ERDAS IMAGINE 2015

RADAR Imagery Made Easy

TIPS AND TRICKS

USFWS WORKSHOP
Radar Analyst

Section Objective

Radar data is different from optical imagery both in its phenomenology and the types of information it records. While optical imagery gives you information about the chemical composition of features on the ground, radar data records information about the physical structure of the objects on the ground. This section is designed as an introduction to radar data and some of the basic tools for interpreting and analyzing radar images.

Tools Used

<table>
<thead>
<tr>
<th>Radar Analyst</th>
<th>Tab in IMAGINE which contains the tools for basic radar data analysis and exploitation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level Slice</td>
<td>Visualize an image by slicing it into three levels based on their magnitude values in the image histogram.</td>
</tr>
<tr>
<td>Real-time Enhancement</td>
<td>Auto Enhance (Blue-is-New)</td>
</tr>
</tbody>
</table>

Exercise 1: Viewing Radar Data

Objective:

Students will use a prepared radar image and learn how to identify different features in the imagery.

Radar data is different from optical imagery in that it is echography and not photography. Light and dark pixels indicate not just the makeup of the landcover, but the physical structure and orientation of the features relative to the radar signal.

In this Exercise, we will be looking at a Radarsat-1 image of the border between Georgia and South Carolina. It is recording in the C-band, with a wavelength of 5.6 cm. The pixels in this image are roughly 13 meters.

Task 1.1: Viewing Radar Data and Identifying Features

1. Click File > Open > Raster Layer... c:\training\Fundamentals2\Radar select 2009_radar.img from the data directory. Do not click OK yet.
2. On the Raster Options tab, select Orient Image to Map System.
3. Click OK on the File selector dialog.

This tells the software to read the calibration data that is included with the image and to project that image in the 2D View.

The radar image is displayed. Lake Hartwell is the large group of dark pixels in the middle of the image. In addition to the lakes, the bright reflections of the mountains in the north of the image are also apparent.
Radar imagery gives information about the physical structure and arrangement of features on the earth’s surface, and, to a lesser extent, the physical makeup of the structure. For example, vertical objects, like walls, will reflect very strongly. Metal objects, like a ship, will reflect more strongly than a wooden object.

<table>
<thead>
<tr>
<th>Specular Reflection</th>
<th>Smooth surfaces (roads, water) reflect the radar signal away from the sensor. They will be dark pixels in the image.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diffuse Reflection</td>
<td>Rough surfaces (foliage, grasses) reflect the radar signal in all directions, including back to the sensor. They will be gray pixels.</td>
</tr>
<tr>
<td>Corner Reflection</td>
<td>Vertical surfaces (walls, ships) reflect most of the radar signal back to the sensor. They will be bright pixels in the image.</td>
</tr>
</tbody>
</table>

4. On the **Home** tab, click **Reset Zoom** to set the zoom to the default level, where one screen pixel equals one image pixel.

5. Select **Home tab** > **Inquire Cursor** (in the Information group) and go to the following coordinates in the image.

   **Y: 34.6841 X: -82.9602**

   ![Image with coordinates](image.png)

   This is the city of Toccoa, Georgia. The bright pixels (bright radar returns) indicate the presence of a large number of vertical structures, or buildings.

6. Now use the Inquire Cursor to go to **Y: 34.8461, X: -83.7118**. This is the mountainous region in the north of the image. Note the foreshortening of the mountains.
7. Use the Inquire Cursor to drive the view to **Y: 34.4463, X: -83.1278**.

The long, dark, linear feature stretching from southwest to northeast is the interstate highway. The relatively flat surface of the road reflects the radar signal away from the sensor, which the image displays as dark pixels.

8. Now use the Inquire Cursor to drive to the following coordinates and identify the features in the radar image.

<table>
<thead>
<tr>
<th>Coordinates</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
Q: What is the look direction of the radar sensor? Hint: Zoom in on the mountains and look at the direction of the foreshortening?

Task 1.2: The Radar Analyst Tab and Level Slice

The Radar Analyst tab contains many of the functions used with radar data in IMAGINE.

2. On the Radar Analyst tab, select Look Direction.

A direction arrow is added to the View indicating the look direction of the radar system.

A Level Slice view allows you to try to isolate and visualize pixels based on their DN values. You will group the image into three groups, or slices: an Upper slice, a Center slice, and a Lower slice. You can
then adjust where the cutoff for each slice is by moving sliders on the image histogram.

3. In the **Display Mode** group on the **Radar Analyst** tab, select **Level Slice**.

A new functional layer is added to the View, and the image histogram is displayed in the eWorkspace. By default, the center of the histogram is colored blue, and the two ends are colored gray. The color shading on the histogram corresponds to the colors in the View.

4. Grab the left-most Slice Adjustment Slider and drag it all the way to the left side of the histogram (around value 117). Drag the right slide so that it is at the point where the curve of the histogram changes from a downward to an upward slope (around value 1950).

Because water is a specular reflector, the water pixels contain dark pixels. On the histogram, these pixels are represented by the small peak to the left of the bulk of the data.
5. On the Radar Analyst toolbar select the **Lower Color** and change it to red. Do the same for the **Upper Color**. Next, right click in the viewer and select **Swipe**.

This will allow you to compare the pseudocolor image you are manipulating via the histogram to the underlying original radar image. The goal is to optimize the land-water separation.

6. Zoom in on one of the large water bodies in the image. Note the areas of water not included in the selection. Adjust the sliders to include all of the water.

Note that there are erratic pixels that are seemingly misclassified e.g. bright “land” pixels in the water bodies. This is because we have been working with “raw” radar data that has not been despeckled. In the next exercise, we will talk more about speckle suppression, but right now, let’s just open a despeckled image.

7. **Clear** the View and open **2009_despeckle.img**.
8. On the **Raster** tab, select > **Radar Analyst**.
Q: Can you display the Look Direction of the despeckled image?

9. In the **Display Mode** group on the **Radar Analyst** tab, select ![Level Slice](image). Note that the two peaks of the bimodal histogram are more clearly resolved and separated. This is because the erratic pixel values resulting from speckle noise have been suppressed.

10. Adjust the sliders so that the blue area is between 307 and 3000.
11. On the **Radar Analyst** tab, in the **Level Slice** group, click the **Rescale** button. This will rescale the histogram to only display the area between the two sliders.

12. Click on **Upper Color** in the toolbar to open the Color Chooser. Check **use opacity** and adjust the slider to 0. Do the same for the **Lower Color**.
13. Zoom in on the water body again.
14. Adjust the right slider back to the water/land breakpoint. Try to include as much water as possible.
15. When you are satisfied with your threshold setting, click Raster to Vector on the Radar Analyst tab in the Level Slice group.

16. Enter a name for the Output Shapefile, such as WaterTemp, and Intermediate Recorded Raster. Click OK to calculate.

18. Display the shapefile on top of the original radar image.
19. Right click on `watertemp.shp` and select remove layer.

**Task 2.2:** Create a Targeted Water Polygon

1. Load the speckle-suppressed file that you think has the best balance of resolution and despeckling.
2. Select **Home** tab > ![Inquire Cursor](in the Information group) and go to the following coordinates in the image.

   34 50 23.4224 N, 83 34 10.5057 W

3. **Zoom** in on the oil slick. Make sure that you can see the entire lake in your view.
5. Select File > New > 2D View > Vector Layer. Name the new file lake.shp.
6. In the New Shapefile Type dialog, select Polygon Shape and click OK.
7. Ensure that lake.shp is selected in the Contents pane.
8. On the Radar Analyst tab, in the Collection group, click on the arrow next to Grow and select Growing Properties.
9. Click to grow the region using the eight surrounding pixels. Change the Spectral Euclidean Distance to 400 and click At Inquire.
A small polygon is created. At this Spectral Euclidean distance it is much too small to encompass the majority of the slick.

10. Use the thumbwheel to increase the distance to **800**. When you let go of the wheel, the polygon updates to show the region grown by the new settings.

11. Continue adjusting the **Distance** until you have grown the polygon to include all connected water.

12. **Save** the shapefile.

13. Continue digitizing the individual lakes. **Save** the file after each polygon is collected.
Exercise 3: Blue-is-New

**Objective:**

In this exercise we will use the real-time Change Detection Tool in the Radar Analyst Workstation.

**Task 3: Identify glacial movement using radar imagery**

1. Open the image: `TDX1_SAR____SSC____SL_S_SRA_20151022T194918_20151022T194920` using the .xml file into an IMAGINE Viewer.


3. Again using the xml file, open `TSX1_SAR____SSC____HS_S_SRA_20091027T232620_20091027T232620` in the same viewer.

4. Right click in the viewer and select **Fit to Frame**
You now have 2 images, one taken on Oct 22nd and one taken on Nov 2nd over the same area.

5. From the Analyst tab > Display group > open the AutoEnhance drop-down menu. Select the Blue-is-New function from the list.

6. A new layer is created in the Viewer that is derived from the two input layers. In this color-coded Change layer, features in Blue are new to the area; that is, they were not in the early captured scene but are in the later dated scene. Similarly, features in Red have exited (“fled”) the scene; they were in the first scene captured but not in the later one. Normally this is done to measure new man made features, but in this case, the movement of the glacier is apparent.
7. Clear all views.