SOFTWARE VALIDATION TEST PLAN AND REPORT
ERDAS IMAGINE®, Version 8.7

Prepared for

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3/29/05
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1 SCOPE OF VALIDATION

ERDAS IMAGINE® developed by Leica Geosystems GIS and Mapping, LLC is a broad collection of software tools designed specifically to process airborne and satellite imagery. This software is an essential tool for image processing across a variety of disciplines under earth and planetary sciences.

This Test Plan and Report will validate four selected techniques, specifically:

- File Management
- Mosaicking DOQ data
- Basic SAR Analysis
- Basic Multispectral Analysis

Software validation of ERDAS IMAGINE should confirm that the software can correctly perform the above listed functions with the provided remote sensing data.

2 REFERENCES

- ERDAS IMAGINE® Tour Guides™, 2003, PDF document
- ERDAS IMAGINE® Field Guide™, 2003, PDF document

3 ENVIRONMENT

3.1 Software

- Operating System: Microsoft® Windows XP Professional, Version 2002, Service Pack 1

3.2 Hardware

- Computer: Intel® Xeon™
- CPU: 3.06 GHz
- Memory: 2 GB RAM

4 PREREQUISITES

4.1 Setting Up the ERDAS IMAGINE Environment

Start ERDAS IMAGINE 8.7. In the **Select Viewer Type** dialog, check the **Don't ask me this question again** and click the **OK** button. Examine the options on the screen (Figure 1).

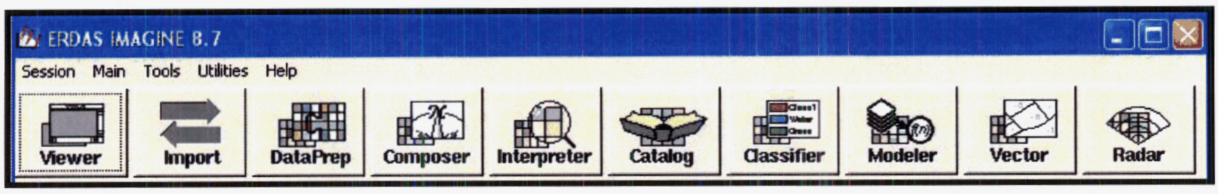

Figure 1. ERDAS IMAGINE Icon Panel

Look for the drop down menu named **Session** in the upper left of the screen on the icon panel. Select the **Preferences** option. This opens the Preference Editor menu. The Preference Editor allows you to control and customize many IMAGINE parameters and default settings. With the **User Interface & Session** category open, change your **Default Data Directory** and **Default Output Directory** to the location of your ERDAS_IMAGINE_validation folders (i.e., d:\ERDAS_IMAGINE_validation data and d:\ERDAS_IMAGINE_validation output directories). Scroll down until you see the **Delete Session Log on Exit** and **Delete History File on Exit**. Click on both of these check boxes and make sure they are on. Change the **Session Log Printing** from **Query** to **Never**. Leave all other options in their default settings. Save the changes using the **User Level** option. Exit the **Preference Editor** by selecting **Close**.

5 ASSUMPTIONS AND CONSTRAINTS

None.

6 TEST CASES

6.1 File Management

6.1.1 Objective

Demonstrate that ERDAS IMAGINE can handle a variety of remotely sensed data formats. ERDAS IMAGINE should identify and read a large number of image formats including ERDAS IMAGINE (.img), GeoTIFF, JPEG, BMP, HDF, and MrSID. These are some of the most common used image formats at the CNWRA.

6.1.2 Test Input

Remote sensing datasets: IKONOS PAN/MSI data, product 72309, IR band, (IMG and MrSID) courtesy of spaceimaging.com; Landsat 4 TM WRS-2, Path 040, Row 034, band 4, June 29,

1989, (GeoTIFF, BMP, JPEG) courtesy of the University of Maryland – Global Land Cover Facility; ASTER data AST_L1B SC:AST_L1B.003:2003286125 data (HDF) courtesy of NASA, GSFC, MITI, ERSDAC, JAROS and the U.S./Japan ASTER Science Team; ERS-1 SAR SLC radar.img, based on the ERS-1, SLCI, orbit-4051, track-399, date-240492 dataset, courtesy of ESA- EURIMAGE and Landsat TM germtm.img ERDAS IMAGINE test data. All datasets are available in the data directory supplied on CD.

6.1.3 Test Procedure

1. In the ERDAS IMAGINE 8.7 **Viewer #1** window, Select **File > Open > Raster Layer.**

2. In the **Select Layer to Add** dialog three .img format datasets are shown: gremtm.img, nir_72309_jan01.img and radar.img. Select the germtm.img dataset. Click **OK**. The dataset will be loaded by default, as an RGB color, bands 4 (R), 3 (G), and 2 (B). Clicking the right mouse button **> Fit Image to Window** and the right mouse button **> Fit Window to Image** will allow visualization of the entire dataset in **Viewer #1**. Repeat this procedure for the other two .img datasets. These images will be loaded by default as Gray Scale images and displayed as black and white images. ERDAS default settings include a contrast stretch.

3. Display the other image datasets by using a similar procedure as in Section 6.1.3, Part 3, by changing the **Files of Type** to MrSid, for visualizing the nir_72309_jan01.sid dataset; TIFF, for visualizing the landsat_p040r34_t890629_nn4.tif dataset); JFIF, for visualizing the landsat_p040r34_t890629.jpg dataset; and BMP, for visualizing the landsat_p040r34_t890629.bmp dataset. With the exception of MrSid dataset, all datasets will be displayed as RGB color.

4. To display the ASTER dataset, click the Import button on the ERDAS IMAGINE Icon Panel. Select as Type ASTER EOS HDF Format and Media as File. Select pg-PR1B0000-2001062102_114_001 as the input file. This file is located in **ERDAS_IMAGINE_validation data** directory. For the output file select aster.img. Place this file in the **ERDAS_IMAGINE_validation output** directory. Click **OK**. Click the **Correction...** button in the **ASTER EOS HDF Format Importer**. In the Correction Parameters dialog, check the **Write Transform to Image** box. Click the **Radiometric Options** tab. Click the **Conversion to radiance** button. Click **OK** and again click **OK** in the **ASTER EOS HDF Format Importer**. The Importing ASTER Data dialog will show the progress of importing four HDF layers into an .img file format. Close the dialog window and the Import/Export window.

5. Display the ASTER dataset. In the ERDAS IMAGINE 8.7 **Viewer #1** window, Select **File > Open > Raster Layer.** Change the directory to **ERDAS_IMAGINE_validation output.** In the **Select Layer to Add** dialog, select the **aster.img** dataset. Click the **Raster Options** tab and select Layer 3 for Red, Layer 2 for Green, and Layer 1 for Blue. Click OK. Right mouse click **> Fit Image to Window** and right mouse click **> Fit Window to Image** will allow visualization of the entire dataset in **Viewer #1**. Check to see if this dataset is georectified (i.e., the information on the bottom part of Viewer #1 should be Geographic (Lat/Lon)/ WGS 84.

5. Close Viewer #1.

6.1.4 Test Results

PASS/FAIL: The test is successful if all required results are obtained in Section 6.1.3.

Tester: Deborah Waiting _____ Test Date: 3/21/05

6.2 Importing and Mosaicking USGS DEM Data

6.2.1 Objective

Demonstrate that ERDAS IMAGINE can correctly import USGS digital elevation models (DEM) data and mosaic two datasets into a single composite DEM. The output DEM will be visualized as a grey, pseudocolor, and relief image.

6.2.2 Test Input

Two data files named 2998270g.dem and the 2998280g.dem are used in this test. These files correspond to two adjacent 30 m DEMs (i.e., Helotes and Castle Hills, Bexar County, TX). These files are provided by the Texas Natural Resources Information System (TNRIS) in USGS DEM format. The projection is Universal Transverse Mercator Projection (UTM), Zone 14N with North American Datum of 1983. Both files were previously extracted from Olympus DISS and placed in the ERDAS_IMAGINE_validation Data directory.

6.2.3 Test Procedure

1. Import the DEM files into ERDAS IMAGINE. From the icon panel, select the **Import** function. In the **Import/Export** dialog, set data type as USGS DEM and the Media as File. Select the 2998270g.dem as the input file and 2998270g.img as the output file. Make sure that the output file will reside inside of ERDAS_IMAGINE_validation output directory. Click OK. In the new dialog window (e.g., **Import DEM data**) check the image information (File Name: HELOTES, TX, Coord System UTM, Zone 14) and image extent (North–3277114m, South–3263231, West–524203, East–536349). Click **OK** and then visualize the image.

2. Redo the same steps as above for the 2998280g.dem. For this dataset the image information and extent should be: File Name: CASTLE HILLS, TX, Coord System UTM, Zone 14 and Image Extent: North–3277159m, South–3263264, West–536304, East–548465. Close Import/Export dialog.

3. Select the **Mosaic Images** mosaicking function by selecting **DataPrep > Mosaic Images** from the ERDAS IMAGINE icon panel. The **Mosaic Tool** dialog appears.

4. Select **Edit > Add Images**. Using the Shift key, select the two DEM files. Click **OK**.

The two images will automatically be placed in their correct geographic locations within the Mosaic Tool window (Figure 2).

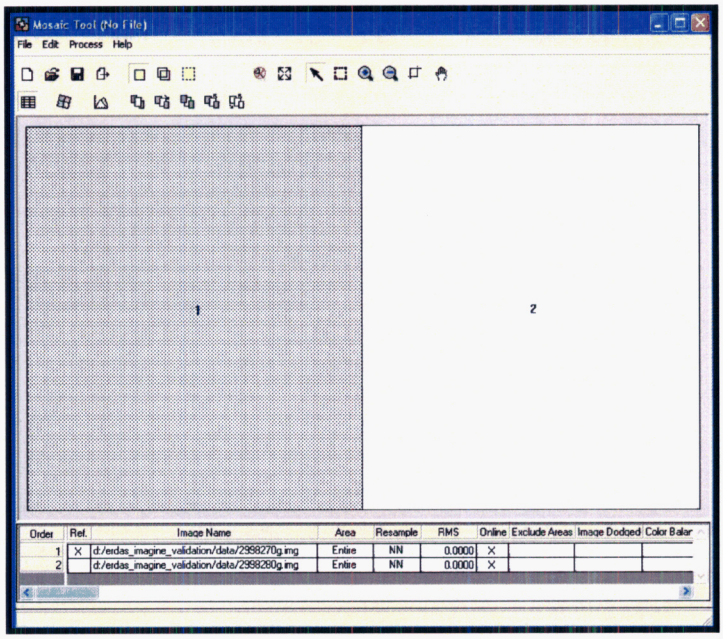

Figure 2. The ERDAS IMAGINE Mosaic Tool Dialog

4. In the **Mosaic Tool** window, select **Process > Run Mosaic**. Enter mosaic_dem.img as the output file name and place it in the ERDAS_IMAGINE_validation output directory. Close the Mosaic Tool dialog (do not save changes before closing).

5. Open a new Viewer and display mosaic_dem.img dataset (to display the dataset follow the instructions in Section 6.1.3, Part 3. Compare the output of the DEM mosaicking process with the output presented in Figure 3 and the file statistics shown in Figure 4. For visualizing file statistics, in Viewer #1 select **Utility > LayerInfo**.

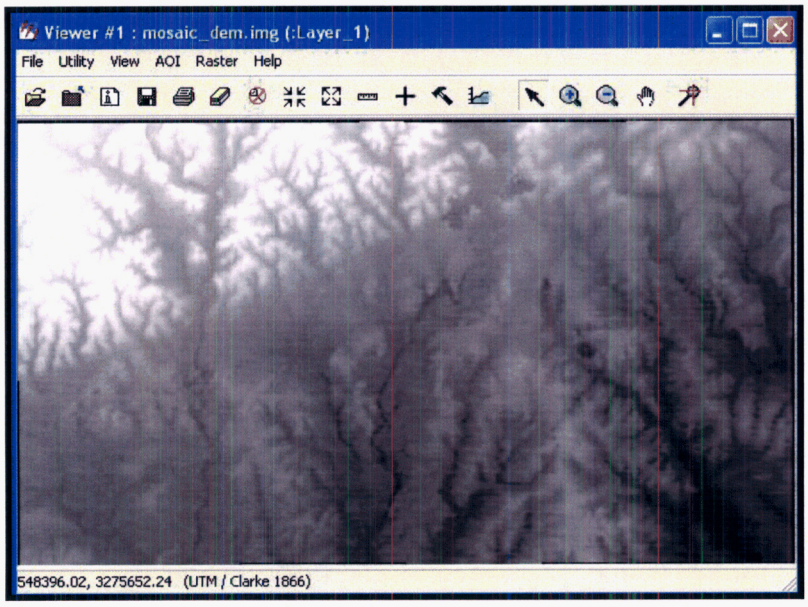

Figure 3. The mosaic_dem.img File

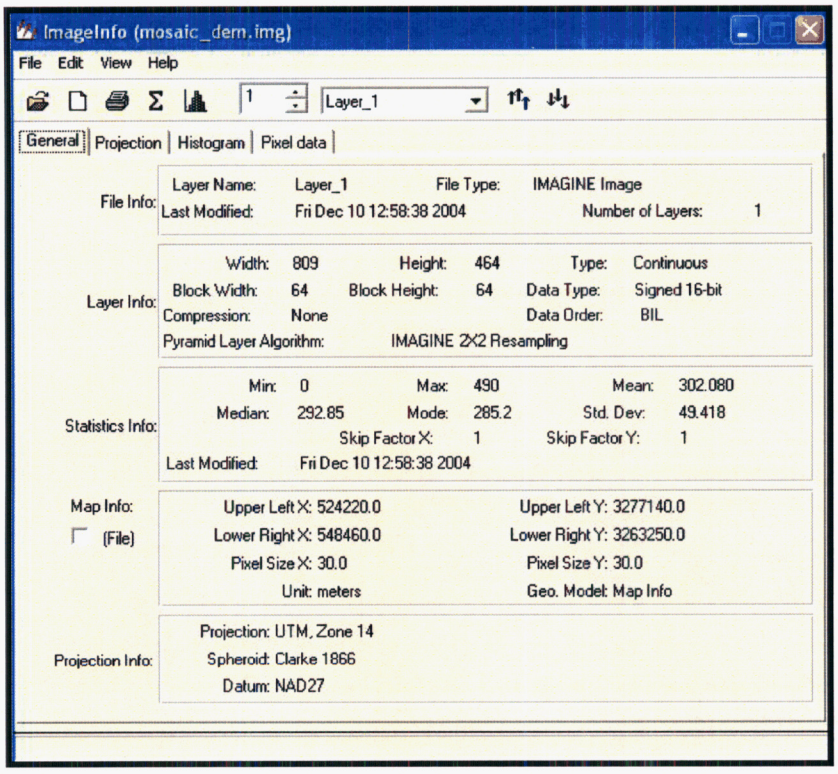

Figure 4. Statistics for the mosaic_dem.img File

6. Visualize the mosaic data as a pseudocolor and relief image.

   a. Reopen the mosaic_dem.img image in Display #1. In the **Select Layer to Add** dialog select the mosaic_dem.img. Click the **Raster Options** tab and **Display** the image **as Pseudo Color**. Click **OK**. Resize the image to window and window to image using the right mouse and selecting **Fit Image to Window** and **Fit Window to Image**. From the Viewer #1 pull down menu select **Raster > Attributes**. In the **Raster Attribute Editor** window select **Edit > Colors**. Use Blue as the **Start Color** and Red as the **End Color**. Change the **Slice Type** to **By Equal Areas** and then hit **Apply**. The result should be similar with the one presented in Figure 5.
   NOTE: When the DEM image is displayed as pseudocolor, the viewer could be black until attributes on the color table are changed. This is normal software behavior.

   b. Open a new Viewer by clicking the Viewer icon on the ERDAS IMAGINE 8.7 icon menu. Select mosaic_dem.img in the Select Layer to Add window. Click the **Raster Options** tab and **Display** the image as **Relief**. Click **OK**. Resize the image to window and window to image using the right mouse and selecting **Fit Image to Window** and **Fit Window to Image**. From the Viewer #2 pull down menu select **Raster > Relief Shading Tool**. In the **Relief Tool** window specify Azimuth as 230 degrees, sun elevation as 40 and the scale 3. Then click **Apply**. The result should be similar with the one presented in Figure 6.

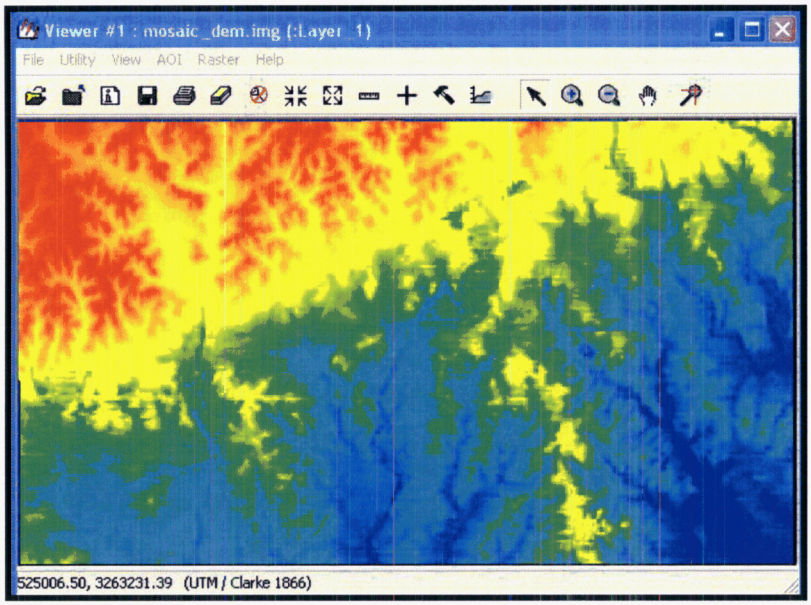

Figure 5. DEM – Pseudocolor Scheme

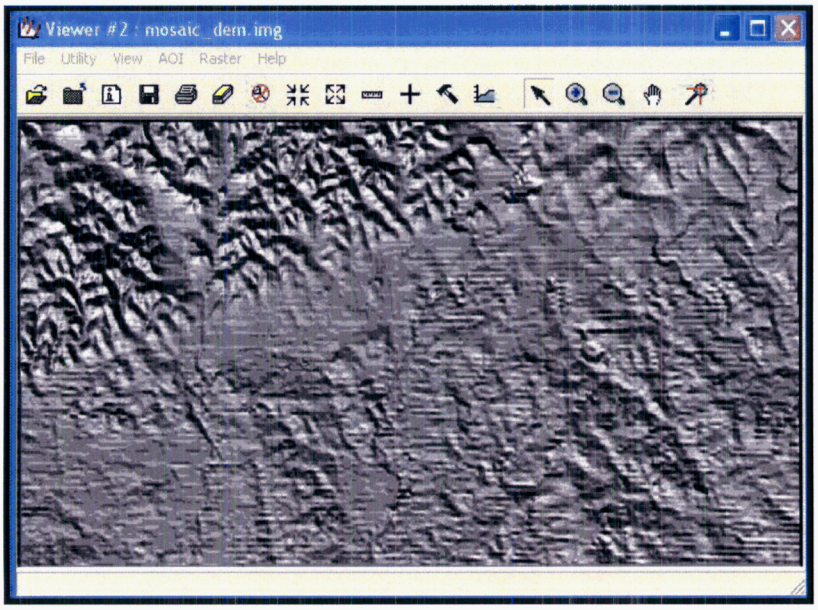

Figure 6. DEM – Digital Relief

7. Close the ImageInfo dialog, Viewer #1, and Viewer #2.

6.2.4 Test Results

PASS/FAIL: The test is successful if all required results are obtained in Section 6.2.3.

Tester: Deborah Waiting _____Test Date: _____

6.3 Basic SAR Analysis

Radar remote sensing has a number of advantages over the optical remote sensing, because it allows obtaining data virtually under any time and condition. Because radar and optical systems operate in different parts of the electromagnetic spectrum (e.g., optical systems operate in the 0.4–12 um and radar in the 0.8–100 cm range), the inferred characteristics of the surface materials have no direct relationship one to another. However, this complementarity is mostly beneficial in providing additional insights about the nature of surface materials. One of the most used radar remote sensing data types is the Synthetic Aperture Radar (SAR) data, subject of this test. SAR proved to be essential to a large variety of applications starting with geology and agriculture to ocean and sea ice. Recently, by exploring phase information on pairs of SAR data, ground subsidence could be measured with centimeter or even millimeter accuracy. These techniques (i.e., radar interferometry techniques) open the possibility of using SAR data in other areas, such as earthquake or subsidence monitoring (like the ones caused by mining activities, tunneling, or fluid dynamics).

6.3.1 Objective

Demonstrate that ERDAS IMAGINE can correctly perform basic single-band SAR data analysis. The following components will be tested:

- Display ERS SAR SLC data
- Contrast Stretching, Adaptive Filters
- Speckle Reduction
- Density Slicing

6.3.2 Test Input

Data used for the test (e.g., *radar.img*) is an ERS–1 Synthetic Aperture Radar Single Look Complex (ERS–1 SAR SLC) dataset, previously resampled (factor 5 on y axis) and converted to ERDAS IMAGINE format. The dataset provided by ESA–Eurimage, was acquired on April 24, 1992 over the Barstow, California area. This dataset contains two bands: band one corresponds to the magnitude and band two to the phase of the retrieved radar signal.

The file is located in the ERDAS_IMAGINE_validation Data directory.

6.3.3 Test Procedure

1. Read and display ERS–1 Single Look Complex (SLC) Data.

    a. ERDAS IMAGINE should be running and a **Viewer** should be open. Open the data files by selecting **File > Open > Raster Layer**. In the **Select Layer to Add** dialog, choose the radar.img file then load it as a **Gray Scale** image.

    b. Visualize the magnitude and phase information. The current viewer (e.g., Viewer #1) displays the magnitude of the signal. Open a second viewer. Load the second band of the radar.img dataset by clicking the Raster Options tab, selecting the **Display as** Gray Scale and Layer 2. Click **OK**. **Fit the Image to Window** and **Fit Window to Image** using a procedure similar to that in Section 6.1.3, Part 3.

    c. Compare the results with the ones shown in Figure 7.

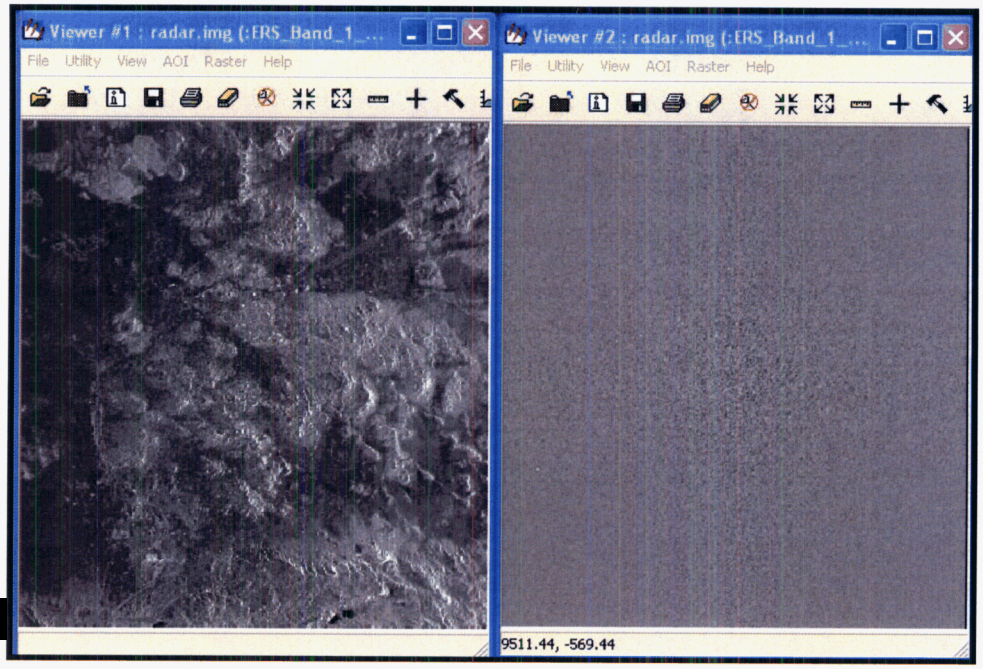

Figure 7. The Magnitude and Phase of the ERS–1 SLC Dataset

2. Remove radar speckle using the Frost adaptive filter.

One of the problems associated with Radar data is the presence of noise. The noise is inherent in a SAR system due to the coherent nature of the radar signal. In this test, a Frost filter is used to reduce speckle while preserving the edges in the data. The filter replaces the initial value of a pixel, a value calculated based on the distance from the filter center, and the local variance. To apply the Frost Filter on the ERS-1 image follow the directions below.

a. From the icon panel, select **Radar > Radar Interpreter > Speckle Suppression**. In the **Radar Speckle Suppression** dialog choose radar.img as the input image, and Frost as the **Filter** to use. Use a **Moving Window,** size of 3, and use the default **Coef. of Variation** (e.g., 0.2). Place the output file (e.g., radar_frost.img) in the ERDAS_IMAGINE_validation output directory. Click **OK.**

b. Close all the windows so the only windows on the screen are the ERDAS IMAGINE icon panel and Viewers #1 and #2. In Viewer #2 open the newly created file (e.g., radar_frost.img). Compare the two images by **Geographical** linking both windows by selecting the **Link/Unlink Viewers** under Viewer's #1 **View** pull down menu (Figure 8). Select the **Inquire Cursor** function under the **Utility** pull down menu. Compare the magnitude values (PIXEL VALUE in each of the images) obtained at the same X,Y location. These values should be in the same order of magnitude. Note the reduced level of the "salt and pepper" noise on the filtered image. Close all the windows so the only windows on the screen are the ERDAS IMAGINE icon panel and Viewer #2.

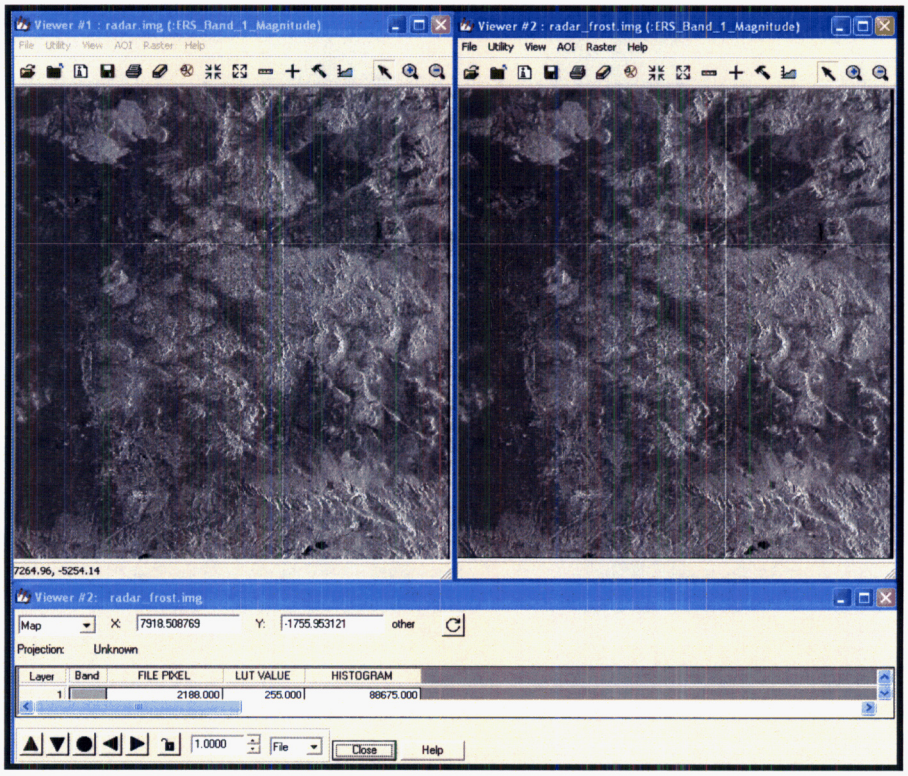

Figure 8. Comparison between the Unfiltered and Filtered ERS–1 SAR SLC Image. Left Is the Original Image. Right Is After Applying a Frost Filter, 3x3 Window Size with a Coefficient of Variation Equal to 0.2.

3. Density Slice.

This technique allows visualization of radar differences using a colormap constructed based on a priori assignment of colors to image brightness intervals. The test will create a density sliced image with four levels, with higher radar backscatter values presented in the warmer colors.

a. Re-open the Frost filtered ERS–1 data and display it as a **Pseudo Color** image (i.e., in the Select Layer to Add dialog select radar_frost.img, click **Raster Options** and display as **Pseudo Color**. Click **OK**. Fit Image to Window).

b. Select **Raster > Attributes**. In the **Raster Attribute Editor** window select **Edit > Colors.** Select the Start Color as Blue and the End Color as Red. Set the number of levels to 5, **Slice Type** as **By Equal Areas** and the **Slice Method** as **IHS Slice**. Click the **Apply** button.

c. Note the feature patterns and colors on the image and compare them with the ones shown in Figure 9.

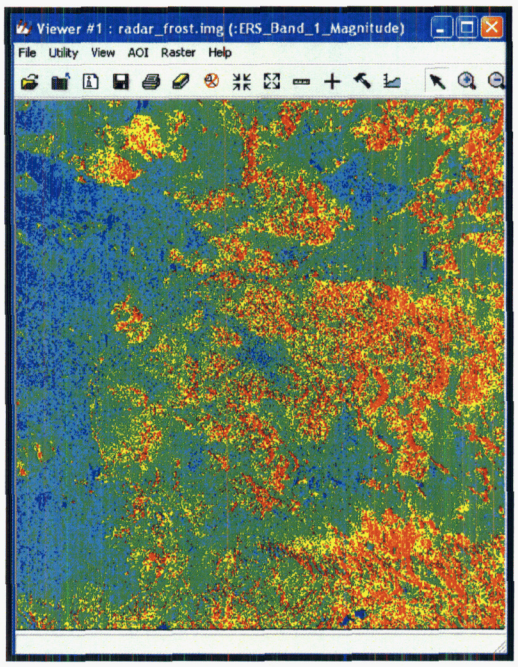

Figure 9. Density Slice Technique Applied to the Filtered ERS–1 SAR SLC Image

d. Close all the windows so the only window on the screen is the ERDAS IMAGINE icon panel.

6.3.4 Test Results

PASS/FAIL: The test is successful if all required results are obtained in Section 6.4.3.

- This test **PASSED.**

Tester: Deborah Waiting Deborah Waiting Test Date: 3/21/05

6.4 Basic Multispectral Analysis

6.4.1 Objective

This test demonstrates ERDAS IMAGINE's ability to perform a multispectral analysis. Results from an unsupervised (ISODATA) and supervised (parallelepiped) classification will be examined.

6.4.2 Test Input

Six band Landsat TM ERDAS IMAGINE dataset data acquired over Germantown, Maryland. This data is already converted from DN to reflectance values. The dataset (germtm.img) is part of the ERDAS IMAGINE tutorial data, and a copy of it was placed in the **ERDAS IMAGINE_validation Data** directory.

6.4.3 Test Procedure

1. Read and display Landsat TM Data.

    a. ERDAS IMAGINE should be running and **Viewer #1** should be open. Open the data files by selecting **File > Open > Raster Layer**. In the **Select Layer to Add** dialog, choose the germtm.img file then display it as a **True Color** image. Select Band 4 for the Red Channel, Band 3 for the Green Channel, and Band 2 for the Blue Channel (Figure 10.).

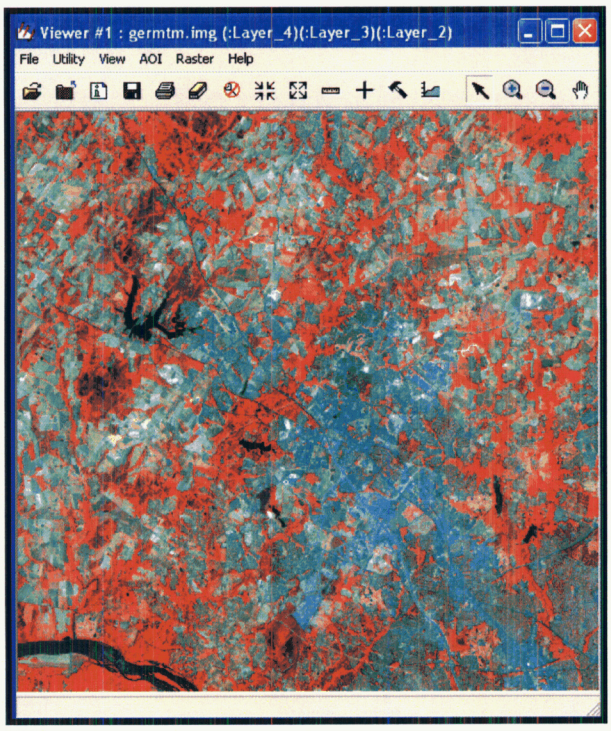

Figure 10. Landsat TM Color Composite R4, G3, and B2

On this 4-, 3-, and 2-color composite image, bright red areas (which denote high infrared reflectance) correspond to healthy vegetation, along the rivers, or under cultivation. Forested areas are represented by a darker red color. Urban and bare soil areas are represented by turquoise or white. Water bodies have low reflectance values and are displayed in black.

2. Performing an unsupervised classification.

Unsupervised classification uses statistical techniques to group n-dimensional data into classes with similar characteristics. Knowledge of the terrain present in the scene, as well as its spectral characteristics, is needed to *aposteori* assigned information to the newly obtained classes.

This test will perform an unsupervised classification using the Iterative Self-Organizing Data Analysis Technique (IsoData) clustering algorithm. IsoData uses a minimum spectral distance formula to form spectrally distinct clusters. The algorithm repeats the clustering of the image until either a pre-defined maximum number of iterations, or a pre-defined maximum percentage of unchanged pixels have been reached between two consecutive iterations.

a. From the ERDAS IMAGINE icon panel, select **DataPrep > Unsupervised Classification**. On the **Unsupervised Classification (Isodata)** dialog choose germtm.img as **the Input Raster File**. Set the **Output File** as germ_iso.img and place it in the Output directory. Choose 10 as the number of classes, maximum iterations as 20, and the convergence threshold as 0.950. Click **OK** to start the process. In the Job Status dialog, click **OK** when the process is 100% complete.

b. Display the original and the output of the classification algorithm. In the same Viewer #1 load the germ_iso.img by selecting **File > Open > Raster Layer**. Make sure that under the **Raster Options** tab the **Clear Display** checkbox is turned off. Click **OK** to display the image file. Right click the mouse button and select **Fit Image to Window** option.

c. Perform a quick evaluation of the classification by using the **Swipe** function under the **Utility** pull-down menu. In the **Viewer Swipe** window drag the mouse to interactively change the **Swipe** position. Cancel the **Swipe** tool (Figure 11).

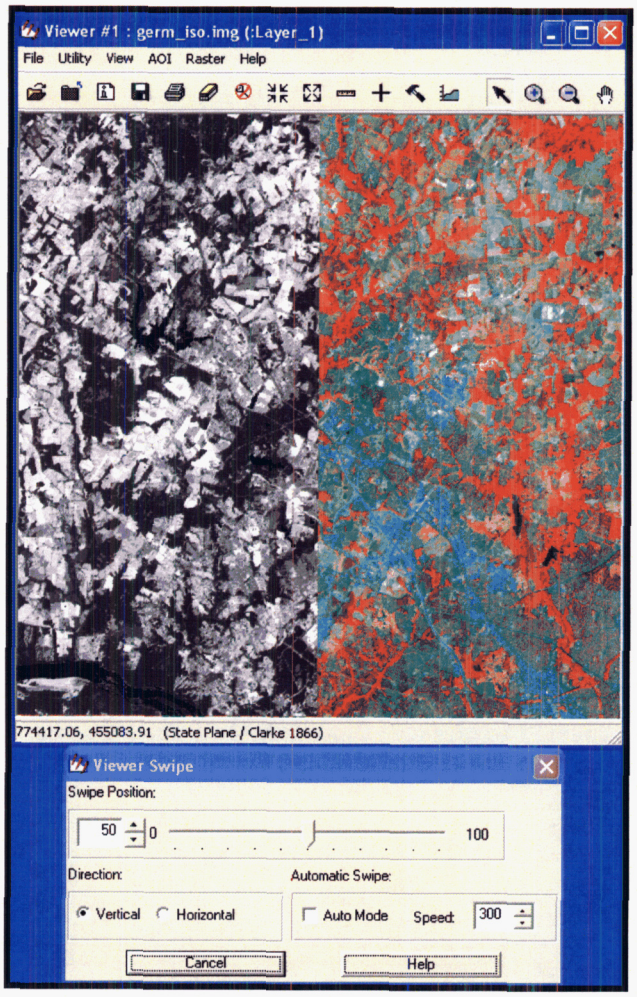

Figure 11. Data Visualization Using the Swipe Technique

d. Assign individual colors for each class. Select **Raster > Attributes**. In the Raster Attribute Editor dialog, select **Edit > Colors**. Click **Apply**. Compare the ISODATA classification results with the one presented in Figure 12.

Figure 11 displays a screen capture of how the swipe technique works. Figure 12 shows the result of classification (e.g., IsoData). After you cancel the swipe tool the image returns to 100%.

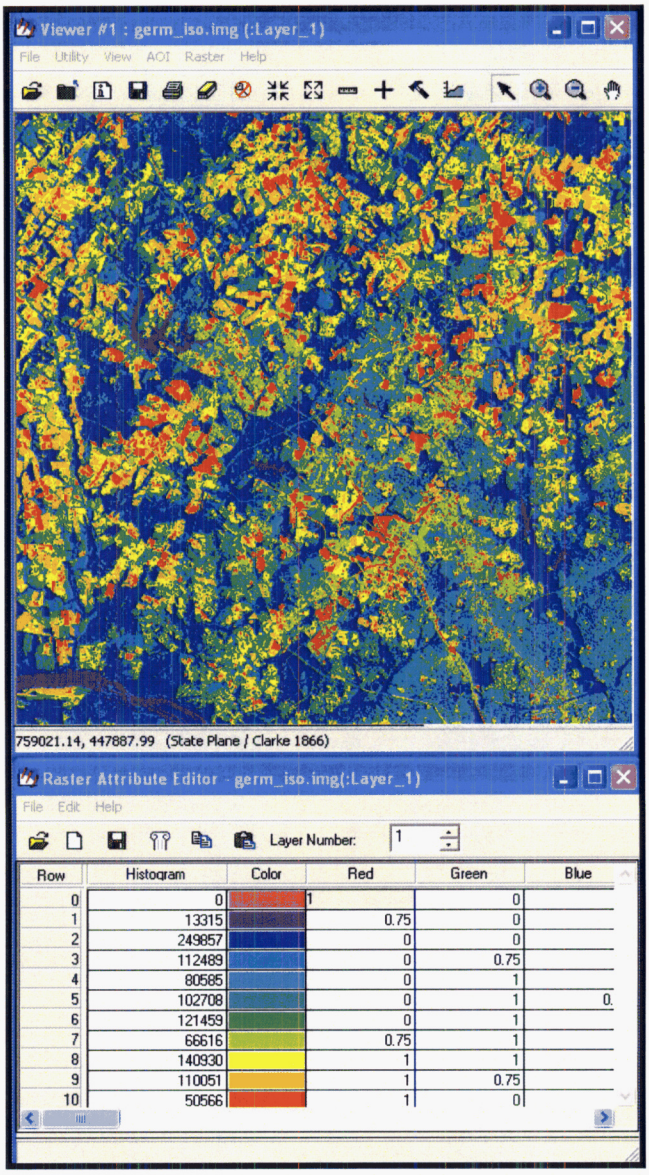

Figure 12. IsoData Classification

e. Close all ERDAS IMAGINE 8.7 Viewers.

3. Performing a supervised classification.

Compared with an unsupervised classification, such as the one performed in Section 6.4.3, Part 2a, supervised classification will require a priori selection of training areas used as the basis for classification. ERDAS IMAGINE provides a broad range of different traditional classification methods, such as the Minimum Distance, Parallelepiped or the Maximum Likelihood.

The test will evaluate the Maximum Likelihood method using as training sites, a list of previously defined spectral signatures extracted from the major land cover classes of the area. These signatures reside in the germtm.sig file.

a. ERDAS IMAGINE should be running and a **Viewer** should be open. Open the data files by selecting **File > Open > Raster Layer**. In the **Select Layer to Add** dialog, choose the germtm.img file then display it as a **True Color** image. Select Band 4 for the Red Channel, Band 3 for the Green Channel, and Band 2 for the Blue Channel.

b. From the ERDAS IMAGINE icon panel, select **Classifier > Signature Editor**. In the **Signature Editor** dialog choose **File > Open** and load the germtm.sig from the **ERDAS IMAGINE_validation Data** directory. Make sure that the function to be performed in the **Load Signature File** directory is set to **Replace**. The signature file assumes that the associated germtm.img is located on D:/erdas_imagine validation. If the data directory is placed in a different location, the file association needs to be updated. To do this click **OK** in the **Message** pop-up window. Select **Edit** from the **Signature Editor** pull-down menu. Click **OK** in the **Error and Messages** pop-up windows. Click **Edit** again and select **Image Association**. Set the associated image to the current location of the data directory. Click **OK**. The table shows the previously defined signatures and their associated names for the land cover classes.

c. From the ERDAS IMAGINE icon panel, select **Classification > Supervised Classification.** Select germtm.img as the Input Raster File and the germtm.sig as the Input Signature File. Set the **Classified File** as germ_supervised.img and place it in the Output directory. Check the **Distance File** button and set the filename as germtm_distance.img. This distance file is a continuous layer in which each pixel value represents the result of a spectral distance measure used in the performed supervised classification. Brighter pixels (e.g., higher distance values) represent pixels more likely to be misclassed. Run the classifier.

d. Examine the result of the classification and compare it with the one shown in Figure 13. Note if pattern differences exist between the supervised images.

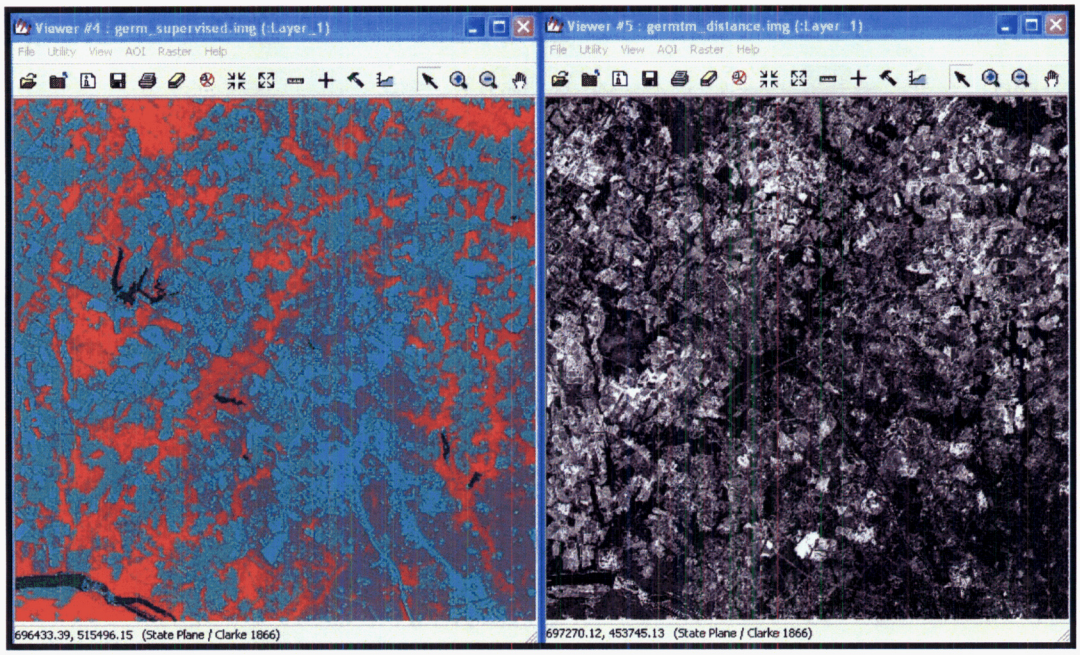

Figure 13. The Result of the Maximum Likelihood Classifier on the Left and the Distance Image on the Right

6.4.4 Test Results

PASS/FAIL: The test is successful if all required results are obtained in Section 6.4.3.

- This test **PASSED.**

Tester: Deborah Waiting Deborah Waiting Test Date: 3/21/05

7 CONCLUSION

The ERDAS IMAGINE, Version 8.7, has completed all tested features successfully.