ENVI Tutorial:
Interactive Display Functions

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Overview of This Tutorial

This tutorial provides an introduction to using ENVI with Panchromatic (SPOT) data, including display, contrast enhancement, basic information about ENVI and some suggestions for your initial investigations of the software. It is designed to introduce first-time ENVI users to the basic concepts of the package and to explore some of its key features. It assumes that you are already familiar with general image-processing concepts. It is recommended that new users begin with either the *Quick Start to ENVI* tutorial or the *Introduction to ENVI* tutorial before beginning this tutorial.

Files Used in This Tutorial

ENVI Resource DVD: `envidata\enfidavi`

File	Description
enfidavi.bil	SPOT Panchromatic Data, Enfidaville, Tunisia
enfidavi.hdr	ENVI Header for Above
enfidavi.dsc	GeoSpot Volume Descriptor File
enfidavi.rep	GeoSpot report file (REP/B: GEOSPOT Structure)
enfidavi.rsc	GeoSpot Raster Source Description File
dxf.txt	DXF coding descriptor file
alti.dxf	Spot height DXF file
energy.dxf	Oil or Gas Pipeline DXF file
hydro.dxf	Hydrology DXF file
industry.dxf	Industrial Areas DXF file
physio.dxf	Physiographic areas DXF file
popu.dxf	Urban Features (Population Centers) DXF file
transpor.dxf	Transportation Networks DXF file
copyrite.txt	Data Copyright Notice Panchromatic Data and Vector Overlays

This dataset is a SPOT Panchromatic image and corresponding DXF files of Enfidaville, Tunisia, courtesy of ITT Visual Information Solutions International France. These data are Copyright CNES-Spot Image and IGN France.

Opening a Panchromatic (SPOT) Image File

Before attempting to start the program, ensure that ENVI is properly installed as described in the Installation Guide that shipped with your software.

1. From the ENVI main menu bar, select **File → Open Image File**.
2. Navigate to the **envidata\enfidavi** directory, select the file **enfidavi.bil** from the list, and click **Open**. The Available Bands List appears on your screen. This is a SPOT Panchromatic image of Enfidaville, Tunisia, courtesy of ITT Visual Information Solutions France. The data in this file is copyrighted as Copyright CNES-Spot Image and IGN France.
3. Select **Band 1**.
4. Ensure the **Gray Scale** radio button is selected - then click **Load Band** to load the image into a new display.
5. Examine the image in the display group.

Performing Interactive Contrast Stretching

Interactive contrast stretching plots a histogram and allows you to interactively control the contrast of the displayed image. Many different types of stretches can be applied. By default, a linear 2% stretch is applied to the data when it is first displayed.

1. From the Display group menu bar, select **Enhance → Interactive Stretching**. An Interactive Stretching dialog for the displayed band appears. This dialog allows you to change the contrast stretch of the displayed image. Two histogram plots display the color or gray scale range of the input image (left) and the output image after contrast stretching (right). Initially, the input and output histograms reflect the default stretch applied to the data when the image was displayed.
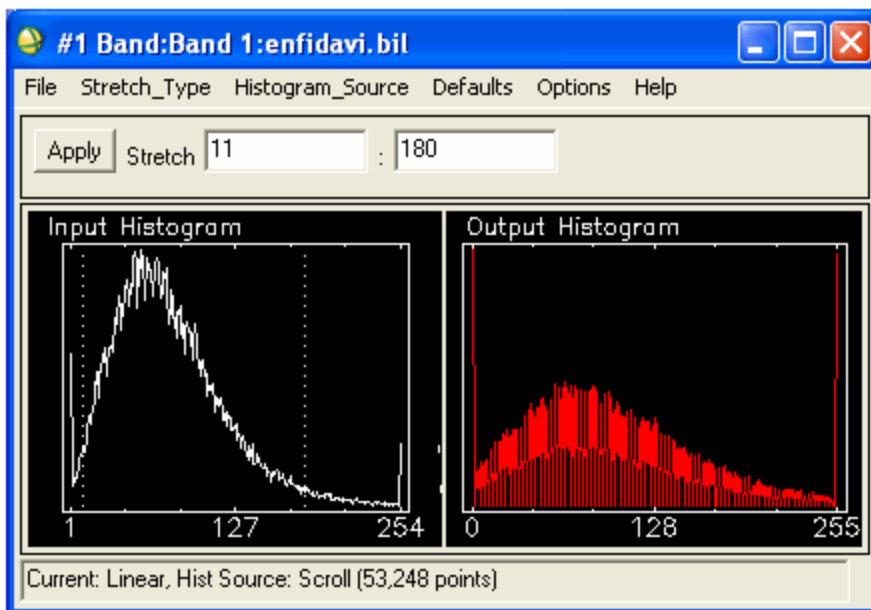

2. Input histogram information can be extracted from the Image window, from the Scroll window (subsampled), from the Zoom window, from the entire image band (all pixels of the data), or from a user defined region-of-interest (ROI). Explore the options available in the **Histogram_Source** menu on the Interactive Stretching dialog menu bar.

Linear Stretching Options

When images are loaded into the display group, a 2% linear contrast stretch is applied by default. This can be modified by selecting **File → Preferences** from the Display group menu bar, then clicking the **Display Defaults** tab.

1. From the Interactive Stretching dialog menu bar, select **Stretch_Type → Linear**. Two vertical dotted lines appear in the input histogram plot—these bars can be repositioned to control the minimum and maximum value used in the contrast stretch.

2. In the Input Histogram window, there are two dotted vertical bars on either side of the histogram. These bars can be repositioned to control the minimum and maximum value used in the contrast stretch. Position the mouse cursor over the left bar then click and hold the left mouse button as you drag the bar from side to side. As the dotted vertical bar is moved across the plot, numbers appear on the status bar of the Interactive Stretching dialog. Whenever the left mouse button is clicked over the histogram plot, the status bar displays the current data value, the number of pixels and percentage of pixels that have that value, and the cumulative percentage of pixels with values less than or equal to the current value.

3. You can choose to have stretching or histogram changes applied to your images automatically, by selecting **Options → Auto Apply** from the Interactive Stretching dialog menu bar. To have changes applied to your image only when you click the **Apply** button, toggle the **Auto Apply** option off. For this exercise, toggle the **Auto Apply** option **on**.

4. Position the left dotted vertical bar in the Input Histogram window so that a cumulative percentage of pixels equaling approximately **5%** is selected. Now move the right bar so that the cumulative percentage is approximately **95%** of the pixels.
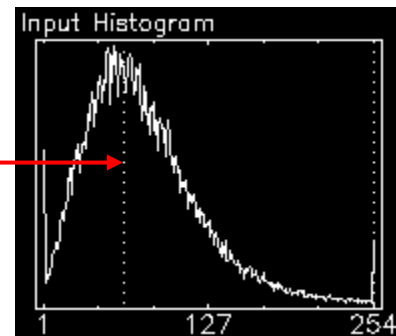
5. You can also position the bars by entering a minimum and maximum value (numbers or percentages) in the **Stretch** fields provided in the dialog. Enter **4%** in the left text field and **96%** in the right text field and press the **Enter** key. The % values are converted to digital numbers and the left and right bars in the display are updated with the data values at 4% and 96%, respectively.

Gaussian Stretching Options

The default Gaussian stretch is centered at a mean of 127 with the data values 3 standard deviations set to 0 and 255.

1. From the Interactive Stretching dialog menu bar, select **Stretch_Type → Gaussian**.

2. From the Interactive Stretching dialog menu bar, select **Options → Set Gaussian Stdv** to set the standard deviation. The Set Gaussian Stdv dialog appears allowing you to adjust the standard deviation value and see the effect when the new setting is applied to the display group.
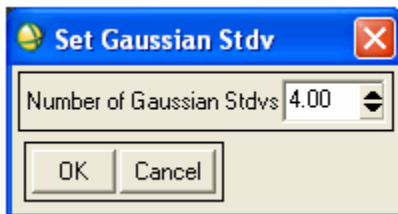
3. Set the Gaussian Stdvs to **4.00** and click **OK**.

4. You can choose to have the stretch automatically applied to the image display group by ensuring **Options → Auto Apply** is selected from the Interactive Stretching dialog menu bar.

Equalization Stretching Options

You can use the **Equalization** option in the Interactive Stretching dialog to automatically scale the data to equalize the number of digital numbers in each histogram bin.

1. From the Interactive Stretching dialog menu bar, select **Stretch_Type → Equalization**.

2. You can choose to have the stretch automatically applied to the image display group by ensuring **Options → Auto Apply** is selected from the Interactive Stretching dialog menu bar.

3. From the Interactive Stretching dialog menu bar, click **File → Cancel** to close the Interactive Stretching dialog.

Applying ENVI Color Tables

You can use **Color Mapping** to apply color tables to images, create interactive density sliced images, control the RGB image planes and to change classification color mapping.


1. From the Display group menu bar, select **Tools → Color Mapping → ENVI Color Tables**. The ENVI Color Tables dialog appears.

2. Explore the color options in the Color Table list and observe the color-coded image.

3. Use the **Stretch Bottom** and **Stretch Top** sliders to apply quick stretches to the displayed image.

4. From the Color Tables dialog menu bar, select **Options → Reset Color Table** to return to the original stretch and gray scale color table.

5. From the Color Tables dialog menu bar, select **File → Cancel** to close the Color Tables dialog.
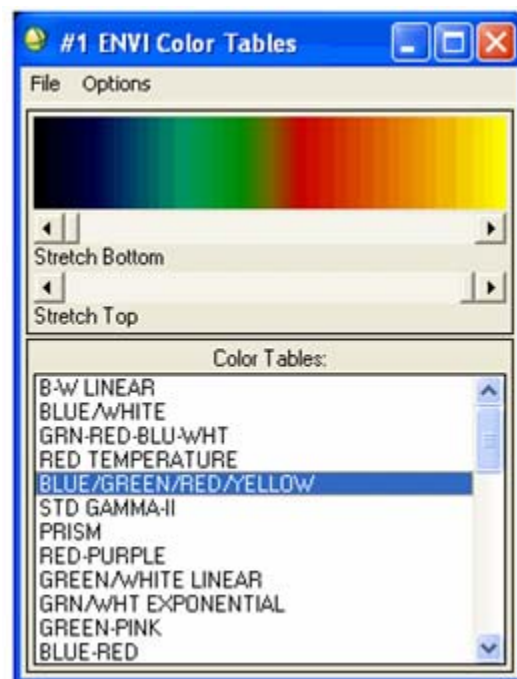
Using the Pixel Locator

The Pixel Locator allows exact positioning of the cursor. You can manually enter a sample and line location to position the cursor in the center of the Zoom window. If an image contains georeferenced data, you can optionally locate pixels using map coordinates. If the image contains an associated DEM, elevation information displays. The Pixel Locator pertains to the display group from which it was opened. You can open a Pixel Locator for each display group shown on your screen.

1. From the Display group menu bar, select **Tools → Pixel Locator** to open the Pixel Locator dialog.
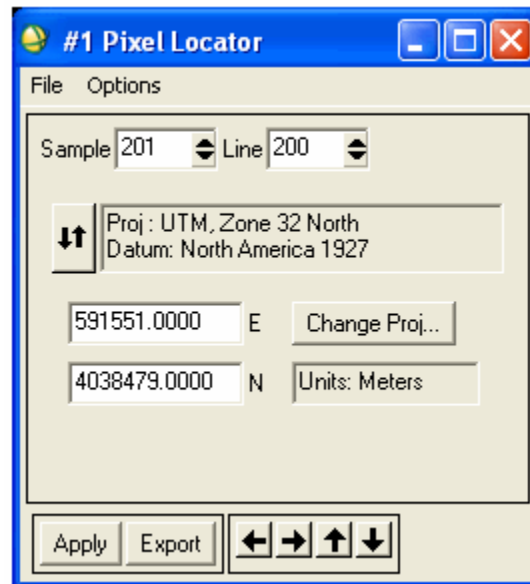
2. Place the cursor in any of the three windows of the display group and click the left mouse button. Notice that the Pixel Locator provides the pixel location for the selected pixel.

3. Click the toggle button ⇅ next to the projection field to toggle between true map coordinates and latitude/longitude geographic coordinates. You can also choose to change the selected projection by clicking the **Change Proj** button.

4. From the Pixel Locator dialog menu bar, select **File → Cancel** to close the Pixel Locator dialog.

Displaying the Georeferenced Cursor Location

You can use ENVI's **Cursor Location/Value** to view image values and geographic location. The Cursor Location/Value option displays the sample (horizontal, X) and line (vertical, Y) coordinates of the cursor along with the data value of the pixel at the cursor location. The position is continuously updated as you move the cursor around the image.

1. From the Display group menu bar, select **Tools → Cursor Location/Value**. The Cursor Location/Value dialog box appears displaying the location of the cursor in the Image, Scroll, or Zoom windows. The dialog also displays the screen value (color) and the actual data value of the pixel underneath the crosshair cursor.
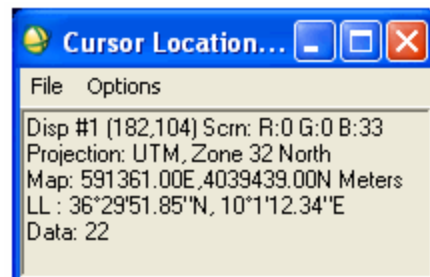
2. From the Cursor Location/Value dialog menu bar, select **File → Cancel** to close the Cursor Location/Value dialog.

Applying Interactive Filters

ENVI gives you the ability to apply several different pre-defined or user-defined filters to a display. The following exercise shows you how to apply a pre-defined filter to the image in the Image window.

1. From the Display group menu bar, select **Enhance → Filter** and choose a desired filter type to apply to the displayed image.

2. Experiment with the different sharpening, smoothing, and median filters on the displayed image.

3. From the Available Bands List, click the **Display #1** drop-down button and select **New Display** to create a second display group.

4. Select **Band 1** and click **Load Band** to load the image into the second display.

5. From the Display group menu bar in image #2, select **Enhance → Filter** and select a filter different from that applied to Image #1.

Comparing Images Using Dynamic Overlays

Use image linking and dynamic overlays to overlay portions of multiple images simultaneously (or flicker images) and to perform identical operations on multiple images from within a single Image window.

1. From the Display group menu bar, select **Tools → Link → Link Displays**. You can also right-click in the image and select **Link Displays**.

2. Click **OK** in the Link Displays dialog to establish the link.

3. Click the left mouse button in one of the Image windows to see the image displays overlaid on one another.

4. To create a smaller overlay area, position the mouse cursor anywhere in either Image window (or Zoom window) and hold down and drag with the **middle mouse button**. Upon button release, the smaller overlay area is set and a small portion of the linked image will be superimposed on the current Image window.

5. Click the left mouse button in the Image window and drag the small overlay window around the image to see the overlay effects.

6. Resize the overlay area at by clicking and dragging the <u>middle</u> mouse button until the overlay area is the desired size.

# Reviewing GeoSpot Map Information

You can review the GeoSpot Map information for this image in the ENVI Header file.

1. In the Available Bands List, right click on the Map Info icon and select **Edit Map Information**. The Edit Map Information dialog appears.

2. Note that the data are in UTM projection, Zone 32 utilizing the NAD27 datum.

3. Click **Cancel** to close the Edit Map Information dialog.
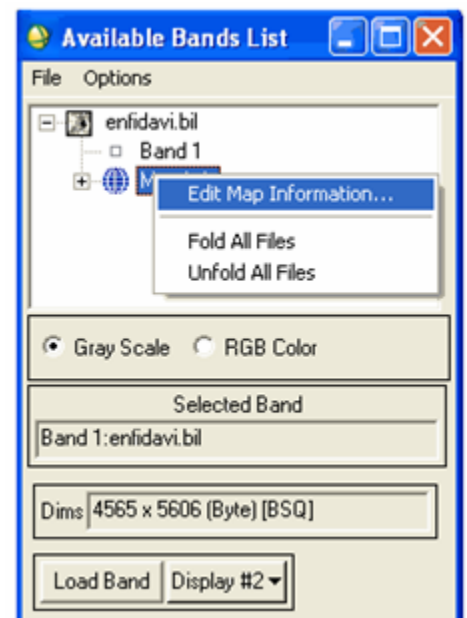
Opening and Overlaying DXF Vector Files

1. From the ENVI main menu bar, select **File → Open Vector File**.

2. In the Select Vector Filenames dialog, click the **Files of type** drop-down list and select **DXF (*.dxf)**.

3. Navigate to the `envidata\enfidavi` directory and select all of the files with the .dxf extension (use the **Shift** key to select multiple files).

4. Click **Open** or **OK**. The Import Vector Files Parameters dialog appears.

5. In the **Native File Projection** section of the dialog (near the bottom), click on **UTM**. This field refers to the map units of the imported vector data.

6. Click the **Datum** button. The Select Geographic Datum dialog appears.

7. Select the **Mexico (NAD27)** datum from the list and click **OK**.

8. In the **Zone** field of the Import Vector Files Parameters dialog, type **32** and click the **N** radio button.

9. Click the **Apply Projection to Undefined** button then click **OK** to load the DXF files and convert them to .evf (ENVI Vector Files). The Available Vectors List dialog appears.

10. On the Available Vectors List, click the **Select All Layers** button.

11. Click the **Load Selected** button. A Load Vector dialog appears which lists all of the available displays.

12. On the Load Vector Dialog, select **Display #1** and click **OK**. The #1 Vector Parameters dialog appears showing the named vector layers.

13. Click on one of the layer names in the #1 Vector Parameters dialog. In the Image window click and drag using the left mouse button and observe map coordinates for the selected vectors in the #1 Vector Parameters dialog.
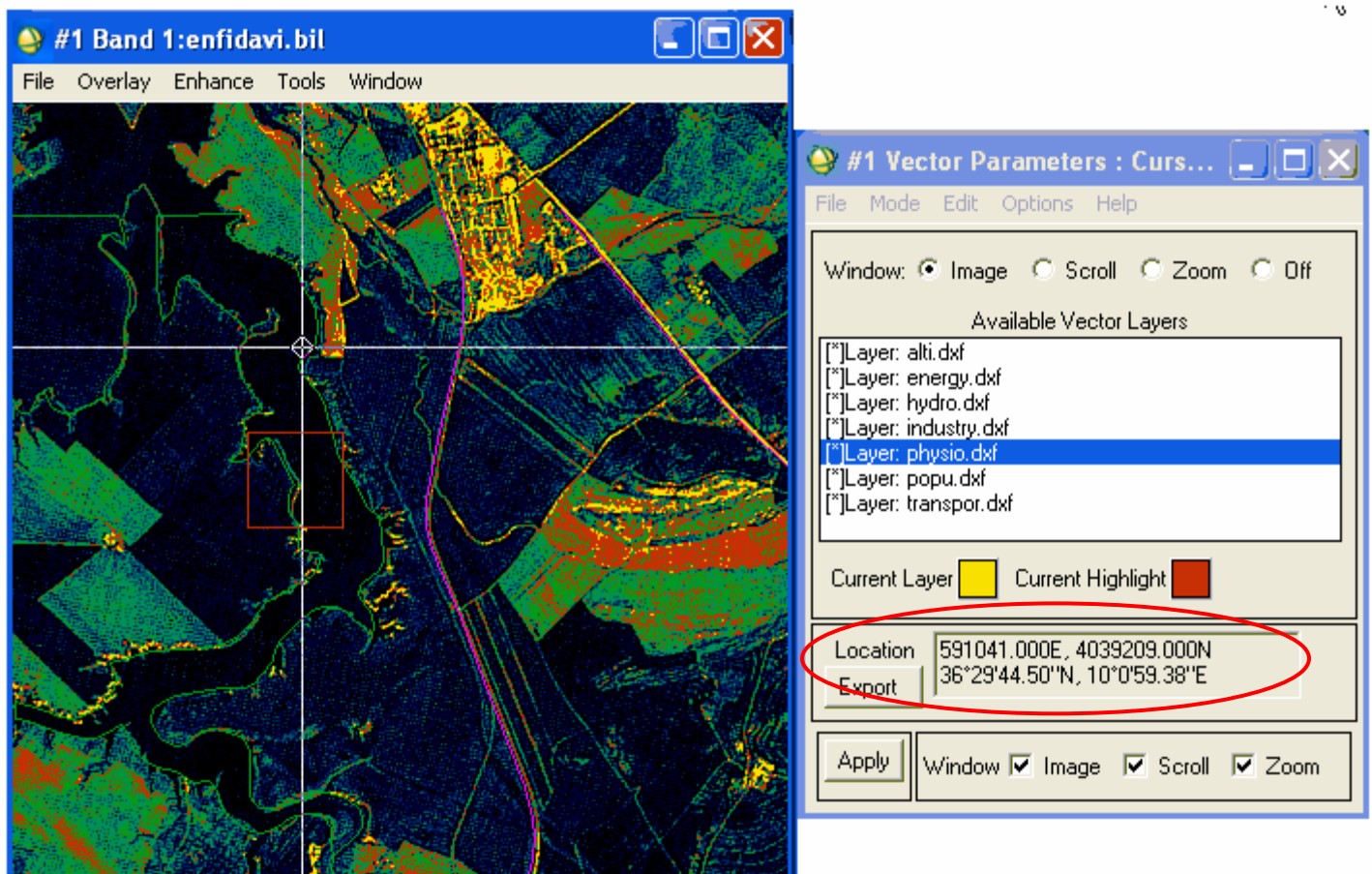
Composing a Basic Map

In this exercise, you will create a basic map. You will add grid lines, annotate your image, and save and output your image.

Adding a Grid to Your Image

You can use **Grid Lines** to overlay one or more grids on an image. Grids can be pixel-based or map-coordinate and/or latitude/longitude based (for georeferenced images). Each display group can have its own set of grids, which are displayed in the Image, Scroll, and Zoom windows.

1. From the Display group menu bar, select **Overlay → Grid Lines**. The Grid Line Parameters dialog appears. Note that an image border is automatically added when you overlay grid lines (visible in the Scroll window).

2. Using the Grid Line Parameters dialog menu bar **Options** menu, you can adjust the grid lines by setting the line thickness and color and the grid spacing.

3. When you have added a satisfactory grid, click **Apply** in the Grid Line Parameters dialog.

Annotating the Image with a Map Key

ENVI's flexible annotation features allow you to add text, polygons, color bars, and other symbols to your plots and images.

1. From the Display group menu bar, select **Overlay → Annotation**. The Annotation dialog appears.
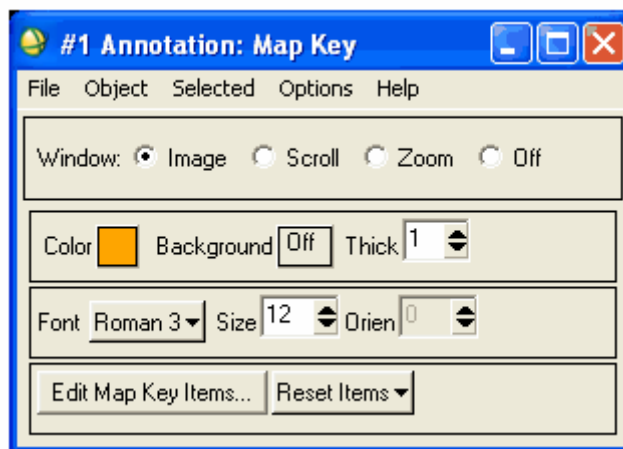
2. To annotate a map key corresponding to the DXF overlays, select **Object → Map Key** from the Annotation dialog menu bar.

3. Click the **Edit Map Key Items** button to edit the map key characteristics. The Map Key Object Definition dialog appears.

4. You can change the names, colors, and fill (for polygons) using the Map Key Object Definition dialog. Click **OK** to return to the Annotation dialog.

5. Add a background color by clicking the color swatch in the Annotation dialog. Use the right-click menu to select a color from a list.

6. Click the left mouse button to place the map key in the Image window. Reposition the map key by clicking, or by clicking and dragging with the left mouse button. Set the map key by clicking the right mouse button in the image.

Saving and Restoring Annotation

You can save your image annotation to a file. If you do not save your annotation in a file, it will be lost when you close the Annotation dialog (you will be prompted to save the annotation if you close without first saving)

1. From the Annotation dialog menu bar, select **File → Save Annotation**.

2. You can also restore saved annotation files by selecting **File → Restore Annotation** from the Annotation dialog menu bar.

3. To suspend annotation operations and return to normal ENVI functionality temporarily, select the **Off** radio button at the top of the Annotation dialog. This allows you to use the scroll and zoom features in your display without losing your annotations.

4. To return to the annotation function, select the radio button for the window in the display group that you are annotating.

Saving and Outputting an Image (Burn-In)

ENVI gives you several options for saving and outputting your filtered, annotated, gridded images. You can save your work in ENVI's image file format, or in several popular graphics formats (including Postscript) for printing or importing into other software packages. You can also output directly to a printer. For this exercise, you will save the file in GEOTIFF format.

1. From the Display group menu bar, select **File → Save Image As → Image File**. The Output Display to Image File dialog appears.

2. Click the **Output File Type** drop-down list and select **TIFF/GeoTIFF** output from the pull-down menu. If the displayed image is annotated and gridded, both the annotation and grid lines will be automatically saved.

3. Type or choose an output filename in the field provided and click **OK** to save the image. Because this is a georeferenced image, ENVI automatically saves it as a GEOTIFF.

Ending the ENVI Session

You can quit your ENVI session by selecting **File → Exit** from the ENVI main menu.