

Image Workshop

User's Guide

image analysis for us all

Version 1.0

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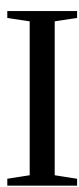
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Preface



What is Image Workshop? Image Workshop is software for the scientific study of image data. It is designed to not only display images from remote sensing and medical devices, but also to aid in the extrapolation of data from such images. This process is facilitated through the use of Image Workshop's built-in image enhancement tools and palettes. These tools and palettes include a set of drawing and painting devices, as well as tools that let you add layers on top of images, hilite specific color values via the color palette, work with several images at once, customize the image display, and compute 3-dimensional images. We hope that it serves you well.

Introduction



The following section outlines the hardware requirements for running Image Workshop, how run the program effectively, the file types that Image Workshop can display, and the purpose of this manual.

HARDWARE REQUIREMENTS

Image Workshop will run on any Macintosh that meets the following requirements:

- Macintosh running Color Quickdraw
- 68020 processor or greater
- Mac II or later
- System 7.0 or later, 32-bit mode (older machines require either Mode32 or the Apple 32-bit Enabler—both available through ftp or on-line services)
- 4 Megs required; 8 recommended
- 2 Megs of hard drive space required.

RUNNING IMAGE WORKSHOP

Before you run Image Workshop, please make sure that the following five items are located within the Image Workshop folder:



There are just a few things you should know about how to run Image Workshop effectively. First, you can store images in either the Image Workshop application folder, or in a separate image folder. Also, at startup time, Image Workshop scans recursively, looking for color tables and external modules to add to itself. Therefore, the program's loading time can be reduced by preventing it from scanning folders that do not contain color tables or externals, which is done simply by adding an option-8 (•) to the beginning of the folder's name. For example, the folder "•Images" will not be scanned because it does not contain any color tables or externals.

FILE TYPES

Image Workshop can display the following types of image formats:

- Raw images
- PICT files
- QuickTime
- Images created with Imagic
- Images saved with Image Workshop

EXTERNALS

You can also add externals to Image Workshop to add functionality, such as file readers, filters and color tables. Simply place these in either the Image Workshop Externals folder or the Color Tables folder. This placement is not required, but recommended. (They can be placed anywhere within the Image Workshop folder hierarchy).

ABOUT THIS MANUAL

This manual presents a detailed description of how to work with Image Workshop. However, despite these descriptions, the manual also assumes that you are familiar with the Macintosh. If you have any problems with the basic functions and commands, consult your Macintosh user's manual.

The first few chapters explain the functions of the tools, palettes, commands, and functions of Image Workshop, whereas the last chapter offers you the opportunity to work with the program via a structured, hands-on learning session. While working with Image Workshop, remember that the "don't save" option is always available, so don't hesitate to try out each function for yourself.

This manual was created on a Macintosh IIfx using Microsoft Word 5.1, Canvas 3.5, and Image Workshop.

Note: It may be useful to print this manual to better illustrate the figures and pictures, if you haven't already done so.

Chapter

1

Image Windows

The most basic element of Image Workshop is the "Image Window." Image Windows can be dragged, re-sized, minimized, and scrolled through just as any other window on your Macintosh. The following section outlines the main functions of Image Windows.

As stated previously, Image Windows are used to display images. A sample Image Window is shown below in Figure 1.1, displaying the image file "Colorado NDVI & Map."

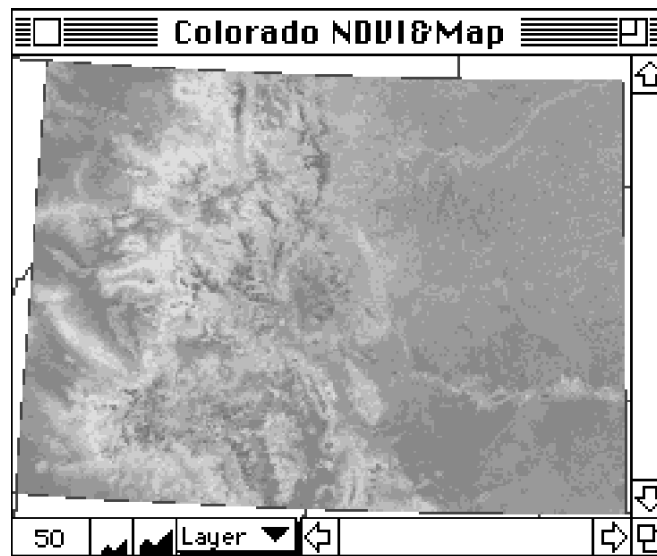


Figure 1.1

Note: A description of how to open an Image Window is found in Chapter 3 on page 15.

In addition to the normal scroll bars, there are a few other features included in the Image Window: the **zoom** command boxes and the **Layer Manager Menu**. These are described in the following two sections.

Note: The Image Window's size is limited by the maximum size shown in the **percentage display** box. For instance, each display size (50%, 100%, 200%, 400% etc...) has a maximum size that it can be re-sized to.

ZOOM COMMANDS

The two zoom commands, **zoom in** and **zoom out**, increase and decrease the magnification factor used to display the image. To use these commands, simply click in either of the two zoom boxes, as shown below in Figure 1.2.

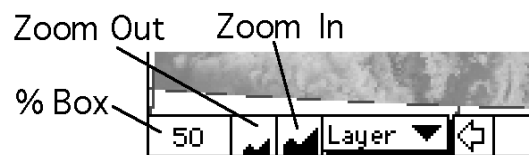


Figure 1.2

By clicking in the **zoom in** box, the image display size is multiplied x2. This is especially useful when you need to view an image with greater detail. Conversely, **zoom out** cuts the image size by 50%. And to return the image to the 100% view after either of these operations, simply click in the **percentage** box.

LAYERS

Another special feature of Image Workshop is the ability to add layers on top of your original images. The **Layer Manager** helps to add, delete, and rename such layers to images. Possible layers are, among others, contour lines, fill-patterns, shapes from the **Tools Palette**, and enhanced layers.

Each of the functions of the tools used for layering are applied to the currently selected layer in the Image Window. Exceptions to this are the tools that effect the size of the image, such as **add border**, **reduce/enlarge**, and the **zoom** commands. These size-altering tools effect all layers within the current Image Window.

For instance, to add contour lines to your image as a separate layer, simply select **contour** from the **Options Menu**. The two images below illustrate a single-layer image and a multiple (2-layer) image.

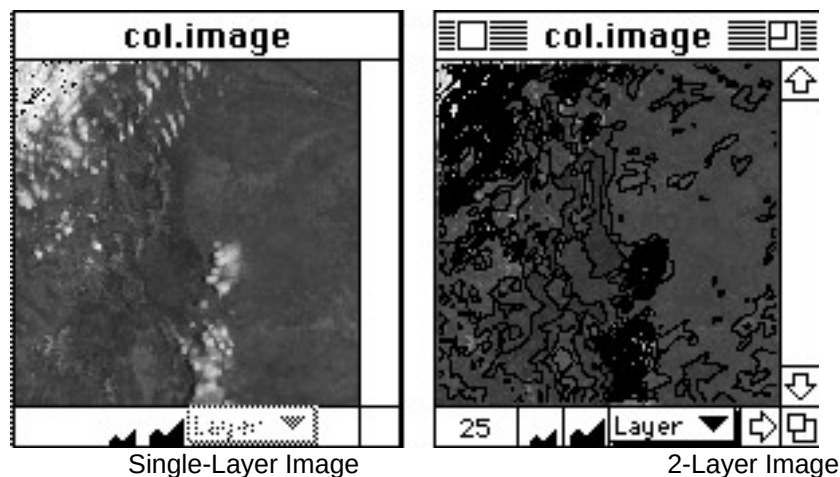


Figure 1.3

After the contour layer has been computed and added to the image, you may either "hide" or "show" the contour lines. To **hide** the lines, simply select **hide layer** from the **Layer Menu**, as shown below in Figure 1.4.

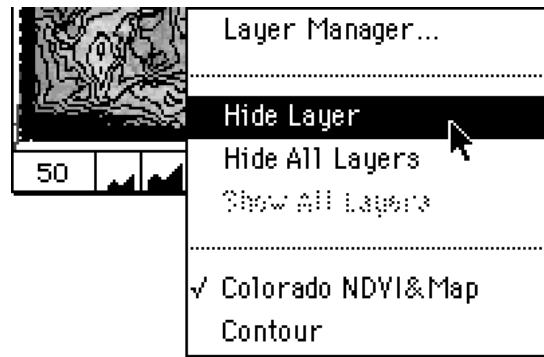


Figure 1.4

To redisplay (show) the layer, select the layer "Contour" from the bottom of the **Layer Manager Menu**. Hidden layers are marked with a "◊" and the active image is marked with a "✓".

Select **Layer Manager** from the top of the **Layer Manager Menu** to add, delete, load, rename, lower, and raise layers within the current Image Window. The **Layer Manager** dialog box is then displayed, as shown below in Figure 1.5.

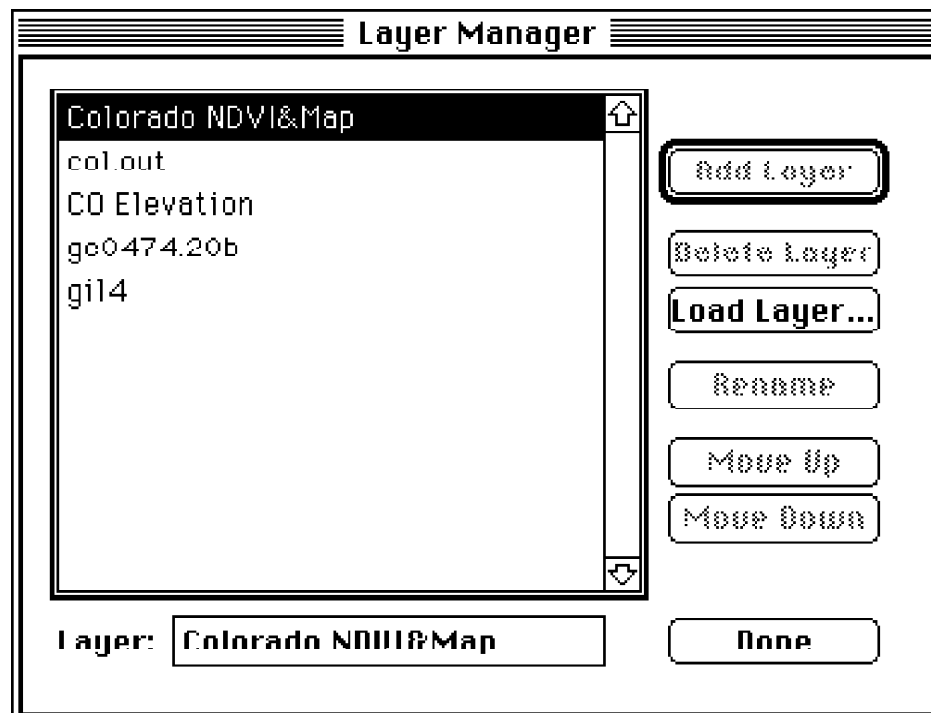


Figure 1.5

The current image's layers are listed on the left side of the dialog box in descending order (top layer on top; bottom layer on bottom). The right side of the dialog box contains six functions. **Load** opens a dialog box that you can select images to add as layers. **Add layer** adds the selected layer. **Delete** simply deletes the current selection. **Rename** lets you rename a selection. **Move up** moves the selected layer up to the next level of the layers, whereas **move down** moves the selected layer down a level.

Chapter

2

Workshop Palettes

Now that you understand what is displayed in the Image Window, the following section describes the palettes that color, enhance, manipulate etc. your images. These palettes are "floating windows," and are, therefore, displayed on top of other open windows to allow for constant access to all of the Image Workshop tools. No longer do you have to dig through endless windows to find the right palette!

TOOLS PALETTE

This section describes each of the different tools available within the **Tools Palette**, as illustrated below in Figure 2.1.



Figure 2.1

As you can see, the **Tools Palette** contains some basic instruments for drawing, labeling, painting, graphing, and moving images.

Note: The rectangle, rounded rectangle, and circle tools can all be set to draw from a center point.

Area Selection

The **area selection** tool is used to select a rectangular section of an image so that it may be moved, copied, cut, pasted, or cropped. Click on a beginning point, drag to an end point, and then release to select the desired region.

Hand

Selection of the **hand** tool allows you to move an image within the Image Window. The **hand** tool works as if you were using your own hand to slide the image on a desktop. Simply select the tool, click on a point, and drag the hand on top of the image.

Text

The **text** tool is used to superimpose text onto an image. Select the **text** tool from the **Tools Palette** and click on an area in which the text is to appear within the image. To change the text's attributes (font, size, justification, and style), use the **Text Menu** as described in Chapter 3 on page 28.

Pencil

The **pencil** tool can be used to draw on an image just like a real pencil. Select the **pencil** tool, click on a starting point and drag the pencil to create freehand lines.

Eraser

By selecting the **eraser** tool, you can erase both small and large areas of an image by zooming in or out to change number of pixels covered by the **eraser** tool. Just click and drag over the part of the image that you want to eliminate.

Fill Tool (Paint Bucket)

The **fill** tool is used to fill an area with the current color, which is selected in the **Color Table**. For more information on selecting colors from the **Color Table**, see Chapter 2 on page 9.

Paint Brush

The **paint brush** works like a real paint brush to color a selected region. The **paint brush**, like the **pencil** tool, uses the current color selection from the **Color Table**. Click on a point and drag to paint. Simply zoom in or out to change the size of the Paint Brush.

Line Tool

The **line** tool is used to draw lines on an image. Click on a starting point and drag to an end point.

Rectangle

The **rectangle** tool is used to draw rectangles on an image using the current color selection from the **Color Table**. Click on a starting point, drag, and release to complete the rectangle. The **Fill Patterns Palette** allows you to fill rectangles with a number of different patterns. To make the center of the rectangle the starting point, double-click on the tool's icon in the **Tools Palette**. A "+" will be placed in the center of the icon to illustrate that the "center-draw" feature has been activated.

Note: Chapter 2 on page 10 offers a detailed description of how to use the **Patterns Palette** for filling in rectangles.

Rounded Rectangle

The **rounded rectangle** tool draws rectangles with rounded corners and can be filled like any other shape by using the **Fill Patterns Palette**. Double-clicking on this tool, like the rectangle tool, causes the starting point to become the center of the rectangle.

Circle

The **circle** tool can draw both circles and ovals, and can be similarly filled in like the other shapes. By double-clicking on this tool, (just as the two **rectangle** tools) the starting point becomes the center of the circle.

Polygon

Not working yet.

Freehand

The **freehand** drawing tool allows you to create freehand shapes. This is similar to the **pencil** tool, except that the lines drawn with the **freehand** tool will always create a closed image that can be filled in with color and fill patterns. See Chapter 2 on page 10 for more on how to fill in freehand objects using the **Pattern Fill Palette**.

Dropper

The **dropper** tool is used to select a color that you want to duplicate directly from the image without having to use the **Color Table** to find the exact color. You can then fill any area with the selected color by clicking (with the dropper tool) on the area to be changed.

Graphing Tool

By selecting the **graph** tool, you can click on any two points of an image and a two-dimensional cross-section of the area between the points is computed and displayed. This chart also includes the image name, starting point, and the end point.

Inspect

The **inspect** tool provides information on the values of an image's individual pixels. Not working yet.

Label

The value of an image's individual pixels can be placed on the image by using the **label** tool. First, click on the **label** tool. Then click on any point on the image, and the value of that point will be labeled.

It may be useful to increase the image's magnification factor (with the zoom tools) to view smaller fonts.

Note: Use the pull-down **Font Menu** to change the attributes of the **label** tool's text, as described in Chapter 3 on page 28.

Nudge

The **nudge** tool moves an image in any direction a user-defined number of pixels. Click on two points, as you would to draw a line, and the image will be "nudged" that many pixels in the direction of the line. To gain more precise movements with the **nudge** tool, hold down the shift key and double-click on one of the four directional arrows. This will allow you to enter the value which the image is nudged by. The **nudge** tool can also be accessed and "torn away" from the **Edit Menu**.

COLOR TABLE

The **Color Table**, as shown below in Figure 2.2, not only displays each of the color values of an image, but can also be used to change the colors of objects created with the **Tools Palette**. To display the **Color Table**, simply select **Show Color Table** from the pull-down **Windows Menu**.

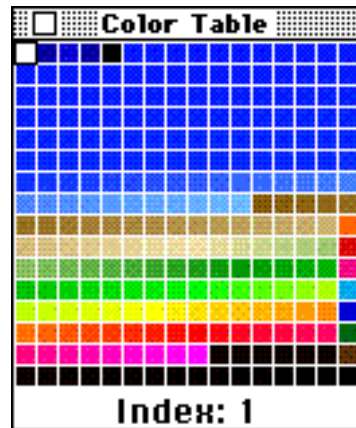


Figure 2.2

The Color Table's display may seem rather simple; however, the information that it provides is very useful. The table itself consists of 255 squares, each representing a different color value. Click on the individual squares to display the **index** number, which is located at the bottom of the **Color Table**.

These **index** numbers also represent the values found in the **Location Palette**. Click on any point on an image to find its value,

which is displayed in the **Location Palette**. If, for instance, the color value from the **Location** palette is 130, then the color for the **index** number "130" is hilited on the **Color Table**.

Note: The **Location Palette** is discussed in Chapter 2 on page 12.

As stated above, the **Color Table** can be used in conjunction with the instruments in the **Tools Palette** to change the colors of lines, shapes, fill patterns, text, and the like. Simply click on a particular color on the **Color Table**, and any tool that you use will utilize that particular color.

If the color tables provided with Image Workshop do not "match" a particular image that you are working with, use the **Edit Color Table** command from the **Options Menu**. The **Edit Color Table** command is explained in Chapter 3 on page 22.

Note: The minimum and maximum calibration values for the Color Tables are 0 and 255, respectively.

PATTERNS PALETTE

The **Patterns Palette**, shown below in Figure 2.3, displays the different fill-patterns available for use with the instruments of the **Tools Palette**. Just as selecting a color from the **Color Table** changes the color of a chosen tool, a selection from the **Patterns Palette** changes the fill-pattern of the object. The **Patterns Palette** is found in the pull-down **Windows Menu**.

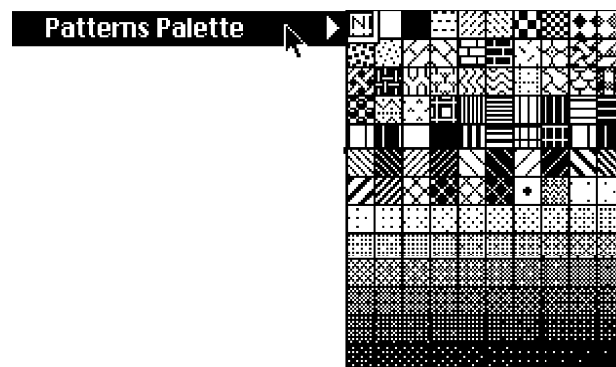


Figure 2.3

The **Patterns Palette** can be "torn away" from the **Windows Menu** by dragging it to the right. Click in the "close window box" located in the upper-left corner of the **Patterns Palette** to put it away.

COLOR SMEAR PALETTE

The **Color Smear Palette**, as shown below in Figure 2.4, displays the current **Color Table**. Select **show color smear palette** from the pull-down **Windows Menu** to display this handy palette.

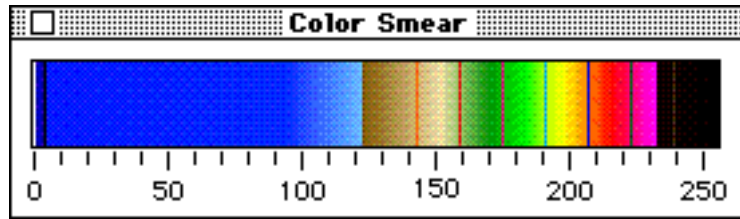


Figure 2.4

A function used concurrently with the **Color Smear Palette** and **Color Table** is **hilite**. It is used to hilite any given range of color values within the **Color Table**. Simply select **set hilite** from the **Options Menu** and enter the desired range to be hilighted.

Note: This value, or value range, must fall between 0 and 255, the minimum and maximum values allowed.

For instance, a **hilite** range of 20 can be set by entering "0" thru "20" as minimum and maximum values, respectively, in the **set hilite** dialog box. This range can then be dragged along the **Color Smear Bar** in the **Color Smear Palette** to **hilite** any 20-value set between 0 and 255.

The **set hilite** dialog box is also used to change the color of the **hilite**. Click **color** to open the "Pick a Hilite Color" dialog box, which offers finer adjustments to the color's hue, brightness, saturation, and RGB levels. Click OK when done.

ENHANCEMENT PALETTE

The enhancement features of Image Workshop enable you to remap an image's **Color Table**. The **Enhancement Palette**, as shown below in Figure 2.5, consists of an Image Histogram which shows the number of occurrences of each pixel value, a Color Table which illustrates the current colors available, a palette of Enhancement Tools, as well as pre-defined Auto, Linear, and Integrate enhancements.

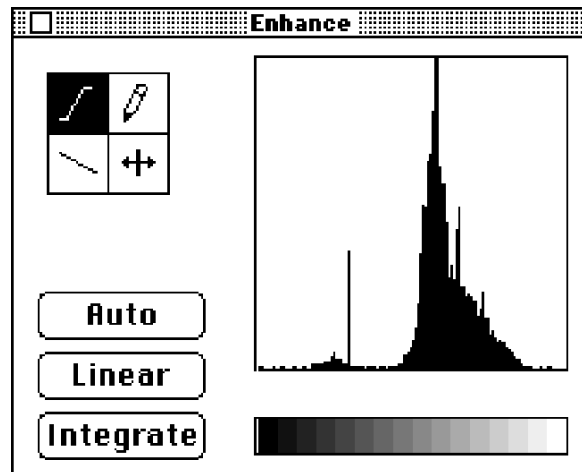


Figure 2.5

The instruments of the **Enhancement Tools Palette** include a **pencil**, a **segment** tool, a **line** tool, and a **slider**. These tools let you customize the enhancement of an image.

The **pencil** in the **Tools Palette** allows you to draw an enhancement function. The **line** draws lines. The **arrow** tool lets you drag control points on the Image Histogram. And the **slider** moves the enhancement function left or right.

The pre-defined enhancements (**auto**, **linear**, and **integrate**) each create enhanced images that "bring out" certain features of an image that you want to hilite, and to subdue the undesired features.

Auto finds the beginning and end of the Image Histogram and then puts the **Color Table** between those two points. The **linear** function simply puts the **Color Table** to 0-255. **Integrate** changes the slope of the **Color Table** to match the slope of the Image Histogram to get the best possible color variation. The derivative of the Image Histogram is used to integrate the color table along the histogram in the **integrate** enhancement.

Again, since the "don't save" option is available, try out each of these useful enhancement features for yourself.

LOCATION PALETTE

Another handy palette in Image Workshop is the **Location Palette**, shown below in Figure 2.6. When a pointer tool is moved across an image, the **Location Palette** displays the coordinates of the point from the image. Also displayed is the color value of the selected point, which corresponds to the pixel value found in the **Color Table**.

Location		
X Loc	Y Loc	Value
191	113	191
Scaled:X	Y	Value
88.24	92.29	191.00

Figure 2.6

The lower section of the **Location Palette** displays scaled (user-defined) X and Y coordinates, as well as scaled values for each coordinate. These can be entered in the **Edit Image Info** dialog box. Change both the **low** and **high scale** values and the **units** for customized coordinates and units. For example, enter 1,000 and 10,000 as the **low** and **high scale** values, and change the units to "feet" to illustrate elevation.

Note: **Edit Image Info** is described in Chapter 3 on page 16.

Chapter

3

Menus & Commands

Image Workshop has six major pull-down menus: **File, Edit, Options, Enhance, Text, and Windows.** These main menus are described in the following six sections.

FILE MENU

The **File** menu contains the most basic functions for opening, closing, saving, and printing files. These are outlined in the following sections.

New

To open a new Image Window, select **new** from the **File Menu**. Next, enter the size of the image that you want to create by entering the X and Y dimensions in the **New Image Size** dialog box. Then click **Create** to open the new Image Window.

Open

To open an image file, select **open** from the pull-down **Edit Menu**, as shown below in Figure 3.1

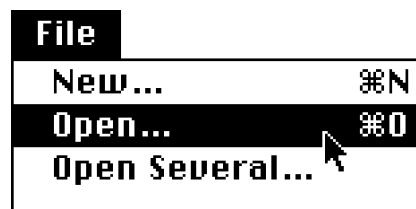


Figure 3.1

Next, you simply need to find your image folder in the dialog box and select the image file that you want to open.

The **open file** dialog box, shown below in Figure 3.2, will then prompt you to enter both the **X** and **Y** dimensions, the **bits per pixel**, and the **header bytes to skip**.

Open : "goes.1020x833"

X Dimension:	<input type="text" value="486"/>	Center Lat	<input type="text" value="0.00"/>
Y Dimension:	<input type="text" value="512"/>	Center Lon	<input type="text" value="0.00"/>
Bits Per Pixel:	<input type="text" value="8"/>	Lat Range	<input type="text" value="360"/>
Header Bytes to Skip:	<input type="text" value="0"/>	Projection:	<input type="text" value="Linear"/>
<input checked="" type="checkbox"/> Read to End of File			
<input type="button" value="Special Format"/>		<input type="button" value="Cancel"/> <input type="button" value="Ok"/>	

Figure 3.2

Special format not working yet.

Click in the "Read Until End of File" box to automatically select the **Y** dimension. The last action is to click OK when all of the fields are completed in order to open the file. This will open a new Image Window to display the image. The tutorial, found in Chapter 4 on page 32, goes through a sample opening of an image file in more detail.

Open Several

If you want to open more than one image file at a time, simply use the **open several** command. Select the files to be opened, click the **add** button in the dialog box, and then click **done**. All of the selected/added images will be opened simultaneously. To move between Image Windows, simply click on the window that you would like to work with. The **rotate windows** command, detailed in Chapter 3 on page 29, also maneuvers between Image Windows.

Image Info

The **image info** command displays the basic information about the current image. This includes the file's name, size, pixel depth, center point, vertical range, projection type, low scale, high scale, and units of measurement. The **image info** box also has a **description box** so that a more detailed description of the image can be entered.

To alter the center longitude and latitude, latitude range, low and high scales, units, projection, and description of the image, click on **edit** within the **image info** dialog box. The **Edit Image Info** dialog box, shown below in Figure 3.3, lets you make these changes.

Edit Image Info

Center Lat: 0.00 Low Scale: 0.00

Center Lon: 0.00 High Scale: 255.00

Lat Range: 180.00 Units:

Projection: Linear

Description:

Cancel Ok

Figure 3.3

Click OK to finalize the changes to the **image info**.

Create Animation

The **File Menu** also contains the **Create Animation** command, which can be used to create Quick Time movies from your images.

Quit ⌘Q

The **quit** command quits Image Workshop. Before completely closing the program, you will be prompted to save all open Image Windows that have not been saved.

EDIT MENU

The **Edit Menu** contains the commands for editing images and portions of images.

Note: Using **cut**, **copy**, **paste**, **crop selected area**, **add color bar**, and **compute statistics** require that an area has been selected with the **area selection** tool.

Undo ⌘Z

The **undo** command allows you to undo your last action from the **Edit Menu**.

Cut ⌘X

The **cut** option "erases" an area selected by one of the Image Workshop tools (such as the **area selection** tool) and places it in the clipboard.

Copy ⌘C

The **copy** command is used to copy a region selected by one of the Image Workshop tools. Use the **paste** command to paste the region elsewhere.

Paste ⌘V

Paste, used with the **copy** command, "pastes" a selected region from the clipboard.

Clear

The **clear** command clears a selected area on an open image.

Duplicate ⌘D

Duplicate makes a duplicate of a selected region.

Select all ⌘A

Select all selects the entire image in the Image Window.

Flips and rotations

The **flips and rotations** table, shown below in Figure 3.4, allows you to flip entire images horizontally, vertically, or diagonally. Rotations of 90 degrees (clockwise and counter-clockwise) can also be done using the rotation commands.

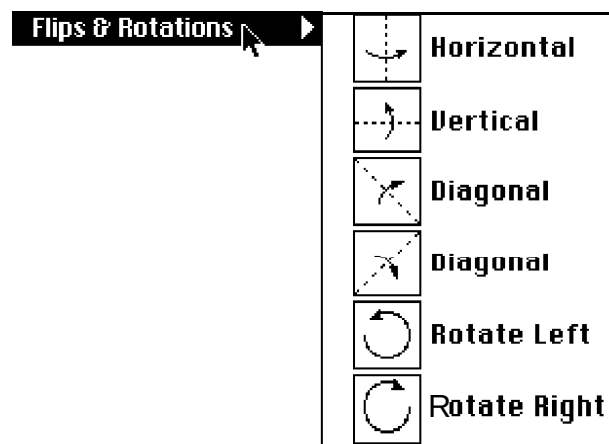


Figure 3.4

Nudge

The **Nudge Palette** offers the same functions as the nudge tool in the **Tools Palette** and can be "torn away" from the **Edit Menu** simply by dragging it to the right. The **Nudge Palette** is shown below in Figure 3.5.



Figure 3.5

To use this tool, simply click on two points, as you would draw a line, and the image will be "nudged" that many pixels in the direction of the line. Shift-double-click on any one of the arrows to enter a more precise movement.

Crop selected area

This command provides a shortcut for selecting, copying, and pasting a section of an image to another Image Window. **Crop selected area** creates a new Image Window for any area that has been selected with the **area selection** tool and pastes the area to the new Image Window, thus creating a new image.

Crop explicit area

The **crop explicit area** works in the same way as **crop selected area**, but it allows greater control over the size of the region that you wish to select. Select **crop explicit area** from the **Edit Menu** and enter the four boundary values for the area to be selected. Then click OK and the region will be displayed in a new Image Window.

Reduce/Enlarge

Select **reduce/enlarge** from the **Edit Menu** to reduce or enlarge the size of an image. Both the image's width and height can be changed by modifying the X and Y value in the **reduce/enlarge** dialog box, which is shown below in Figure 3.6. **Reduce/enlarge** effects all layers in the Image Window.

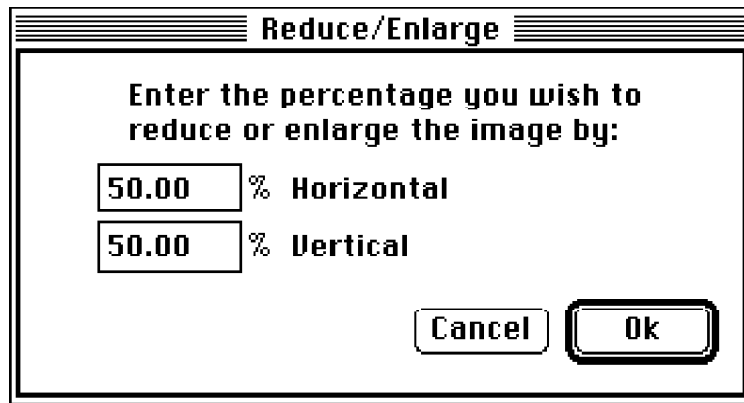


Figure 3.6

To reduce an image's size, enter percentages less than 100. Conversely, percentages larger than 100 will enlarge the image. For example, entering 50% will reduce the image by 50%, whereas entering 150% will enlarge the image.

Add color bar

The **add color bar** command superimposes a vertical or horizontal color bar on an image. Select a region with the **area selection** tool and choose **add color bar** from the **Edit Menu**. The submenu shown below will appear.

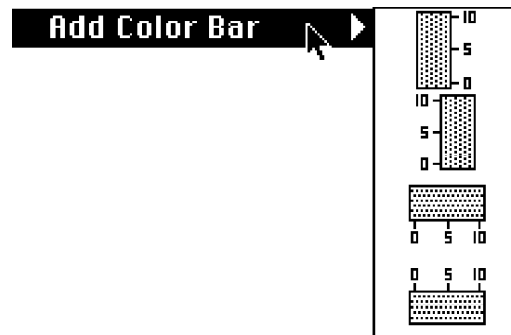


Figure 3.7

There are four different configurations of color bars that you can add to the selected region: horizontal with the color values on the top or bottom, and vertical with the color values on the right or left of the color bar. Simply choose one of these configurations from the **add color bar** submenu.

Note: The default size of the text displayed with the color bar is 9 point. If you wish to use a larger type, simply select a different size from the **Text Menu** before creating a color bar (the text size cannot be changed once the color bar has been placed).

Compute statistics

Compute statistics creates a dialog box, shown below in Figure 3.8, that displays the minimum and maximum values, the average value, as well as the standard deviation.

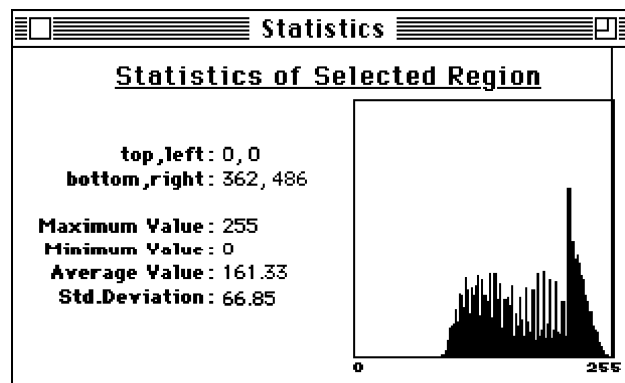


Figure 3.8

This command can be used to display the statistics for either a selected region or the entire image. Computing the statistics of an image is a quick way to get basic, but useful, information as illustrated above.

Preferences ⌘Y

The **preferences** dialog box lets you set some of the default parameters, including a printing option and the "show active layers when painting" option. The **preferences** dialog box also allows you to set the low and high calibration values, as well as calibration units. The bottom section of the dialog box contains the options for setting the image compressor.

OPTIONS MENU

The **Options Menu** contains commands for changing colors, adding borders and contour lines, combining images, calibrating values, setting hilites, and marking coordinates. These are outlined in the following sections.

Color tables

The **Color Tables** submenu allows you to change the display colors to suit your particular image. As described in Chapter 1, Image Workshop scans for **Color Tables** at startup time. These **Color Tables** can be displayed and utilized by selecting **Color Tables** from the **Options Menu**. The following figure depicts the **Color Tables** that come with Image Workshop.



Figure 3.9

Also, the **edit color table** command enables you to alter the existing color tables, as well as create new color tables.

Edit color table ⌘E

This option allows you to edit and customize color tables for your images if the ones provided do not suit your particular needs. The **edit color table** dialog box is shown below in Figure 3.10.

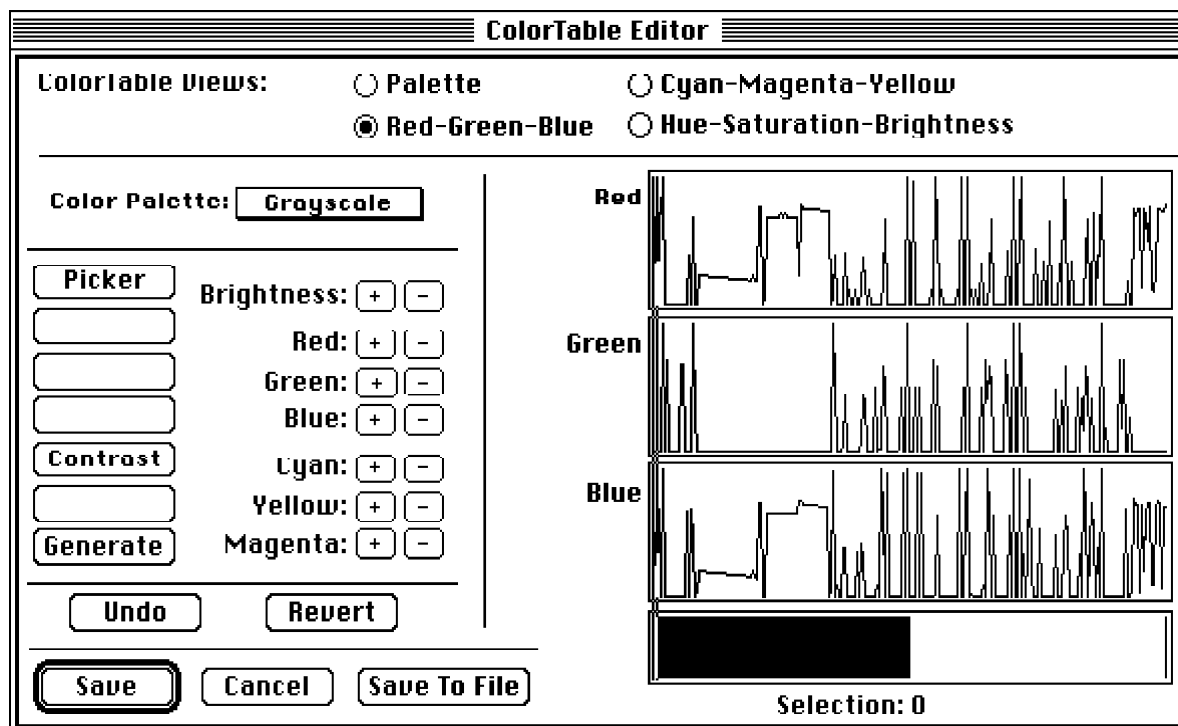


Figure 3.10

The top section of the **edit color table** dialog box lets you select one of four views to be used in conjunction with the **Color Table**. The first view is the **Palette** view, which displays a **Color Table** on the right side of the dialog box. Similarly, the other three views (red-green-blue, cyan-magenta-yellow, and hue-saturation-brightness) display their respective views of values, or range of values, of the **Color Table**. For instance, the RGB view shows the amount of red, green, and blue within the pixel selected from the **Color Table**.

As you can see in Figure 3.10 above, the left side of the **Edit Color Table** dialog box holds seven functions, as well as tools for increasing the brightness, RGB, and CYM for a selected pixel. These seven tools are: picker, smear, cycle, reverse, contrast, posterize, and generate.

The **picker** allows you to change a single color. The **smear** function produces a linear smear between the endpoints of a range of RGB colors. Similarly, **cycle** produces a linear smear between two endpoints for a range of RGB colors. **Reverse** simply "swaps" the color positions of a range of colors. The **contrast** function contrasts colors in increments and decrements. **Posterize** reduces the number of colors in a selected range. Finally, **generate** randomly generates a new color table.

The lower left side of the dialog box contains the basic commands for saving new color tables, reverting to original color tables, and "undoing" actions while editing color tables.

Don't worry, if the color table that you are editing does not turn out the way that you expected it to. Simply use the **revert** command to revert to the original color table. Also, clicking **undo** will undo your last action.

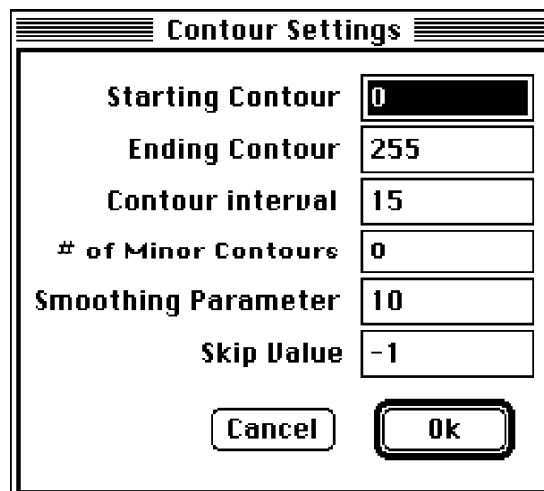
Note: For more information on editing color tables, a step-by-step example is given in the tutorial.

Add border

With the **add border** command, a user-defined border can be added to all layers of an image. Just enter the border width for each of the four sides and click OK. This option adds a border to the edges of the image and does not eliminate any part of the image itself.

Contour

Contour creates a customized contour map of any image. Enter the values in the **Contour Settings** dialog box, as illustrated in Figure 3.11 below.

The image shows a dialog box titled "Contour Settings". It contains six input fields with labels to their left: "Starting Contour" with value 0, "Ending Contour" with value 255, "Contour interval" with value 15, "# of Minor Contours" with value 0, "Smoothing Parameter" with value 10, and "Skip Value" with value -1. At the bottom are "Cancel" and "Ok" buttons.

Contour Settings	
Starting Contour	0
Ending Contour	255
Contour interval	15
# of Minor Contours	0
Smoothing Parameter	10
Skip Value	-1
<div>Cancel Ok</div>	

Figure 3.11

First, select the starting and ending values for the contour map in the dialog box. These values must lie within the calibrated values of the **Color Table**. Then enter the contour interval, number of minor contours, smoothing parameter, and skip value. Click OK and a contour map layer will be drawn on the image. (For more on layers, see Chapter 1 on page 3).

Combinations

When more than one Image Window is open, the **combinations** command can be used to create "mixes" of two or more images. You can **add**, **subtract**, **multiply**, or **divide**, any images together, as well as use the **and**, **or**, and **Xor** commands to combine images.

Again, since the "don't save" option is always available to you, try out each function for yourself.

Composites

The **composites** command creates composites of images by allowing you to set the maximum, minimum, average, median, and RGB values.

Set hilite %U

Hilite is a function used concurrently with the **Color Smear Palette**. It is used to hilite any given range of color values on an image.

Simply select **set hilite** from the **Options Menu** and enter the desired range to be hilited. This value must fall between 0 and 255, the minimum and maximum values allowed. For instance, a **hilite** range of 20 can be set by entering "0" thru "20" as minimum and maximum values, respectively. This range can then be dragged along the **Color Smear Bar** in the **Color Smear Palette** to hilite any set of 20 between 0 and 255.

Note: The **Color Smear Bar**, **Color Table**, and **Color Smear Palette** are explained in Chapter 2, and an example the **hilite** command is given in Chapter 4: A Quick Tutorial, found on page 40.

Mark coordinate ⌘L

Mark coordinate marks any selected point on an image with one of three symbols: x, +, or •. Simply enter the latitude and longitude, and select a marking device from the **mark coordinate** dialog box to utilize this feature.

ENHANCE MENU

Some of Image Workshop's most useful features are found in the **Enhancement Menu**. The enhancement functions allow you to enhance your images to emphasize specific features of the image. These functions are outlined in the following sections.

Enhance ⌘E

For a detailed description of the **enhance** command and the **Enhancement Palette**, refer to Chapter 2 on page 11.

Borrow enhancement ⌘B

The **borrow enhancement** feature simply borrows an enhancement from another image. See the section on the **Enhancement Palette** in Chapter 2 on page 11 for more on enhancements.

Filters

Image Workshop allows you to impose four different filters on your images, as shown below.



Figure 3.12

They include median, mean, and shadow filters, as well as a custom mask filter that lets you to customize the values in the spreadsheet matrix, which are the weights that are applied to the varying pixels.

Change pixel value ⌘T

Change pixel value enables you to change the value of an individual pixel. Just enter both the pixel value to be changed and the new pixel value in the dialog box to change the value, as shown below in Figure 3.13.

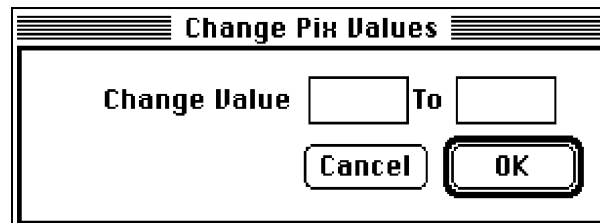


Figure 3.13

Shift pixel values

You can also shift the values of any given range of pixels by using the **shift pixel values** command. The **shift pixel values** dialog box is shown below in Figure 3.14.

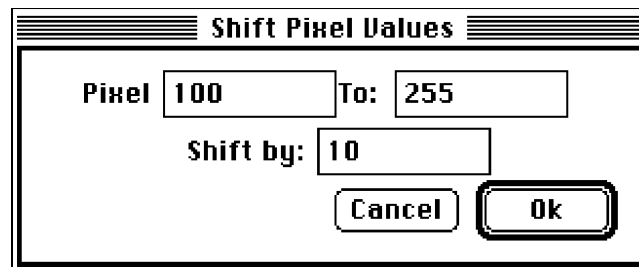
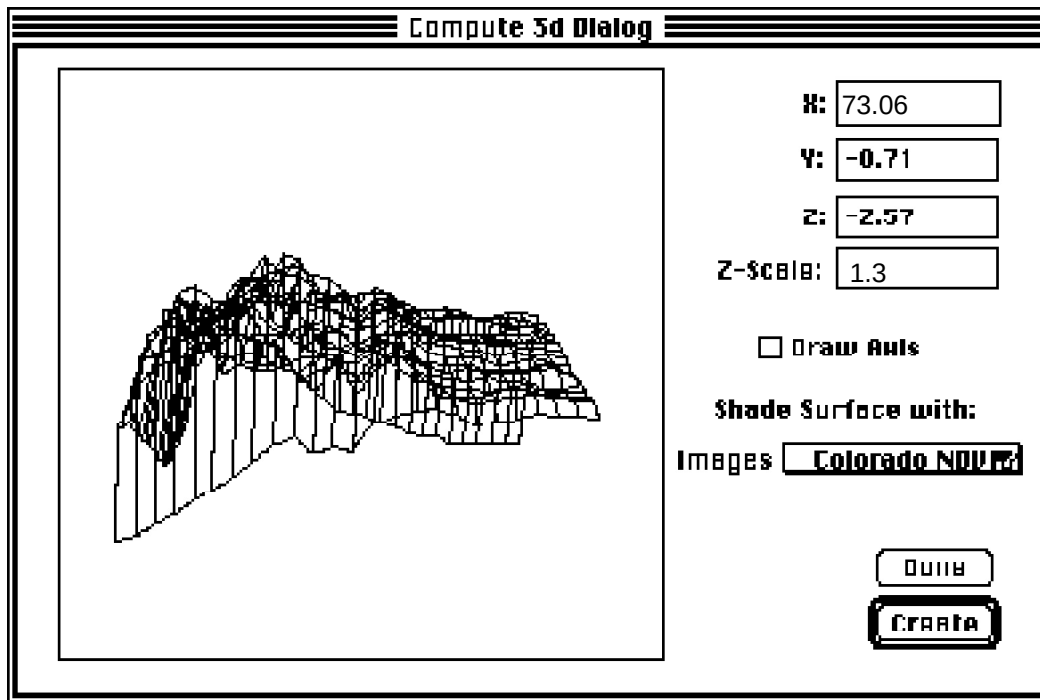


Figure 3.14

Enter the **low** and **high** values of the range to be shifted and the number of pixels that the range is to be shifted by.

Compute 3-D

Another useful feature of Image Workshop is the **compute 3-D** function. **Compute 3-D**, in the **Enhance Menu**, creates a dialog box, as shown below in Figure 3.15.



Figure

3.15

The left side of the Compute 3-D dialog box contains the 3-D image surface grid, which displays a grid in accordance with the X, Y, Z, and Z-scale coordinates on the right side of the dialog box.

The image is first drawn in an overhead view, but can be rotated in any direction to display different perspectives. Click and drag on any point on the image surface grid within the dialog box and the new perspective is automatically drawn.

You may also change the perspective by entering new X, Y, Z, and Z-scale coordinates. Pressing the tab key after each new coordinate is entered creates a new image surface grid that can be computed into a 3-dimensional image.

Below the coordinates list is the "draw axis" box. Click in this box to draw the X and Y axis on the 3-dimensional image.

Another option in the dialog box is the **Shade Surface Menu**. This option allows you to select any of the open Image Windows to be used as surface shaders. Simply click on the menu and select an image.

When you have found the "correct" perspective for creating a 3-dimensional image, click on **Create**. Image Workshop will then take a moment to create a new Image Window and a 3-dimensional image. The 3-D view of "Colorado NDVI" is shown below in Figure 3.16.

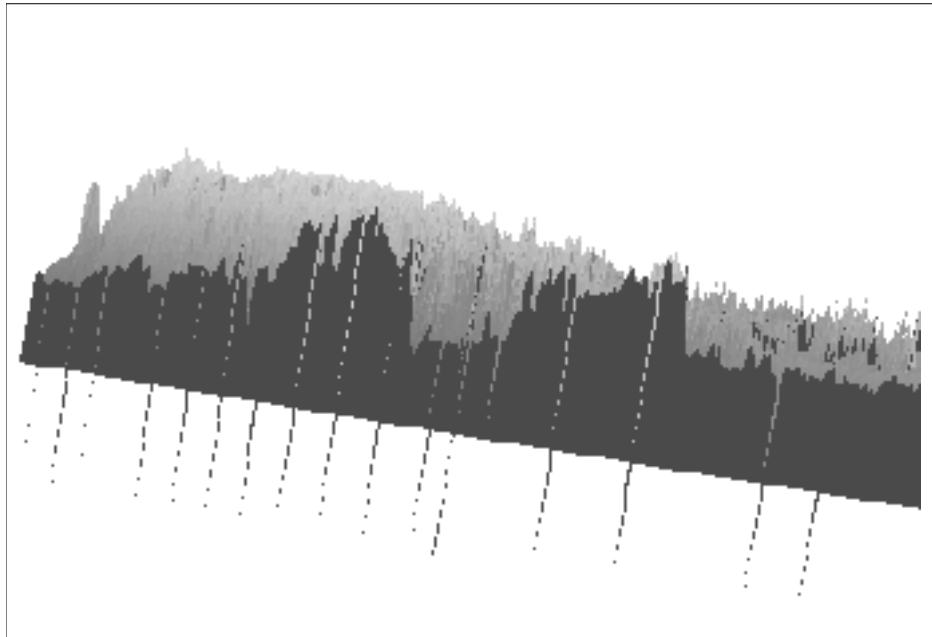


Figure 3.16

Note: A step-by-step description of this command is given in the Tutorial.

TEXT MENU

Image Workshop also offers a range of different font sizes and styles for writing on and labeling images. These text options are outlined in the following sections.

Font

Simply select any font installed on your Macintosh from the **font** submenu and use the text tool from the **Tools Palette** to write on your image.

Size

The **size** submenu simply selects the text size.

Style

Style refers to the attributes of a font. The **style** submenu effects include plain text, bold, underline, outline, shadow, as well as condensed and extended text. Select any of these styles from the **style** submenu.

Align left

Align left simply left-justifies text that you type on an image.

Align center

Align center centers text that you type on an image.

Align right

Align right right-justifies text that you type on an image.

WINDOWS MENU

The **Windows** menu offers all of the tools necessary to keep the palettes and windows of Image Workshop where you want them on the desktop. The major functions of the **Windows Menu** are outlined below.

Note: Each "hide" option has a converse "show" option, such as "hide color palette" will show the color palette after it has been hidden.

Hide ⌘H

The **hide** command hides whatever Image Window is currently open. See the **show all** or the **open images display** sections below for information on "unhiding" Image Windows.

Hide all

Hide all hides all of the open Image Windows on the desktop.

Show all

Show all displays all hidden Image Windows on the desktop.

Close all

Close all closes all open Image Windows.

Rotate windows ⌘R

When there are two or more Image Windows on the desktop, the **rotate windows** command rotates between the open windows. This tool is pretty handy for working with multiple images.

Show clipboard

The **show clipboard** command displays the clipboard and any text or graphic element within it.

Show/Hide color table palette

This command simply shows or hides the **Color Table**. For more on this palette, see Chapter 2 on page 9.

Show/Hide location palette

This command shows or hides the **Location Palette**. For more on this palette, see Chapter 2 on page 12.

Show/Hide color smear palette

This command shows or hides the **color smear palette**. For more on this palette, see Chapter 2 on page 11.

Tools

This menu item simply displays the **Tools** palette, as discussed in Chapter 2 on page 6.

Patterns

The **Patterns Palette** is used to fill in objects created with the **Tools Palette**. For more on this feature, see Chapter 2 on page 6.

Line size

The **Line Size Palette** allows you to select the line width for use with the tools in the **Tools Palette**.

Open Images Display

Open images display simply lists the Image Windows that are currently open in Image Workshop.

Chapter

4

A Quick Tutorial

Running through this tutorial should also be painless. By this point, you know that Image Workshop is easy to use and that most of the commands and functions are somewhat obvious; however, just in case you missed something, the following tutorial provides a step-by-step introduction to guide you through some of the processes. The tutorial is, hopefully, more than a simple descriptive list, but rather a working example that shows you how to utilize most of the tools, commands, options, and functions of the program. It should only take a few minutes to complete.

A QUICK TUTORIAL

After completing this tutorial, you will have performed some of the more "significant" functions of Image Workshop including, among others, the opening, rotating, hiliting, labeling, enhancing, and layering of images. Simply follow along in the program, completing each "bulleted" step as you go.

STEP **1** Opening an Image File

The first step of the tutorial will demonstrate the opening of an image file. The image file that we will be using, "Colorado NDVI & Map," is found in the "•Images" folder included with Image Workshop.

- Select open from the file pull-down menu, as shown below in Figure 4.1.

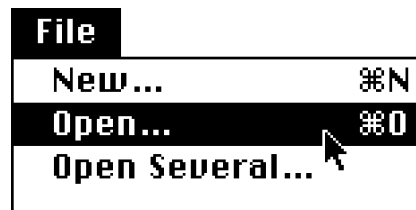


Figure 4.1

- Next, find the "•Image" folder on your hard drive and select the "Colorado NDVI & Map" image from the list.

You will then be prompted to enter some figures about the image in the "Open: *Filename*" dialog box, as shown below in Figure 4.2.

Open : "Colorado NDVI & Map"

X Dimension: 486

Y Dimension: 512

Bits Per Pixel: 8

Header Bytes to Skip: 0

Center Lat: 0.00

Center Lon: 0.00

Lat Range: 180.00

Projection: Linear

☒ Read to End of File

Special Format

Cancel Ok

Figure 4.2

Note: The variables in the dialog box shown in Figure 4.2 must be entered every time you open an image file. These will vary from image to image and they must be entered for Image Workshop to display them "correctly".

• Now enter the **X and Y dimensions** for Colorado NDVI, which are 486 and 362, respectively.

Next, the **bits per pixel** should be entered. Colorado NDVI & Map is an 8 bit image.

• Enter an "8."

If the image had header bytes within it, you would enter the number of header bytes for Image Workshop to ignore. Since Colorado NDVI does not have any header bytes, a 0 may be entered.

• Enter a "0" in the **header bytes to skip** box.

The **Center Latitude** and **Center Longitude** can be entered to fix the center point. Simply enter the center point of Colorado.

• Enter the Center Latitude and Center Longitude of Colorado in the boxes.

The **latitude range**, or vertical range, specifies the scaled height of the image.

• The **latitude range** for this particular image is about 6, so enter a "6."

Now you must choose the image's projection by selecting the desired projection from pull-down **Projection Menu**. For this example, you should use a linear projection.

- Select **linear** projection from the **Projection Menu**, located on the right side of the dialog box.

That last entry completed both the opening process and Step 1. So click OK and move on to Step 2.

- Click OK.

STEP **2** Changing & Editing the Color Table

Image Workshop allows you to display images using a variety of color tables. When you opened the Colorado NDVI image in Step 1, the default "greyscale white on black" color table was used. You can now change the color table to "NDVI Colors" by selecting the **NDVI Colors** option from the **Color Tables** submenu within the **Options Menu**.

- Select **Color Tables** from the **Options Menu**, which shows the list of available color tables.
- Go down the **Color Tables** submenu and select **NDVI Colors**.

You will notice that not only the image changed colors, but the **Color Table Palette** and the **Color Smear Palette** now reflect the color change as well.

But let's say that the **NDVI Colors** are not what you are looking for to display the image. Perhaps you are particularly fond of a certain color. The **edit color table** command will allow you to change the **Color Table** to your specifications.

- First, select **Edit Color Table** from the **Options Menu**.

This will bring up the **Color Table Editor**. The following figure depicts the top left section of the **Color Table Editor**.

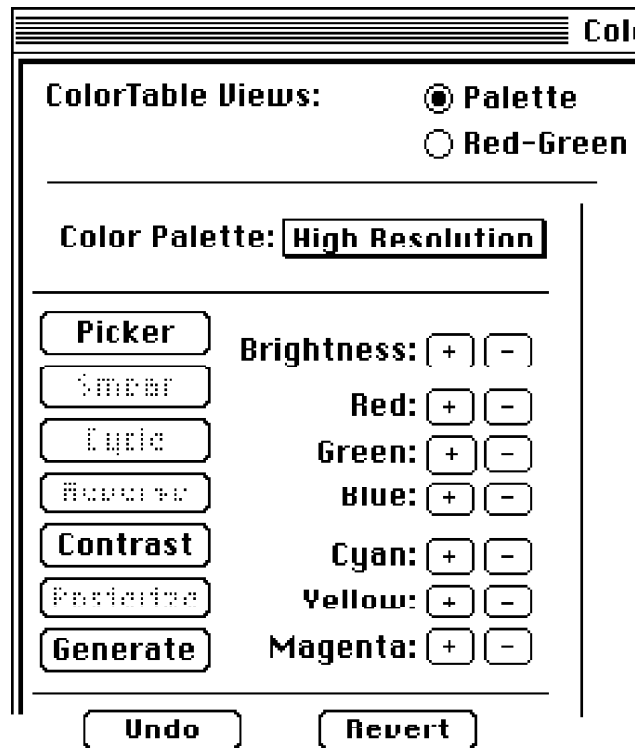


Figure 4.3

As described in Chapter 3, the **Color Table Editor** allows you to both edit and create **Color Tables**. In this example, you will go through a few features offered in the **Color Table Editor**.

First, the **Color Table** on the right side of the **Color Table Editor** can be used just like the regular **Color Table**, but this palette differs in that it allows you to manipulate the colors.

- Click on any one of the 255 color squares in the palette.
- Click **picker** on the left side of the editor.

This will open the **Picker Menu**, which allows you to change the attributes of the selected color. The left side of the **Picker Menu** contains tools for making minute changes in the selected color, whereas the right side lets you make these changes by visually picking a color from the color circle. For this example, you will shift the color's color spectrum with the **scroll bar**, located on the left side of the menu.

- Drag the **scroll bar** up and down to change the **color circle**.

Now, select a new color from the **color circle** with the selector.

- Select any color from the **color circle** with the selector.
- Click OK.

The color that you selected with the **picker** will now be shown on the **Color Table**. To revert to the original **Color Table**, simply click **revert**.

- Click on **revert**.

Next, you can change the attributes of a range of colors in the **Color Table Editor** by clicking and dragging on the **Color Table**.

- Click on any one color and drag to select a range of colors

This range can now be changed as a whole by using the functions on the left side of the **Color Table Editor**. In this example, the colors within the range will be reversed.

- Click on **reverse**.

This simply switched the placement of the colors within the range from top to bottom and vice versa.

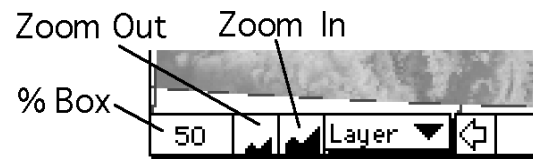
- Click on **revert** to go to the original **Color Table**.
- Click on **cancel** to exit the **Color Table Editor**.

For a detailed description of these features, see Chapter 3 on page 21.

STEP **3** Zooming In

The next operation will allow you to get a closer view of the Colorado NDVI image. Use the **zoom** command to increase the magnification factor used to display the Colorado NDVI image.

- Simply click on the **zoom in** box at the lower left corner of the Image Window, as shown below in Figure 4.4.



Figure

4.4

Now that you have gone from the 100% to the 200% view, move on to Step 4.

STEP 4 Selecting & Cropping an Area

With the image still in the 200% view, you will now select a specific area of the image and create a new Image Window. This is done with the **area selection tool**. (Any area of any size will do for this exercise; however, you don't want to select an area so large that you just duplicate the original image).

- Using the **area selection tool** from the **tools palette**, select an area that you wish to work with.
- Click on a beginning point using the **area selection tool**, drag the mouse to enlarge the area, and release to select an end point.

This area will now have "marching ants" surrounding it to illustrate your selection. It's now time to create a new image from the selected area.

- Select **crop selected area** from the pull-down **edit** menu.

The new image, consisting of your selected area, will be opened and displayed automatically in a new Image Window. This new image can be opened, closed, and manipulated just as any other Image Window in Image Workshop.

STEP 5 Zooming Out & Labeling a Point

The next step is to return the Colorado NDVI image to the 100% view. You can use either the **zoom** commands or click in the percentage display box. You may use either of the following two options:

- Click in the **zoom out** box, as shown above in Figure 4.4

- or -

- Click in the **percentage display** box

Now that the image is in the 100% view, the next step is to pick and label a specific point on the image.

First, select the **label tool** from the **tools palette**.

- Next, using the **location palette** as a guide, find the point 223 on the X axis and 107 on the Y axis.
- Click on the point.

This will label the point (223, 107) on the image with the value for the specific pixel, which is "177." This number also corresponds to the value shown in the **location palette** and the **index** number in the **Color Table**.

Note: In order to display a labeled point, you should be in at least the 100% view.

STEP 6 Computing Statistics

The **compute statistics** command computes and displays the maximum, minimum, and average values, as well as the standard deviation for either a selected area or the entire image. In this example, you will compute the statistics for the entire image.

- Select **compute statistics** from the pull-down **Edit Menu**.

The following figure is displayed as the statistics are computed.



Figure 4.5

Next, the **Statistics** dialog box, as shown below in Figure 4.6, is displayed.

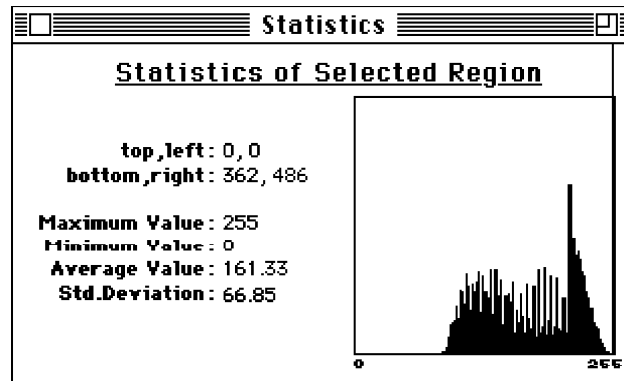


Figure 4.6

Now that you have the information from the **Statistics** dialog box, it's time to move on to Step 7.

STEP 7 Enhancing the Image

As stated in Chapter 2, an attribute of Image Workshop is the ability to illustrate certain features of an image through enhancement.

- Select **enhance** from the **Enhance Menu**.

The dialog box, shown below in Figure 4.7, will appear.

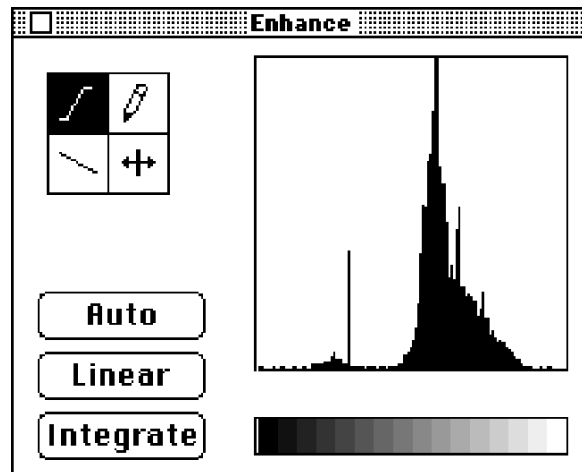


Figure 4.7

In this example, you will use the pre-defined enhancements. The **auto** function puts the **Color Table** between the two endpoints of the Image Histogram.

- Click **auto** in the Enhancement Palette.

The Colorado NDVI image now reflects the enhancement. Now, try the **integrate** function, which changes the slope of the **Color Table** to match the slope of the Image Histogram.

- Click on **integrate**.

Next, you can return the **Color Table** to 0-255 ("normal") by selecting the **linear** enhancement.

- Click **linear**.

To close the **Enhancement Palette**, click in the "close window box" in the upper right corner of the window.

- Click in the close window box

Now it's time to move on to Step 8.

STEP 8 Hiliting a Range

Step 8 explains how the **hilite** function can be used to hilite a specific value on an image.

- Select the **hilite** command from the **Options Menu**.

The following dialog box is displayed.



Figure

4.8

The **hilite** command, as described in Chapter 2 on page 11, hilites a specific user-defined range of values on the image. To select this range, you need to enter the values of the pixels that you wish to be hilited in the **set hilite** dialog box.

For this example, use the values 100 and 150 as minimum and maximum values.

- Enter 100 in the left box and 150 in the right box.

You may specify which color that Image Workshop uses to **hilite** the image with by clicking in the **color** box in the **set hilite** dialog box.

- Select any color that is used the least on the image, possibly white in the case of the Colorado NDVI image
- Click OK.

All of the points on the image with values falling between 100 and 150 will now be shown in the color that you selected.

- Select **turn off hilite** from the options menu.

This turns off the **hilite** and the original image is displayed. Now you can move on to Step 9: Computing a 3-D Image.

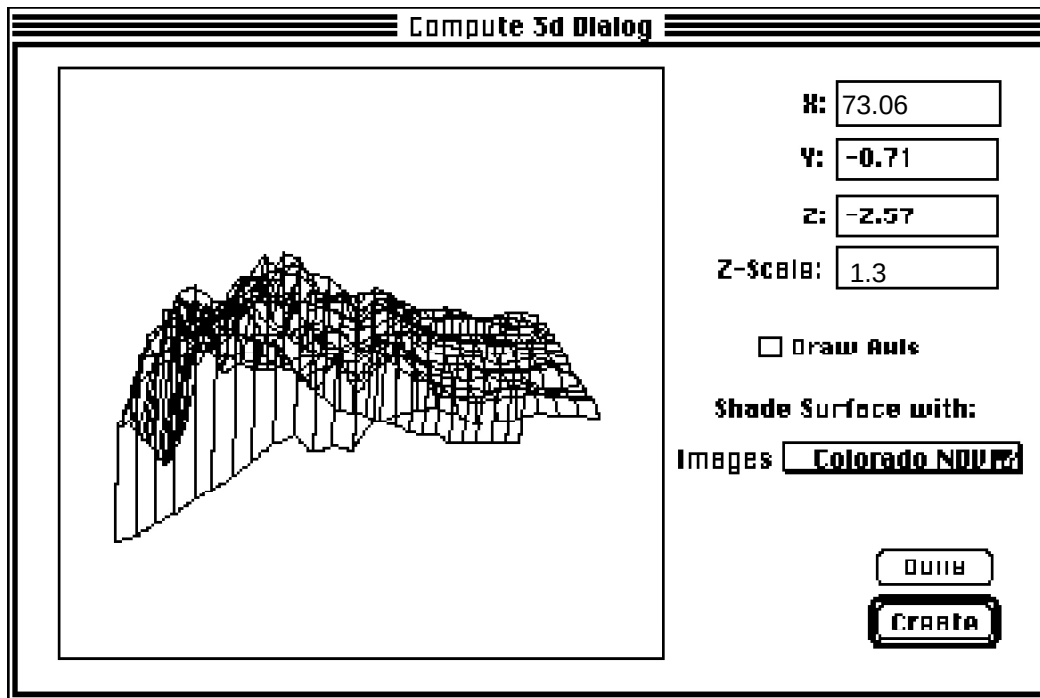
STEP 9 Computing a 3-D Image

The next step in the tutorial is to create a 3--dimensional drawing of the Colorado NDVI image.

- Select **compute 3-D** from the **Enhance Menu**.

A window illustrating the computer's progress will then be displayed, and a 3-D dialog box is created when the calculations are

finished. The 3-D dialog box, shown below in Figure 4.9, contains a surface grid of the image, as well as X, Y, Z, and Z-scale coordinates.



Figure

4.9

The surface grid can be rotated on its axis in any direction by clicking and dragging.

- Click on one of the top edges of the image and drag it upwards until it has rotated approximately 90 degrees.
- Release the mouse and the new perspective is automatically re-drawn.

This gives you a side view of the image.

The next step is to change the height of the image surface grid that you just rotated by changing the Z-scale. For this example, the new Z-scale will be "3."

- Enter a "3" in the Z-scale box and press the tab key.

Now it's time to create a 3-dimensional image using the data that you just entered.

- Click on **create**.

Image Workshop will now take a moment to create a 3-dimensional image of the Colorado NDVI image. When the computations are finished, a new Image Window will be created to display the image. Once the image appears on your screen, you can close the **Compute 3-d** dialog box.

- Click on **done**.

This new Image Window can be manipulated, saved, or discarded before you move on to the Tutorial's final step.

STEP **10** The Final Step

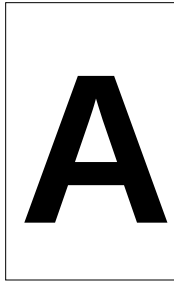
The last step is simply for you to "fiddle" with Image Workshop: Sometimes this proves to be one of the best methods, and if you don't understand a particular function, the previous chapters offer definitions and examples.

Try opening several different image files and perform different operations on each one. Compare the effects of each tool with what is displayed on your screen. This should help you to use Image Workshop more effectively. Always remember that you do not have to save the changes to your images if you don't want to.

ABOUT THE TUTORIAL IMAGE

The Colorado NDVI image is 486 x 362. This image is a particularly good example to work with, especially in the 3-D view. Water and trees are easily viewed in this image as well.

Appendix



This section contains the External Modules Programming Reference and the Commands Reference Card.

PRELIMINARY DRAFT

This document needs much more work. This is merely preliminary to get people started in using the External Modules. -- BSP

Preface:

Before writing External Modules, you should be familiar with Macintosh Programming basics. You should also be familiar with how to create code modules with whichever development environment you choose. Two basic projects are included for Metrowerks CodeWarrior and Symantec C++ v7.0. This reference assumes that you will be using C or C++ for the module; however, you may write the software in any language. However, if you write it in anything other than C, you will have to convert the library traps from the C source included into whichever language. Additionally, any external module developed may be freely distributed, etc. The author of the external module has all rights to it. The University of Colorado/CCAR makes no warranties and takes no responsibility for any external modules written.

Using External Functions

Setting up the Module:

The first step in creating an external function is deciding what your function will do. Next, you must set up the function so that Image Workshop can help you achieve this goal. You must create a resource of type 'Xcfg'. This resource is loaded along with your code resource and contains the configuration settings of your module. This resource MUST have the same resource number as the code resource and be contained within the file. All Code Resource files MUST have a filetype of 'EXBP' to be loaded by Image Workshop. A ResEdit template is contained in the included file, "Xcfg Template." This allows you to use ResEdit to edit your Xcfg resource.

The first parameter is the number of images required by your module to function. This is a short value. Set this value to the minimum number of images your module requires. If your module acts independantly of images, enter a value of 0.

The second parameter is the command number to append your function after in the menus. This tells Image Workshop where in its pull-down menus it should put your function. Look in the reference later for a table of command numbers. For example, if you would like your function to appear after the Shadow Filter in the Filter submenu, you would enter a value of 4153. If you enter a value of 0, then your module will automatically be appended to the Custom pull-down menu. This value is ignored if you enter TRUE for the last parameter.

The last parameter is a Boolean value stating whether or not your module is a file reader/saver. For custom file readers and savers, you would enter a TRUE value for this. Otherwise, if it is a general module, enter FALSE.

Additionally, each module may have and use it's own resources such as ALERT's, DLOG's, etc.

Using the Module:

THIS SECTION NEEDS MUCH FURTHER DISCUSSION

Image Workshop calls your external function through its main. A message and data are passed through this main. Traditionally on the Macintosh, code resources are not allowed to use Global Variables. Therefore, Image Workshop will hold one handle for each external module so that it may keep whatever information it wishes. This data must be allocated and deleted by each external module. This is accessed through the variable myData.

All modules receive a ModuleInit message. This function is called whenever Image Workshop boots up. If you need to do any initialization at run-time, perform it here. Additionally, when Image Workshop is quitting, you will receive a ModuleDispose message. Here, you can clean up any memory, etc. that you may have allocated.

Depending on what your function does, you will receive different messages. Most modules will receive the ModuleExecute message when the user selects it from the menu. This is your chance to perform the module's function.

If it is a file reader/saver, you will receive a ModuleRead or ModuleSave function depending on the user actions.

If your code begins background processing through the call to Image Workshop, then you will receive a ModuleProcessTask function every few ticks (you can set the number of ticks) for you to process while the user is doing other things. If the user cancels, you will receive a ModuleCancelTask message. Each message is commented and explained in ModuleFunctions.c.

Every function called is passed four data members:

`functions`: This is an array of function call-backs to Image Workshop

`data1`: This is a Ptr of data that your function may need.

`data2`: This is a second Ptr of data that is passed into your function

`myData`: This is a handle for the module private use. You can store any data into this handle.

Calling Image Workshop Functions

All Image Workshop callback functions are described in detail in the reference. To call a function, dereference it from the functions variable passed into each function. To call the function, GetTopImage use the syntax:

```
topImage = functions->GetTopImage();
```

This calls back to Image Workshop and returns the top image reference number. All images are referenced using a short value. To keep track of a particular image, you will use a reference number.

Reference

Command Constants:

The following table contains every command and their command numbers:

File

New	2
Open	3
Open Several	1054
Close	4
Save	5
Save As	6
Revert To Saved	7
Image Info	1052

Create Animation	1053
Page Setup	8
Print	9
Quit	1
Edit	
Undo	16
Cut	18
Copy	19
Paste	20
Clear	21
Duplicate	2001
Select All	23
Flips & Rotations (submenu)	
Horizontal	2101
Vertical	2102
Diagonal Right	2103
Diagonal Left	2104
Rotate Left	2105
Rotate Right	2106
Nudge (submenu)	
Cannot access	
Add Color Bar (submenu)	
Vertical Right	2121
Vertical Left	2122
Horizontal Bottom	2123
Horizontal Top	2124
Crop Selected Area	2005
Crop Explicit Area	2006
Reduce/Enlarge	2007
Compute Statistics	2010
Preferences	2011
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Enhance	4001
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Filters (submenu)	

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ColorSmear Palette	6010

Layer Manager Popup Menu	
Layer Manager	6200
Hide Layers	6216
Hide All Layers	6217
Show All Layers	6218

Miscellaneous Constants:

Function Reference:

CTabHandle GetColorTable(short imageNum)

Return a handle to the color table of a given image.

void SetColorTable(short imageNum, CTabHandle
 cTable)

Set the color table of a given image with the given color table handle.

short GetTopImage(void)

Return the image reference value of the current top image.

void PrintImage(short imageNum)

Print the given image.

void CloseImage(short imageNum)

Close the given image, prompting the user to save if changes were made.

GWorldPtr GetCurrentLayer(short imageNum)

Return a pointer to the offscreen gworld of the current layer of the given image.

Boolean BeginDrawing(short imageNum)

Set the port and lock the pixels of the current gworld layer used by the given image. NOTE: This call must be followed by a matching EndDrawing call; otherwise, you will leave the QuickDraw port dangling. Additionally, this function will save the given image for undo. This allows the user to cancel whatever your function has done.

```
void                EndDrawing(short imageNum)
```

Finish the drawing of the given image.

```
short                NewImage(Point *size, GWorldPtr gWorld)
```

Create a new image window with the given size and using the given gworld data. If gWorld is NULL, then a new, blank image will be created with the given size.

```
void                GetGeography(short imageNum, LatLon  
                                *center,  
                                double *latrange, short *projection)
```

Get the geographical data from the given image.

```
void                SetGeography(short imageNum, LatLon  
                                *center,  
                                double latrange, short projection)
```

Set the geographical data for the given image.

```
short                LoadImage(StandardFileReply *reply, short  
                                imageNum)
```

Load an image. The file described by the reply structure will be loaded by Image Workshop. If you want it loaded into a new image, specify 0 for the imageNum. Otherwise, specify an image to load the given file into a new layer.

```
short                AddLayer(short imageNum, GWorldPtr gWorld)
```

Add a layer to the given image. If gWorld is NULL, then a new, blank layer is added, otherwise the data from gWorld is added to the new layer.

```
short                GetCurrentLayerNum(short imageNum)
```

Return the index to the current layer used by the given image.

```
short      CountLayers(short imageNum)
```

Return the number of layers currently used by the given image.

```
void SetCurrentLayer(short imageNum, short
                    layernum)
```

Set the current layer of the given image to the given layer index value.

```
void GetSelectionRect(short imageNum, Rect
                    *selRect)
```

Return the selection rectangle that the user has currently chosen for a given image. If selRect is returned NULL, then no selection range has been set.

```
void      BeginTask(void)
```

Begin the task that the module is performing. After BeginTask is called, the module function, ModuleProcessTask, will be called repeatedly until a call to EndTask is made.

```
void                EndTask(void)
```

This will end the processing that is being made by the current external module.

```
void                RedrawImage(short imageNum)
```

Redraw a given image to update any changes that may have been made.

Commands Reference C

Borrow Enhancement ⌘ B

Change Pixel Value ⌘ T

Close ⌘ W

Copy ⌘ C

Cut ⌘ X

Duplicate ⌘ D

Edit Color Table ⌘ E

Hide ⌘ H

Image Info ⌘ I

Mark Coordinate ⌘ L

New ⌘ N

Open ⌘ O

Paste ⌘ V

Preferences ⌘ Y

Print ⌘ P

Quit ⌘ Q

Rotate Windows ⌘ R

Save ⌘ S

Select All ⌘ A

Set Hilite ⌘ U

Undo ⌘ Z

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