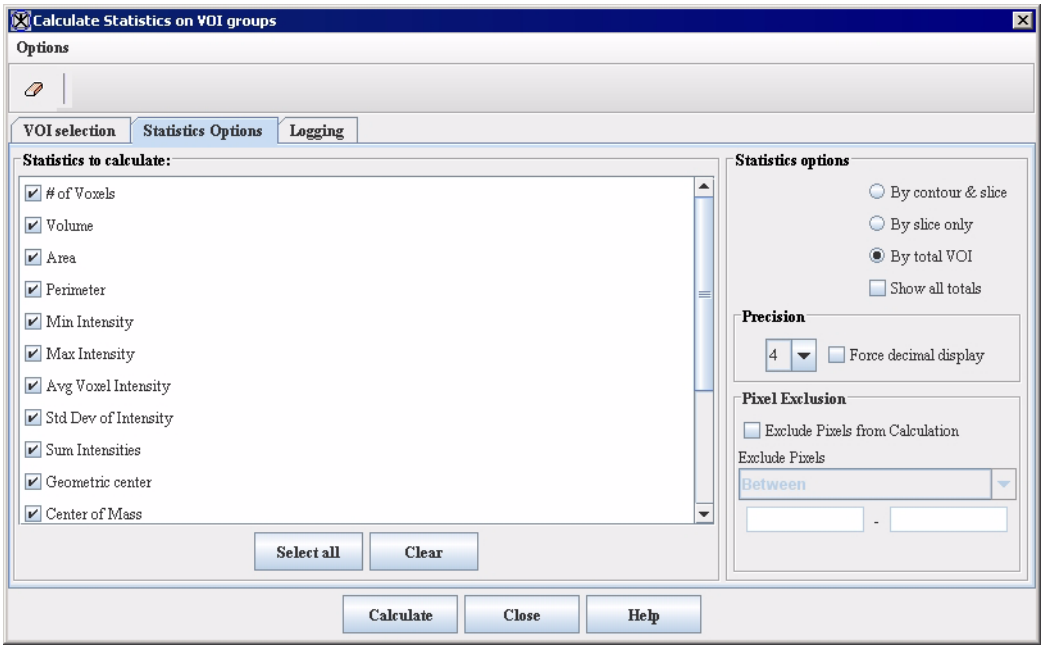
14 Select one of the following options in the Statistics options group:

- By contour & slice
- By slice only
- By total VOI

15 Select Show all totals if appropriate.

16 Click Calculate. The Logging page (Figure 201) appears with the results of the statistics you selected.

17 Click Close when finished to close the Calculate Statistics on VOI Groups window.



Statistics to calculate	**No. of voxels**—Indicates the number of voxels—including voxels that span frames in an image stack—enclosed in the VOI.
	Volume—Measures the amount of space occupied by a 3D VOI. To calculate the volume, the software multiplies the number of pixels by the resolution of each dimension.
	Area—Measures the surface of the VOI. To calculate the area, the software multiples the number of pixels by the resolutions of the *x* and *y* dimensions.
	Average voxel intensity—Calculates the average intensity of the voxels in the VOI by adding the intensity of all voxels in the VOI and dividing the result by the sum of the voxels.
	Std. dev. of voxel intensity—Calculates the standard deviation of the intensity of the voxels in the VOI.
	Center of mass—Indicates the point at which the whole mass of the VOI is concentrated. It is calculated as the sum of all *x* coordinates divided by the number of points and the sum of all *y* coordinates divided by the number of points.
	Principal axis (only 2D)—Calculates the principal axis for 2D images only.
	Eccentricity (only 2D)—Describes the geometric shape of the VOI as an ellipse, with 0 indicating a circle and 1 indicating a straight line.

Figure 200. Statistics Option page in Calculate Statistics on VOI Groups window

Statistics options	**By contour & slice**—Runs the selected statistics on both the contour and slice.
	By slice only—Runs the selected statistics on only the slice.
	By total VOI—Runs the selected statistics on the entire VOI.
	Show all totals—Specifies to display all of the totals for _____.
Pixel exclusion	**Exclude pixels from calculation**—Indicates to exclude the pixels in the Pixel range boxes from the calculation. When you select this check box, the Exclude pixels button and the Pixel range boxes become available.
	Exclude pixels—Indicates to exclude the pixels between, above, below, or outside the range shown in the Pixel range boxes.
	Pixel range—Lists a specific range of pixels between, above, below, or outside that should be excluded in the calculations.
Select all	Selects all of the statistics listed in the Statistics to calculate group.
Clear	Clears all of the statistics listed in the Statistics to calculate group.
Calculate	Runs all statistics that are selected on the Statistics Options page according to the options specified.
Close	Closes this window.
Help	Displays online help for this window.

Figure 200. Statistics Option page in Calculate Statistics on VOI Groups window

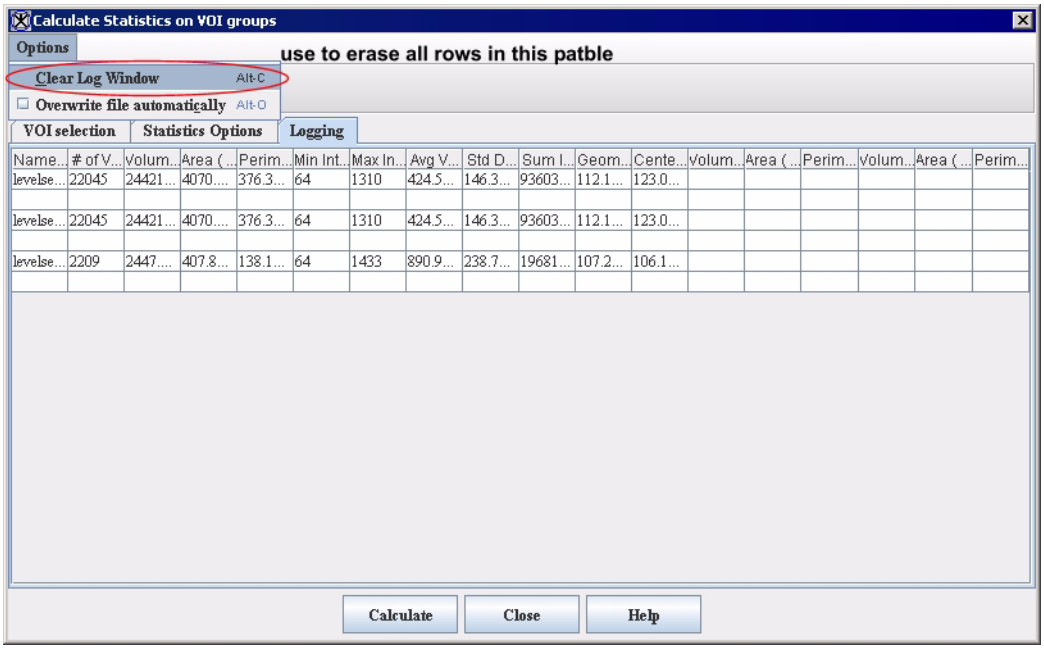
To exclude a range of pixels from the calculations

When you run statistics on VOIs in an image but want to exclude a specific range of pixels from the calculations, make sure that you do the following:

1. Select Exclude pixels from calculation on the Statistics Options page in the Calculate Statistics on VOI Groups window. The Exclude pixels list and the Pixels range boxes become available.
2. Select Between, Above, Below, or Outside in the Exclude pixels list.
3. Type a range of pixels in the Pixel range boxes.

4 Continue to select statistics and other options for the calculation.

5 Click Calculate.



Statistics table	Lists all of the statistics that were calculated according to the selected statistics and the options specified on the Statistics Options page.
Calculate	Runs all statistics that are selected according to the options specified on the Statistics Options page.
Close	Closes the window.
Help	Displays online help for this window.

Figure 201. Logging page in the Calculate Statistics on VOI Groups window

To save the calculations to a specific file

By default, the software saves the results of the calculations to the following path and file name:

```
c:\Documents and Settings\[username]\voistatistics.table
```

However, you can easily change the file name by typing over the default file name in the VOI statistic file destination box on the VOI Selection page in the Calculate Statistics on VOI Groups window. To change the path, type over the current path, or click Browse to select another path.

To use the calculations in a database application

Saving the statistics in a tab-delimited file allows you to import them into a database application.

1. Make sure—before running the calculations—that you select the Tab-delimited check box on the VOI Selection page in the Calculate Statistics on VOI Groups window.
2. Change the path and file name, if necessary, in the VOI Statistics File Destination box on the VOI Selection page.
3. Click Calculate. The resulting statistics appear on the Logging page and in the file you specified.

To rearrange the columns in the logging table

You can adjust the order in which the columns in the logging table appear as well as their width. To change the order, simply click on the title of a column and drag the column to the new position. To make a column wider, click on the line between it and the next column and drag it to the desired width.

To compare statistics

If you calculate statistics on an image more than once in a MIPAV session, the Logging page shows the previously run calculations for the VOIs in that image. For example, suppose you calculate statistics on the VOIs in an image and then save the image and close it. Later, you reopen the image and decide to run additional statistics on the previous VOIs or on any new VOIs. As long as you did not exit MIPAV and are therefore in the same session, the Logging page in the Calculate Statistics on VOI Groups window still displays the results of the statistics you previously ran on the VOIs in the image.

When you perform additional calculations on the same or new VOIs on that image or on VOIs in another image, the results of those calculations appear below the earlier run statistics. This allows you to compare the results of both.

To clear, or delete, all of the statistics on the Logging page

When you no longer need the statistics on the Logging page or after you saved them to a file, you can clear, or delete, all of the statistics on the Logging page. To do so, do one of the following:

- Select Options > Clear logging page in the Calculate Statistics on VOI Groups window.
- Press Alt C.
- Select Clear on the Statistics Options page.

The software deletes all of the statistics on the Logging page.

To overwrite logging files automatically

If you ran calculations previously in your current MIPAV session and then select Calculate in the Calculate Statistics on VOI Groups window, the File Exists message appears asking whether to overwrite the previously saved logging file or cancel the action. If you select Overwrite, the software replaces the previously saved file with the new statistics. Selecting Cancel means that MIPAV does not perform any calculations.

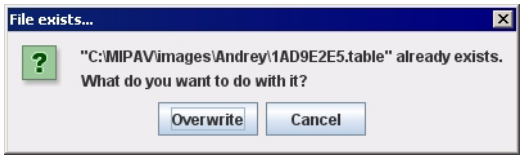


Figure 202. File Exists message

Recommendation: It is recommended that you decide in advance on a standard procedure for handling statistics files. That is, do you need to keep them for historical purposes? Do you need to keep statistics on individual images in separate files? If so, you may want to assign unique names to the statistics file for each image. If not, you may want to simply overwrite the statistics file each time you calculate statistics of VOI groups.

If you do not want to keep the statistics in separate files, it may become tiresome to always receive and need to respond to the File Exists message. To this end, the software offers an option for always overwriting the logging files. To use this option, simply select Options > Overwrite File Automatically in the Calculate Statistics on VOI Groups window.

Tip: To turn the overwrite command on, press Alt O on the keyboard. To turn it off, press Alt O again.

Calculating the volume of masks

You can calculate the volume of painted voxels, or mask, in an image and view the information about the volume on the Data page of the Output window.

To calculate the volume of masks

1. Open an image, and paint the voxels in a desired area of the image.
2. Follow the instructions for manually creating a mask in "Generating masks" on page 331 in Chapter 9, "Segmenting Images Using Contours and Masks."
3. *Do not* commit the paint, which permanently merges the paint layer with the image layer.
4. Click the Calculate Volume of Paint icon, in the Paint toolbar.

   The region grow information (how many voxels or pixels are painted) and the volume of all painted voxels appear on the Data page of the Output window (Figure 203).

To view the information

1. Select the Output window.
2. Select the Data tab on the Output window to view the information. The Data page of the Output window (Figure 203) appears.

Figure 203. Data page in the Output window (left) listing the region grow and volume information from the painted voxels in the image (right)

Remember: You can type directly onto the Data page if you want to record such information as the date and time the calculations were run.

To save the information

1. Select File > Save Messages in the Output window.

   The Save dialog box opens.
2. Specify a name for the messages file and select a location for storing it.
3. Click Save. The software saves the file and places it in the specified location.

Generating graphs

MIPAV allows you to generate intensity profiles, or contour VOI graphs, for VOI contours. For delineated VOIs, you can generate 2D, 3D, or 4D intensity graphs. You can also generate a 3D intensity graph at a specific point across all slices in a dataset. For information on how to contour a VOI, refer to Chapter 9, "Segmenting Images Using Contours and Masks."

Generating contour VOI graphs

Contour VOI graphs display the intensity values of the selected contour's boundary in the Contour VOI Graph window (Figure 204). You can generate either 2D or 3D contour VOI graphs.

To generate 2D contour VOI graphs

1. Open an image.
2. Delineate a 2D VOI on the image using one of the 2D icons in the MIPAV window.

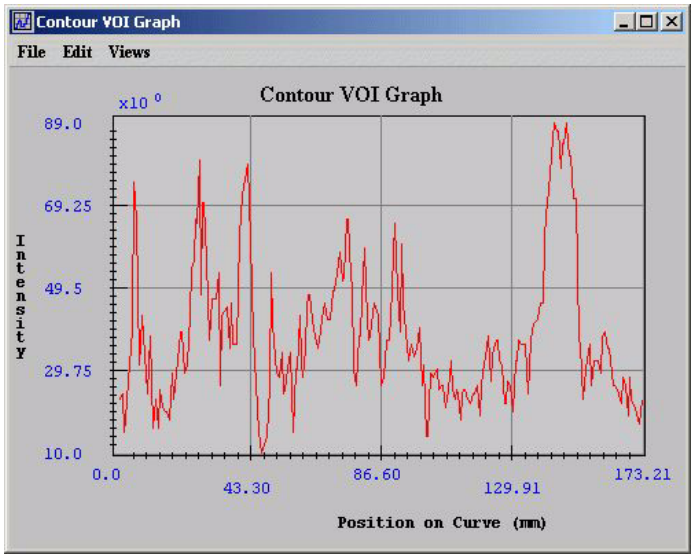


Figure 204. Contour VOI Graph window

File	**Open Graph**—Opens a PLT file that contains graph data. When you select this command or press Ctrl O on the keyboard, the Open Graph Data dialog box appears.
	Save Graph—Saves the graph data in a PLT file. When you select this command or when you press Ctrl S on the keyboard, the Save dialog box opens.
	Print Graph—Allows you to print the graph. When you select this command or press Ctrl P, the Print dialog box opens.
	Close Graph—Closes the Intensity Graph window. To close the window, you can also press Ctrl X on the keyboard.
Edit	**Delete Function**—Allows you to delete a specific function. However, you cannot delete a function if it is the only function displayed in the window.
	Copy Function—Copies a function that is currently displayed in the window.
	Paste Function—Pastes a previously copied function into the window. The pasted function has a different color than the first function displayed in the window.
Views	**Modify Graph Features**—Allows you to customize the appearance of the graph.
	Reset Range to Default—**[TBD]**
	Reset Graph to Original—**[TBD]**.
Help	**Help Topics**—Displays online help topics.

Figure 204. Contour VOI Graph window (continued)

3 Select the VOI.

As an option, copy the VOI to other slices in the dataset by selecting VOI > Propagate and one of the following commands:

- To Next Slice
- To Previous Slice
- To All Slices

4 Do one of the following:

- Select VOI > Graph > Boundary Intensity in the MIPAV window.
- Right click on the VOI and then select Graph > Boundary Intensity.

The Contour VOI Graph window (Figure 204) opens.

To generate 3D contour VOI graphs

1 Open an image.

2 Delineate a VOI on the image using the 3D rectangular VOI icon, in the MIPAV window.

3 Select the VOI.

As an option, copy the VOI to other slices in the dataset by selecting VOI > Propagate and one of the following commands:

- To Next Slice
- To Previous Slice
- To All Slices

4 Do one of the following:

- Select VOI > Graph > Boundary Intensity in the MIPAV window.
- Right-click on the VOI and then select Graph > Boundary Intensity.

The Contour VOI Graph window (Figure 204) opens. This window displays a graph of the intensity values of the selected contour's boundary.

Generating intensity graphs

Intensity profiles, or graphs, present information on the intensity values of the VOI region in an image. The intensity graph appears in the Intensity Graph window (Figure 205).

To generate 2D intensity graphs

1. Open an image.
2. Delineate a 2D VOI on the image using one of the 2D icons in the MIPAV window.
3. Select the VOI.

   As an option, copy the VOI to other slices in the dataset by selecting VOI > Propagate and one of the following commands:

   - To Next Slice
   - To Previous Slice
   - To All Slices

4. Do one of the following:

   - Select VOI > Graph in the MIPAV window and either of the following:
     - *2.5D Total Intensity*—To generate a graph of the sum of the intensity values of the VOI region.
     - *2.5D Average Intensity*—To generate a graph of the average of the intensity values of the VOI region.
   - Right-click on the VOI and then select Graph and one of the following commands:
     - *2.5D Total Intensity*—To generate a graph of the sum of the intensity values of the area delineated by the VOI per slice.
     - *2.5D Average Intensity*—To generate a graph of the average of the intensity values of the VOI region.
     - *2.5D Total Intensity with Threshold*—TBD.
     - *2.5D Average Intensity with Threshold*—TBD.

   The Intensity Graph window (Figure 205) opens.

File	**Open Graph**—Opens a PLT file that contains graph data. When you select this command or press Ctrl O on the keyboard, the Open Graph Data dialog box appears.
	Save Graph—Saves the graph data in a PLT file. When you select this command or when you press Ctrl S on the keyboard, the Save dialog box opens.
	Print Graph—Allows you to print the graph. When you select this command or press Ctrl P, the Print dialog box opens.
	Close Graph—Closes the Intensity Graph window. To close the window, you can also press Ctrl X on the keyboard.
Edit	**Delete Function**—Allows you to delete the function that you select. However, you cannot delete a function if it is the only function displayed in the window.
	Paste Function—Pastes a previously copied function into the window. The pasted function has a different color than the first function displayed in the window.
Views	**Modify Graph Features**—Allows you to customize the appearance of the graph.
	Reset Range to Default—TBD.
	Reset Graph to Original—TBD.
Help	**Help Topics**—Displays online help topics.

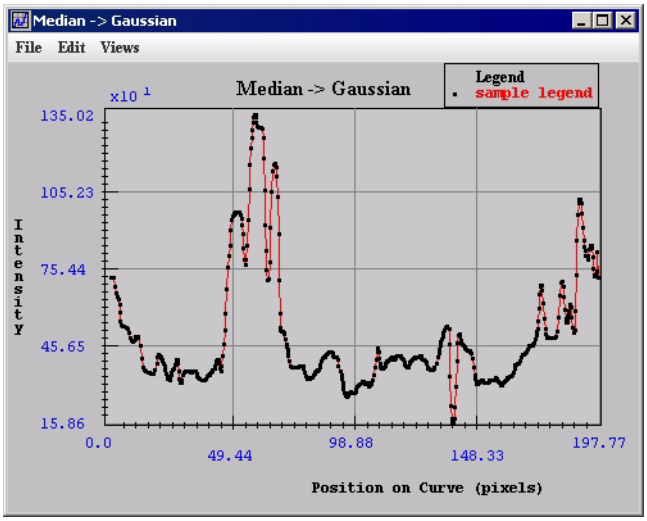


Figure 205. Intensity Graph window

To generate 3D intensity graphs of all slices in a dataset at a specific point

1. Open an image.
2. Draw a point VOI on the image (Figure 206).
3. Select the VOI.
4. Do one of the following:

- Select the Propagate VOI to all slices icon.
- Select VOI > Propagate > To All Slices.
- Right-click on the VOI, then select Propagate > To All Slices (Figure 206).

5 Right-click on the VOI and select Show VOI Graph (Figure 206).

The Intensity Graph window (Figure 205 on page 379) opens.

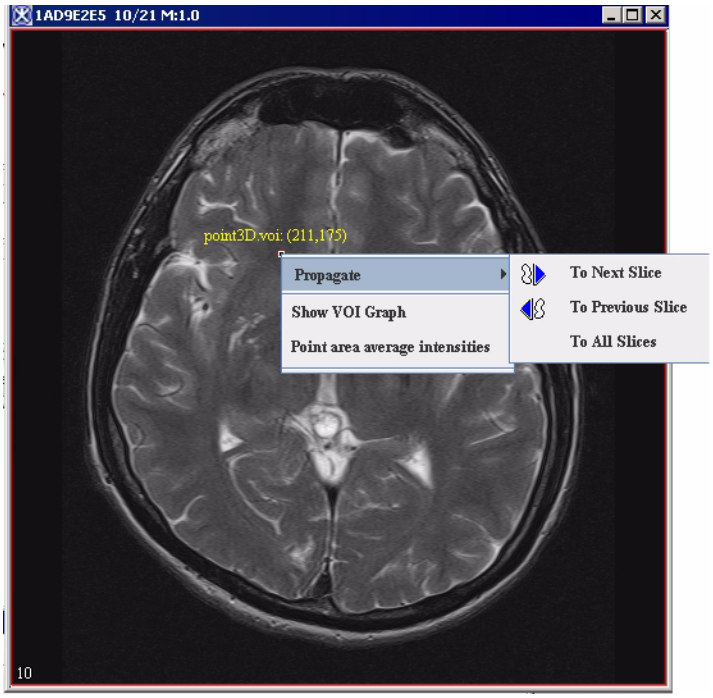


Figure 206. Point VOI

To generate 3D intensity graphs of specific areas

1 Open an image.

2 Delineate a VOI on the image using the 3D rectangular VOI icon.

3 Select the VOI. Then, do one of the following:

a Select VOI > Graph and either of the following in the MIPAV window:

- *2.5D Total Intensity*—To generate a graph of the sum of the intensity values of the area delineated by the VOI per slice.

- *2.5D Average Intensity*—To generate a graph of the average of the intensity values of the VOI region.

b Right-click the VOI, and then select Graph and one of the following commands in the MIPAV window:

- *2.5D Total Intensity*—To generate a graph of the sum of the intensity values of the area delineated by the VOI per slice.
- *2.5D Average Intensity*—To generate a graph of the average of the intensity values of the VOI region.
- *2.5D Total Intensity with Threshold*—TBD.
- *2.5D Average Intensity with Threshold*—TBD.

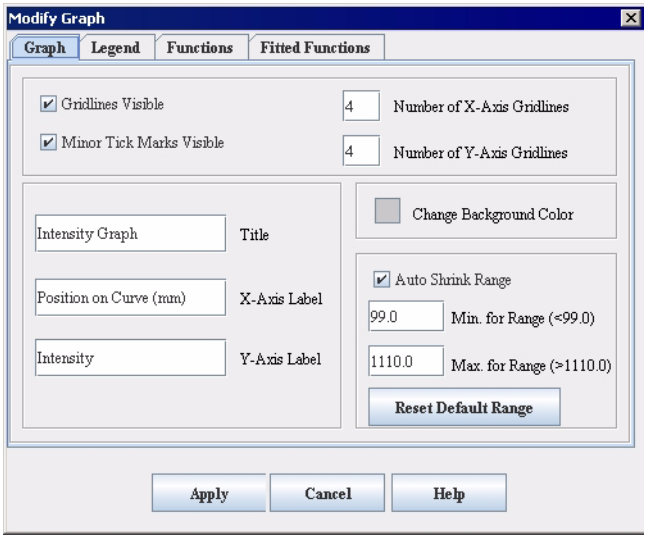
The Intensity Graph window (Figure 205 on page 379) opens.

CUSTOMIZING THE APPEARANCE OF GRAPHS – MODIFY GRAPH DIALOG BOX

You can adjust the appearance of graphs to interpret the information more clearly or easily. To customize graphs, you use the Modify Graph dialog box (Figure 207), which is accessible through Views > Modify Graph Features in both the Contour VOI window (Figure 204) and the Intensity Graph window (Figure 207). The Modify Graph dialog box includes the following four tabbed pages:

- *Graph tab* (Figure 207), which allows you to show or hide the gridlines and tick marks, change the number of gridlines and background color of the graph, change the labels on the graph, and change the range values.
- *Legend tab* (Figure 215), which lets you determine whether a legend should appear on the graph and allows you to assign a specific name to each function.
- *Functions tab* (Figure 217), which allows you to change the appearance of the functions in the graph.
- *Fitted Functions tab* (Figure 219), which allows you to modify the functions.

Graph tab	
Gridlines visible	Displays, if selected, gridlines on the graph in the Intensity Graph window.
Minor tick marks visible	Displays, if selected, the tick marks on the *X* and *Y* axes of the graph in the Intensity Graph window.
Number of X-axis gridlines	Indicates the number of gridlines that appear on the *X* axis of the graph. The default number of gridlines is 4. You can specify from 1 to 50 gridlines.



Number of Y-axis gridlines	Indicates the number of gridlines that display on the *Y* axis of the graph. The default number of gridlines is 4. You can specify from 1 to 50 gridlines.
Title	Specifies the name of the graph. By default, the name is *Intensity Graph.* However, you can replace this name with any name you choose.
***X* axis label**	Specifies the name that appears for the *X* axis. By default, the name is *Position on curve (mm).*
***Y* axis label**	Specifies the name that appears for the *Y* axis. By default, the name is *Intensity.*
Change background color	Allows you to choose the color of the background of the graph. When you select this icon, the Pick Background Color dialog box opens. By default, the background color for graphs is light gray. The HSB values are 0 hue, 0 saturation, and 100 brightness and the RGB values are 255 red, green, and blue.
Auto Shrink Range	Check/uncheck this box to expand or shrink the graph.
Min. for range	The default minimum range is 207,437.0. If you specify another range, it must be less than the default range.
Max for range	The default maximum range is 595,910.0. If you specify another range, it must be more than the default range.

Figure 207. The Graph page of the Modify Graph dialog box

Reset default range	Erases the current minimum and maximum ranges and replaces the values with the default minimum and maximum ranges.
Apply	Applies the changes you made in this dialog box.
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 207. The Graph page of the Modify Graph dialog box (continued)

To display or hide the points, or tick marks, on graphs

1. Open an image.
2. Delineate a VOI on the image.
3. Generate an intensity profile (refer to "Generating graphs" on page 375). Either the Contour VOI Graph window (Figure 204 on page 375) or the Intensity Graph window (Figure 205 on page 379) opens.
4. Select Views > Modify Graph Features in either the Contour VOI Graph window or the Intensity Graph window. The Graph page of the Modify Graph dialog box (Figure 207 on page 382) appears.
5. Do one of the following:
   - If you want to make the points appear on the graph, select Minor tick marks visible. A check mark appears in the check box.
   - If you want to make the points invisible, clear Minor tick marks visible.

6 Click Apply.

- If you selected **Minor tick marks visible**, the tick marks along the *X* and *Y* axes in the graph appear.
- If you cleared **Minor tick marks visible**, the tick marks disappear from the graph.

7 Do one of the following:

- Close the Modify Graph dialog box.
- Keep the Modify Graph dialog box open to continue modifying the graph.

To display or hide the gridlines on graphs

1 Open an image.

2 Delineate a VOI on the image.

3 Generate an intensity profile (refer to "Generating graphs" on page 375). Either the Contour VOI Graph window (Figure 204 on page 375) or the Intensity Graph window (Figure 205 on page 379) opens.

4 Select Views > Modify Graph Features in either Contour VOI Graph window or the Intensity Graph window. The Graph page of the Modify Graph dialog box (Figure 207 on page 382) appears.

5 Do one of the following:

- To make the gridlines appear on the graph, select, if not already selected, Gridlines visible. A check mark appears in the check box.
- To make the gridlines disappear from the graph, clear Gridlines visible. The check box is empty.

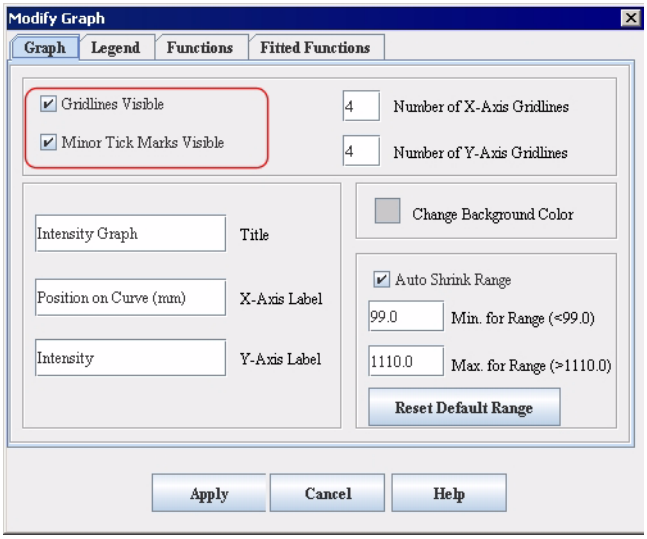


Figure 208. Displaying or hiding the gridlines and tick marks on the graph

6 Click Apply.

- If you selected Gridlines visible, horizontal and vertical gridlines appear in the graph.
- If you cleared the check box, the gridlines disappear from the graph.

7 Do one of the following:

- Close the Modify Graph dialog box.
- Keep the Modify Graph dialog box open to continue modifying the graph.

To change the number of gridlines in graphs

1 Select Views > Modify Graph Features in either the Contour VOI Graph window (Figure 204 on page 375) or the Intensity Graph window (Figure 205 on page 379). The Graph page of the Modify Graph dialog box (Figure 207 on page 382) appears.

2 Change the number of *X*-axis gridlines in Number of *X*-axis gridlines (Figure 209) by specifying a value from 1 to 50. The default number of gridlines is 4.

3 Change the number of *Y*-axis gridlines in Number of *Y*-axis gridlines (Figure 209) by specifying a value from 1 to 50. The default number of gridlines is 4.

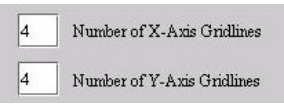


Figure 209. Number of *X*-axis and *Y*-axis gridlines

4 Click Apply.

The number of horizontal and vertical gridlines that you specified appear in the graph in the Intensity Graph window.

Tip: If you specify many gridlines, to see the gridlines more clearly, resize the Modify Graph dialog box.

5 Do one of the following:

- Close the Modify Graph dialog box.
- Keep the Modify Graph dialog box open to continue modifying the graph.

To change the graph title and labels on the *X* and *Y* axes

1 Open an image.

2 Delineate a VOI on the image.

3 Generate an intensity profile (refer to "Generating graphs" on page 375). Either the Contour VOI Graph window (Figure 204 on page 375) or the Intensity Graph window (Figure 205 on page 379) opens.

4 Select Views > Modify Graph Features in Contour VOI Graph window or the Intensity Graph window. The Graph page of the Modify Graph dialog box (Figure 207 on page 382) appears.

5 Type the new title and axes labels in Title, *X*-axis label, and *Y*-axis label boxes (Figure 210).

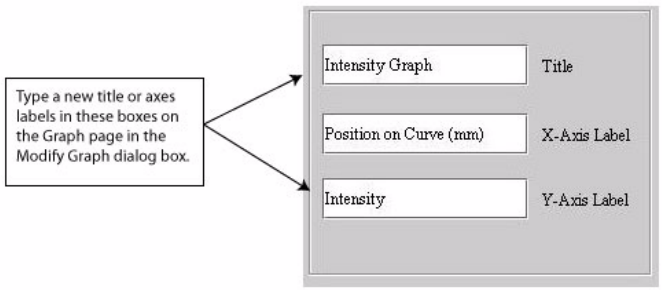


Figure 210. Title, *X*-axis label, and *Y*-axis label boxes in the Modify Graph dialog box

6 Click Apply.

The new title appears number of horizontal and vertical gridlines that you specified now appear in the graph (Figure 211).

Tip: If you specify many gridlines, you might want to resize the Modify Graph dialog box to see the gridlines more clearly.

7 Do one of the following:

- Close the Modify Graph dialog box.
- Keep the Modify Graph dialog box open to continue modifying the graph.

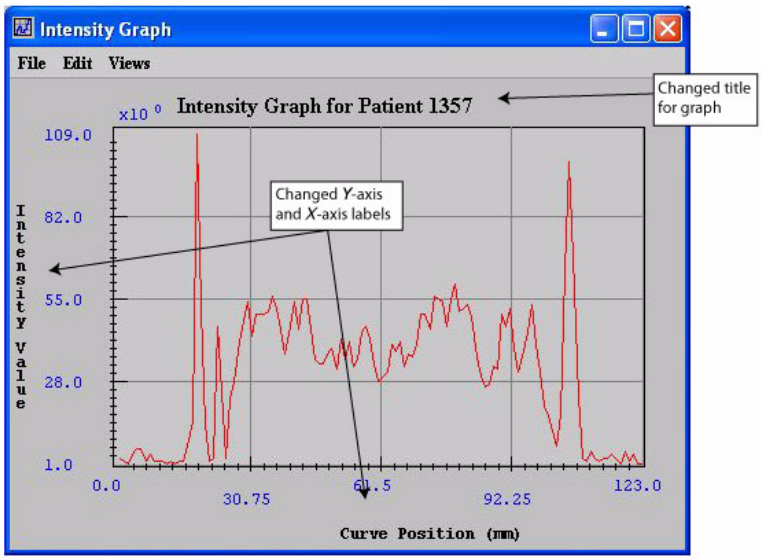


Figure 211. Changed title and axes labels in the Intensity Graph window

To change the background color of graphs

1. Open an image.
2. Delineate a VOI on the image.
3. Generate an intensity profile (refer to "Generating graphs" on page 375). Either the Contour VOI Graph window (Figure 204 on page 375) or the Intensity Graph window (Figure 205 on page 379) opens.
4. Select Views > Modify Graph Features in either the Contour VOI Graph window or the Intensity Graph window. The Graph page of the Modify Graph dialog box (Figure 207 on page 382) appears.
5. Select Change background color (Figure 212).

Figure 212. Change background color button

The Pick Background Color dialog box (Figure 213) opens.

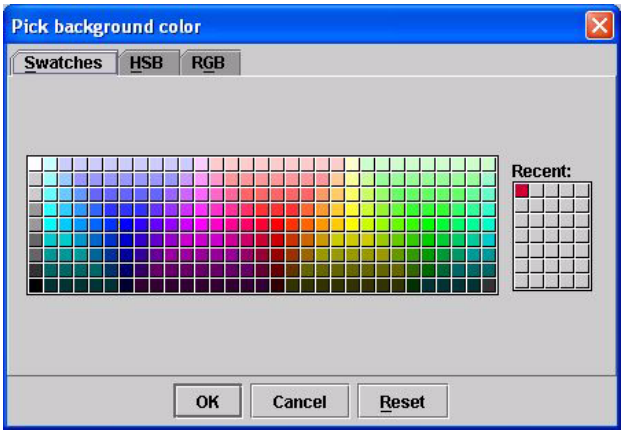


Figure 213. Pick Background Color dialog box

6 Select a color from one of the three pages in this dialog box. Refer to "To change background and border colors" on page 263 for information on how to select a color. Refer to "To change background and border colors" for information on how to select a color.

7 Click OK to apply the color to the graph background. The Pick Background Color dialog box closes, and the graph background (Figure 214) changes to the color you selected.

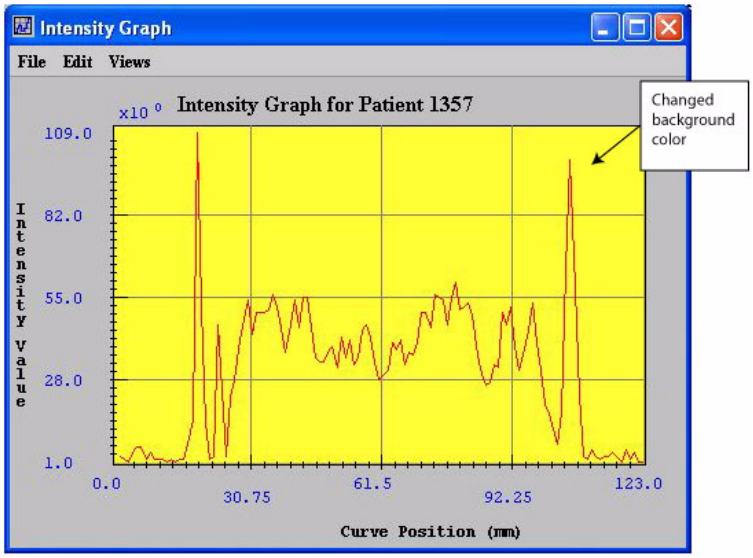


Figure 214. Changed background color for the graph

To reset graphs to their original background colors

To return either the intensity graph or the contour VOI graph back to its default colors, select Views > Reset Graph to Original or press Ctrl Z in either the Contour VOI Graph window or Intensity Graph window as appropriate.

CHANGING THE LEGENDS FOR FUNCTIONS

The Legend page controls whether a legend appears on the contour VOI graph or intensity graph and allows you to assign a specific name to each function. By default, the legend does not appear on the graph; however, when you choose so, the legend appears in the upper right corner of the graph.

To display or hide legends

1. Open an image.
2. Delineate a VOI on the image.
3. Generate an intensity profile (refer to "Generating graphs" on page 375). Either the Contour VOI Graph window (Figure 204 on page 375) or the Intensity Graph window (Figure 205 on page 379) opens.
4. Select Views > Modify Graph Features in either the Contour VOI Graph window or the Intensity Graph window. The Modify Graph dialog box (Figure 207 on page 382) appears.
5. Select the Legend tab. The Legend page (Figure 215) appears.
6. Do one of the following:
   - To display the legend on the graph, select Show legend. A check mark appears in the check box.
   - To hide the legend, clear Show legend. The check mark disappears from the check box.

7 Click Apply.

- If you selected Show legend, the legend appears in the upper right of the graph (Figure 216).
- If you cleared Show legend, the legend disappears from the graph.

8 Do one of the following:

- Close the Modify Graph dialog box.
- Keep the Modify Graph dialog box open to continue modifying the graph.

Legend tab	
Show legend	Displays, if selected, the legend on the upper right side on the graph in either the contour VOI graph or the Intensity Graph window.
Function *N* name	Specifies the name of the function. By default, the name is *Function 1,* but you can replace this name with any name you choose. This page allows you to specify up to five function names as long as those functions exist.
Apply	Applies the parameters that 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.

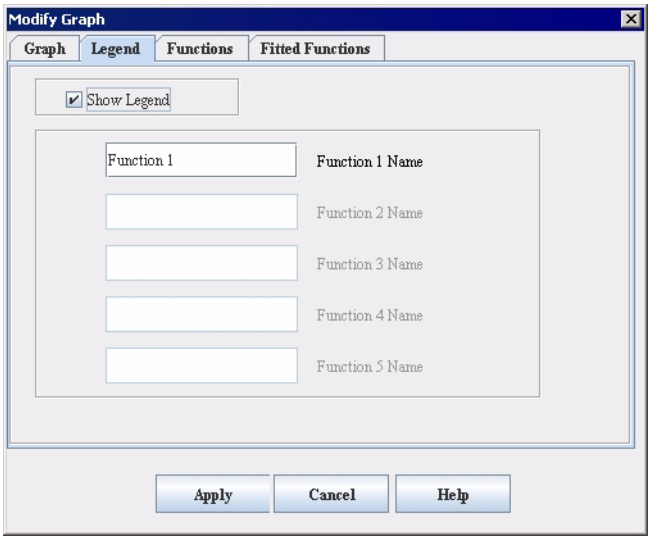


Figure 215. Legend page of the Modify Graph dialog box

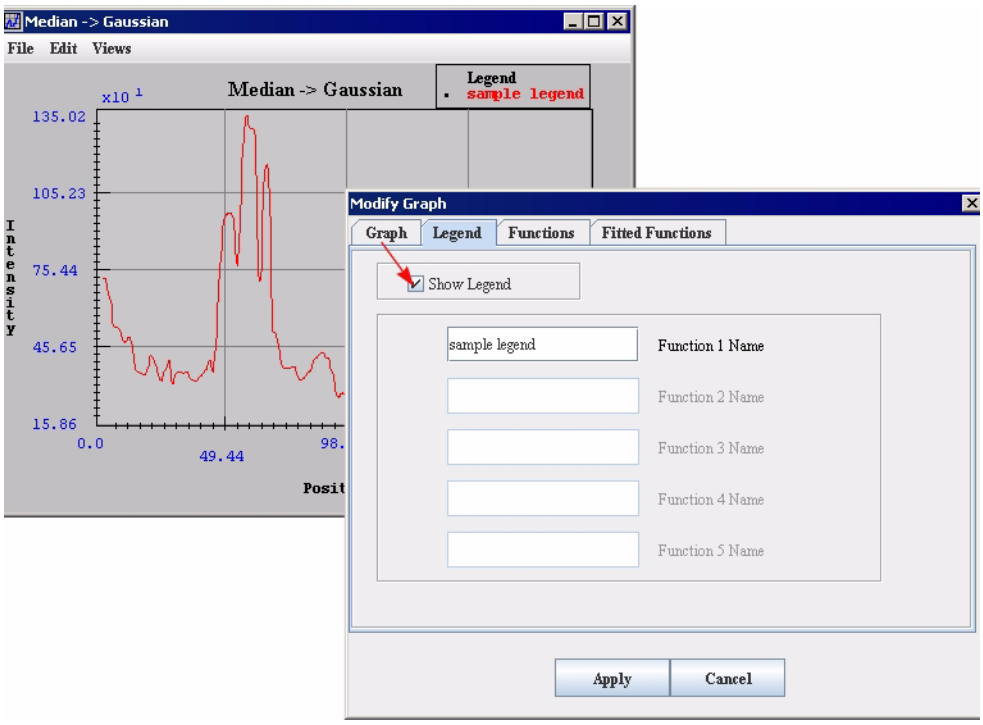


Figure 216. Legend at the upper right of the graph

CHANGING THE APPEARANCE OF FUNCTIONS

The Functions page in the Modify Graph dialog box allows you to display or hide the points on functions, display or hide from one to five functions, and change the color of functions.

Functions tab	
Points visible	Displays, if selected, all of the points on the functions.
Function *N* visible	Displays, if selected, function *#N* on the graph. You can display from one to five functions. This dialog box allows you to select only those functions that exist. Otherwise, they are dimmed.
Change function *N* color	Allows you to choose the color to use for displaying function *N* (listed on the left). When you select this icon, the Pick Background Color dialog box opens.
Apply	Applies the parameters that 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.

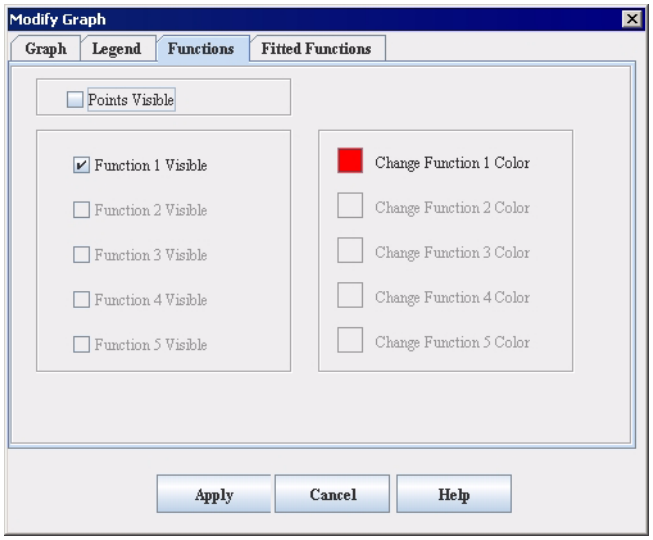


Figure 217. Functions page in the Modify Graph window

To display or hide the points on functions

1. Open an image.
2. Delineate a VOI on the image.
3. Generate an intensity profile (refer to "Generating graphs" on page 375).

   Either the Contour VOI Graph window (Figure 204 on page 375) or the Intensity Graph window (Figure 205 on page 379) opens.

4 Select Views > Modify Graph Features in either the Contour VOI Graph window or the Intensity Graph window.

The Modify Graph dialog box (Figure 207 on page 382) opens.

5 Select the Functions tab. The Functions page (Figure 217) appears.

- To display the points, select Points visible. A check mark appears in the check box.
- To make the points invisible, clear Points visible. The check mark disappears from the check box.

6 Click Apply.

- If you selected Points visible, the points appear on the functions (Figure 218).
- If you cleared Points visible, the points disappear from the function.

7 Do one of the following:

- Close the Modify Graph dialog box.
- Keep the Modify Graph dialog box open to continue modifying the graph.

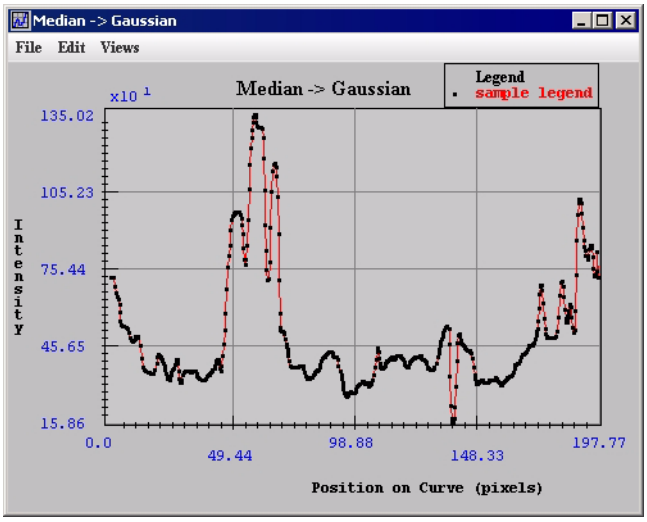


Figure 218. Points on a function whose color changed from red to blue

To display or hide functions

1. Open an image.
2. Delineate a VOI on the image.
3. Generate an intensity profile (refer to "Generating graphs" on page 375).

   Either the Contour VOI Graph window (Figure 204 on page 375) or the Intensity Graph window (Figure 205 on page 379) opens.
4. Select Views > Modify Graph Features in either the Contour VOI Graph window or the Intensity Graph window.

   The Modify Graph dialog box (Figure 207 on page 382) opens.
5. Select the Functions tab. The Functions page (Figure 217) appears.
6. Do one of the following:
   - To display the function, select Function *N* visible. A check mark appears in the check box.
   - To remove the function from the graph, clear Function *N* visible. The check mark disappears from the check box.
7. Click Apply.
   - If you selected Function *N* visible, the function appears on the graph.
   - If you cleared Function *N* visible, the function disappears from the graph.
8. Do one of the following:
   - Close the Modify Graph dialog box.
   - Keep the Modify Graph dialog box open to continue modifying the graph.

To change the color of functions

1. Open an image.
2. Delineate a VOI on the image.
3. Generate an intensity profile (refer to "Generating graphs" on page 375).

   Either the Contour VOI Graph window (Figure 204 on page 375) or the Intensity Graph window (Figure 205 on page 379) opens.

4 Select Views > Modify Graph Features in either the Contour VOI Graph window or the Intensity Graph window.

The Modify Graph dialog box (Figure 207 on page 382) opens.

5 Select the Functions tab. The Functions page (Figure 217) appears.

6 Do one of the following:

- To change the color of the function, select Change Function *N* color. A check mark appears in the check box.
- To keep the color the same, clear Change Function *N* color. The check mark disappears from the check box.

7 Click Apply.

- If you selected Change Function *N* color, the function appears in the new color.
- If you cleared Change Function *N* color, the color of the function remains the current color.

8 Do one of the following:

- Close the Modify Graph dialog box.
- Keep the Modify Graph dialog box open to continue modifying the graph.

To reset functions to their original colors

To return the functions on either the intensity graph or the contour VOI graph back to their default colors, select Views > Reset Graph to Original or press Ctrl Z in the Intensity Graph window or the Contour VOI Graph window as appropriate.

MODIFYING FUNCTIONS ON GRAPHS

The graph modifying or *fitting* is designed for fitting of statistical functions used in parameters' evaluation. Available functions are currently various statistical functions with linear or exponential autocorrelation functions. In the Fitted Functions tab, you can select the autocorrelation function and then fit the data.

As the result you will obtain the fitted curve and the set of its parameters. The fit report will appear in the Fitting Data tab and can be saved into a file using Save Messages button.

Fitted functions	
Fit linear	Use the linear autocorrelation function (a1*x+a0).
Fit exponential	Use the exponential autocorrelation function.
None	Do not use the autocorrelation function.
Fitted function *N* visible	If checked, adds the fitted curve to the graph. If this is not desirable, uncheck the box.
Apply	Applies the parameters that 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.

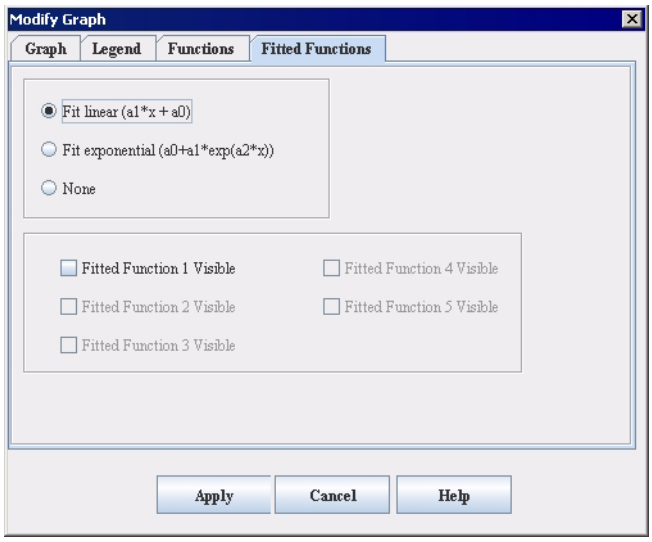


Figure 219. Fitted Functions page in the Modify Graph dialog box

Opening, saving, printing, and closing graphs

The File menu in the Contour VOI Graph window and the Intensity Graph window allows you to open, save, print, and close graphs.

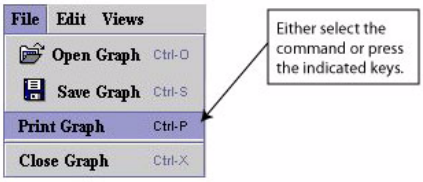


Figure 220. File menu in the graph windows showing the Open Graph, Save Graph, Print Graph, and Close Graph commands

To open previously saved graphs

1. Select File > Open Graph in either the Contour VOI Graph window or the Intensity Graph window, or press Ctrl+C. The Open dialog box appears.
2. Navigate to the directory where the graph was stored.
3. Type or select the file name in File name.
4. Click Open. The graph opens.

To save contour VOI graphs or intensity graphs

1. Select File > Save Graph in either the Contour VOI Graph window or the Intensity Graph window, or press Ctrl+S. The Save Graph dialog box opens.
2. Navigate to the directory where the graph was saved.
3. Type or select the file name in File name. Use *.PLT for the extension.
4. Click Save. The graph is saved in the specified directory.

To print contour VOI graphs or intensity graphs

1. Select File > Print Graph in the Contour VOI graph window or Intensity Graph window, or press Ctrl+P. The Print dialog box opens.
2. Select the printer and number of copies you want to print.
3. Click OK. The printer prints the graph.

To close graphs

Select File > Close Graph in either the Contour VOI Graph window or in the Intensity Graph window, or press Ctrl+X. The graph closes.