GEO/EVS 425/525 Unit 7
More on Vector Images

Our coverage of vector images in Unit 5 was fairly simple: It dealt with the differences between point, arc, and polygon images and did not deal with the structure of an arc coverage. In this exercise, we will look in more detail at the structure of the files making up a coverage, manipulate some of the files to carry out a very useful function, and convert files from vector form to raster and back.

There is a huge difference between the way in which raster images are stored and the way in which arc coverages are stored. Raster images in ERDAS Imagine are simple files, with several files being involved with a single image. All files comprising a single image have the same name (e.g. SHAKERHEIGHTS); they are distinguished by their extensions (i.e. the part of the complete file name after the dot). Extensions that can be found in ERDAS Imagine files include *.img, *.rrd, *.sig, *.ovr, *.aoi, etc. You have run into some of these file forms already. Vector images, on the other hand, are not stored in simple files. Rather, they are stored in workspaces. This is a directory (as opposed to a file) which contains one or more vector layers. This organization provides a convenient means for organizing layers into related groups, in which the naming convention is highly consistent. Each workspace includes a number of file types, including:

File Type	File	Description
Feature Definition Types	ARC	Line coordinates and topology
	CNT	Polygon centroid coordinates
	LAB	Label point coordinates and topology
Feature Attribute Files	AAT	Arc (line) attribute table
	PAT	Polygon or point attribute table
Feature Cross-Reference Files	PAL	Polygon/line/node cross-reference file
Layer Description Files	BND	Coordinate extremes
	LOG	Layer history file
	PRJ	Coordinate definition file
	TOL	Layer tolerance file
Imported Attribute Data	ACODE	Arc attribute information
	PCODE	Polygon attribute information
	XCODE	Point attribute information

A particular workspace need not contain all of these file types, but it may contain most or all of them. As you can probably tell from the descriptions of the individual file types, there are two basic functions to the files. One set (most of them) are those related to the layout of the image itself. These files include the boundary, tic, point, arc, and polygon definition files. The other set (the more interesting, for most purposes) are those related to the attributes of the objects in the image. These files include the basic feature attribute files (AAT and PAT), as well as the imported attribute data files (ACODE, PCODE, and XCODE). In addition to the directory for each workspace, arc coverages also involve the INFO directory, which provides Imagine with a directory of what is in each of the coverages.

We do not need to look at all of these files, although you should look at some of them as you go through this exercise. Of major interest to us will be the attribute tables (i.e. AAT, PAT, ACODE, PCODE, and XCODE), since these tables provide the linkage between the image and its significance to the real world. The images on which we will be concentrating are the DLGs you created in Unit **6.**

Making a DEM from a DLG

Open the image you created from the hypsography DLG for your quadrangle. It consists of a number of contour lines. What information is contained in this image? Click on Vector-Attributes to see what attribute values are stored there. The attribute table is blank. On the vector attributes menu bar, click View to look at the points and polygons attributes. The only attributes in the image are the locations of points. This doesn't tell us much! The problem is that when you imported the DLG, you imported the arcs, the associated topology, and the associated attribute information, but the only thing that was needed to make the image was the arcs themselves. The arc information went into the ARC table within the workspace, but the topology and attribute information was not incorporated into the image because it was not needed to recreate the image.

Let us look at the structure of the workspace. Go to a Windows NT command prompt (click on the Start button, then Programs, then Accessories, then Command Prompt). The command-prompt window will open; it should have your X> drive as the command prompt. Go to the workspace. To do this, type CD xxxx, and hit the return key, where xxxx is the name of the workspace. That is, if your image is named cl402ohp, your workspace is also named cl402ohp. You would type CD cl4020HP. The prompt will now change to X:\CL402OHP (or whatever you called your image). Do a directory. That is, type DIR and hit the return key. You will notice that the files include a number of the files indicated in the table above, with the extension ADF. These are, in fact, the files making up the image. But there is neither an AAT file nor a PAT file. The attributes have not been defined. In a hypsography image, the elevation attributes are a consequence of the topology. When you imported the DLG, you created an image, but you did not build the topology of that image. You plotted lines within the coordinate system of the image, but the lines are in segments that you did not formally associate with each other. To do the formal association, you need to Build or Clean the image.

Building and Cleaning vector coverages are the ways you associate lines with each other and with their topological attributes. The two operations are similar in some ways, but different in others. Building simply associates objects with each other in the context of the type of objects found in the image. Cleaning does this - plus editing arcs to insure that nodes exist where they should. You will need to Clean images on which you have edited arcs. Normally, however, Build is preferable and should be used rather than Clean. For a DLG, you have not edited any of the arcs, so you do not need even to consider Cleaning the image. One thing that should be remembered in all of the vector utilities in Imagine: **You should NEVER use the Build and Clean utilities on a file that is open in the viewer. Erase the file from the viewer before working on itl**

Invoke Build by clicking on Vector-Build Vector Layer Topology from the main Imagine control panel. Enter the name of your arc coverage in the "Input coverage (*.arcinfo)" field (it's best to do this with the mouse; that way you are assured of spelling it correctly and insuring that you are in the right directory. Also, make sure that the "Feature" type is Line (since a DLG is inherently a line file). Click on OK.

Load the file into the viewer again, and look at Vector Attributes. The arc attribute table is there, and it contains a number of attributes, although none of them deals with elevation. Go back to the command prompt window and do another directory on the workspace. A new table has been created: AAT.ADF, which contains the topological attribute data.

The image still contains no elevation data. But the elevation data are there! Open the Table Tool by clicking on Vector-Start Table Tool. The table tool is an extremely powerful tool that will enable you to edit the individual ARC/info tables, combine them, or carry out other operations. Open a table by clicking on File-Open from the menu bar or on the File Open icon. The dialog which opens first asks for the location of the info directory. This is your X directory. When you click on the appropriate Info icon, (or type in x:\info), the Table List window will list available tables in alphabetical order by image. Scroll down the table list to your image and click on xxxx.aat, again where xxxx is the name of your image. The arc attribute table will open, and you will notice that it contains exactly the same information as the Vector Attribute table you opened from the viewer. This should not surprise you, because it is precisely the same table. Look at the xxxx.bnd table. This provides the boundaries of the image. Now look at the xxxx.tic table. This provides for tic marks. You will notice that there is a table named xxxx.acode. You did not see this as a separate file in the workspace when you did the directory of the workspace, but the information was there. This is the imported attribute data for your DLG, and it contains the elevation information. Click on the file and click on OK to open it in the table tool.

Before we can go any further, you need to know some more about DLGs. Information in a DLG is coded, so that different classes of information are associated with codes that indicate the class of information. The class is indicated by the major code; the value for the class in question is indicated by the minor code. Hypsography DLGs contain 2 classes of information: major code 20 and major code 22. You can ignore major code 20; major code 22 is the elevation information. You will notice, as you look at the ACODE table, that it contains up to 8 levels of major and minor codes, and that each major code has a minor code associated with it. Major code major1 is almost always 20, so we can ignore major1 and minor1. Major code major2 is often 22, but it is sometimes 20. Major code major3 is typically 22 where major2 is 20 and -99999 otherwise. Most of the other code fields are -99999. What this means is that we need to take our elevation values from either minor2 or minor3, depending on the value of major2 or major3. Be sure that you understand the logic of this statement! How do we make our choice? It's really quite simple. For this region (although not all), where major2 is equal to 20, the associated minor2 is always a smaller number than the elevation of the arc being evaluated. That is, we can simply take the larger of minor2 and minor3, and this will be the elevation.

Let us add a new column to the table. Enable editing of the table by clicking on Edit-Enable Edit. Then add the column by clicking on Edit-Add a Column. You can name it anything you want (like Elev), but be sure that the data type is Integer. Click on OK to add the column. Now click on the header column of the new column. It turns blue, indicating that it has been selected. Invoke hidden functions by right-clicking on the column header for the elevation column. Click on Formula. You want to populate the column (i.e. the elevation attributes) with the larger of minor2 and minor3. The formula to do this is

max ($"MINOR2", $"MINOR3")

Use your mouse to input this formula. Then click on Apply to populate the column. Click on Close to close the formula generator, and save the table by clicking on the Table Save icon in the Table Tool icon bar. Look at the table. Most of the cells in the elevation field are filled with elevation numbers, but some contain the value -99999, indicating that the arcs referenced by these rows are not contour lines. You will have to ignore these when you generate your DEM image, but you won't do that yet. Before we leave the ACODE table, look at the field at the left of the table. It has a name something like xxxx-ID. This field has a unique number for each arc in the image. It is the key to merging the existing AAT table with the updated ACODE table. Now clear the table tool by clicking on File-Clear, and be sure that your image is not loaded into the viewer.

Now merge the ACODE table with the Arc Attribute Table. Click on Utilities-Table Merge from the table tool menu bar. Be sure that the Info directory for the input table, the join table, and the output table are all x:\info. Your input table (i.e. the table to which you are joining the ACODE table) is xxxx.aat. Your join table is xxxx.acode. Name your merged table xxxx.aat. By doing so, you are saying that you want to merge the ACODE file into the AAT file and that you want the resulting file to be the AAT file. This will work as long as you do not have the old AAT file in the table tool editing window. Be sure that the Join Field is xxxx-ID. Then click on OK, and the tables will merge.

Reload the image into the viewer, and click on Vector-Attributes. The elevation field is now listed as an attribute. Erase. the image from the viewer.

You are now ready to create a surface from your DLG. Open the Surface tool by clicking on Interpreter-Topographic Analysis-Surface. When the dialog opens, first indicate that it is a Line coverage. Then load your coverage as the input file, and designate your elevation field as the Z value. A new window opens, showing the values for X, Y, and Z. If you scroll down this window, you will see that a number of the Z values are -99999. You need to ignore these. Right-click on the row header of one of the fields to invoke hidden row functions, and click on Criteria. The criteria window opens. As your criterion, enter something like:

$"Z" == -99999

or

$"Z" < 0

Either will do. The result will be that the rows in which Z is the background value will be selected. Close the formula window. Now click on the column header to the Use field to select it, and then right-click the same column header and click on Formula. Your formula is the number 0 (zero). Then Apply the formula, and close the formula window. What you did here is to change the value of the Use column -for all records that have been selected - from X to blank. The only records that were selected were those in which the elevation value was -99999 (or less than zero). The other records - which were not selected - were not affected by the formula. Scroll up and down the file and satisfy yourself that all records in which the elevation value was a reasonable number contain an X in the Use field and that the Use field is blank for the others. Now click on the Resample icon. A new dialog opens, in which you will put the data for your new raster image. Give it a suitable name. Use the defaults for surfacing method and output corners. Choose an appropriate pixel size. Accept the default for background value, but check the "Ignore zero in stats" box. When you are satisfied with your parameters, click OK The surfacing operation can take a long time, although it can be fairly speedy if your output raster is of a reasonable size and your input arc coverage isn't too complex. When the surfacing is complete, look at your raster image in the viewer. Now superimpose the original contour diagram over this raster image. **The composite diagram of your raster surface and vector contour image should be included in your portfolio for this unit.**

Editing a Vector Coverage

Open the image of the Roads DLG for your quadrangle in your viewer to remind yourself what it looks like, and then erase it from the viewer. You are going to edit this file so that you add a new superhighway, but you will first copy it to a new coverage (so that you don't lose the old one). Recall the file structure of Arc Coverages. Basic directory information is located in the Info directory, and specific coverage information is located in the workspace directory. You can't just copy stuff the way you do with normal programs. You have to use the Arc Coverage tools. Click on Vector-Copy Vector Layer in the main Imagine control panel. Insert the names for your old and new files, and click on OK The coverage will be copied into the new workspace. Now load the copy into the viewer. Enable editing by clicking on Vector-Enable Editing. Be sure the vector tools palette is available to you. If it isn't, click on Vector-Tools. Now add your superhighway. To do this, click on the "Place a Line Feature in the Coverage" icon (the Z-shaped line in the upper right comer of the tools palette). Use your mouse to add the superhighway. Each time you click on the left mouse button, a new vertex for the line is added. To end your line, double-click the left mouse button.

When your superhighway is completed, you can sit back and contemplate your work. It probably isn't exactly what you want, so you will need to edit it. Point your mouse at the line you've created, and click. The line turns yellow, and it is bounded by a bounding box. If you want to move the entire line, you can grab one of the handles on the box and drag it. Or, if you want to move individual points, you can click on the "Reshape a single line . . ." icon (the vaguely bow-and-arrow-shaped icon just below the scissors). When you click on that icon, the line you've selected darkens, and the vertices appear as discrete dots. You can move individual vertices by clicking on them with the mouse and dragging them to the place you want them. Do this with several vertices until your superhighway is precisely where you want it. When you are done, save your file.

Rasterizing a Vector File

Copy the vector file, SHSOILS, from the Q: drive, onto your X: drive. This is the soils map for the Shaker Heights quadrangle. Remember that you need to use the vector tools built into Imagine in order to do this. Load the map on your X: drive into your viewer. At the present time, this is a vector map. There are many instances in which we would prefer that the soils map be a raster map. Converting a vector file to a raster file (and vice versa) is quite simple. Before you rasterize the map, however, you will use the table tool to simplify it.

Open the table tool, and load the PAT file for SHSOILS. This is the table containing the polygon attributes for the coverage. Since soil name is a polygon attribute, the soil names are to be found in this table: Click on Edit-Enable Editing to enable editing, and then Edit-Add a Column to add a column. Give the column a suitable name, such as SoilType, and place it after MUSYM (this is the column containing the soil names). Again, it must be an integer. Go to the right-hand side of the table, and click on the column header for your new column to select it (it turns blue). You will then select each of the soil types found in the table, in turn, and then change the soil type ID number. To do this, right click in the row headers for one of the records. This opens hidden row functions. Select Criteria. If the first soil in the list is UeA, your first criterion would be MUSYM==UeA (you will pick MUSYM and == with your mouse and type in UeA). When you Apply the criterion, all UeA records will turn yellow. Now right-click in the header for your soil type ID column, and select Formula. Your formula is the number 1. When you click on Apply, it will change the number for all Selected rows (i.e. those for which MUSYM==UeA) to 1. Then go back to your criteria statement and change UeA to the next soil type (Ub). The rows originally selected for UeA deselect, and the Ub rows are Selected Clear the Formula dialog, and enter the number 2 as a new formula. When you Apply the formula, the Ub layers change their soil type ID to 2. Go through the list, and change the soil type ID numbers for all soil types to different numbers.

You are now ready to rasterize the coverage. Click on Interpreter-Utilities-Vector to Raster. Your input vector is X\SHSOILS; your output raster is whatever name you choose to use. The input coverage type is polygon. Check the box labeled Use Attribute as Value, and select your soil type ID field as the attribute against which to set Z. Then click OK The conversion will take place.

Now load the new soils map into the viewer, and give the different soils color. To do this, click on Raster Attributes (be sure to load it as a pseudocolor image), and click on Edit-Color's from the attributes menu bar. Choose interesting beginning and ending colors for the scale, and hit OK Now place the vector soil map over the raster. The vectors will outline the individual soil units. **This map should be included in your portfolio for this unit.**

Questions to Consider

1 What sorts of images are more useful as rasters? As vectors? As composites of both?

2. Are there any images which are limited to either vector or raster.?

Portfolio

1. Composite of your rasterized DEM with the contour lines from the DLG superimposed over it.

2. Composite of your rasterized soils map of Shaker Heights, in color, with the vector soils map superimposed over it.