Exercise #5A

Image Classification and Feature Space

Objective

- **Learn the concept of classification of an image.**
- **Create a feature space file.**

Classification

There are two types of classification – unsupervised and supervised.

Unsupervised

In unsupervised classification (also known as clustering), the computer groups together pixels having similar spectral properties into distinct classes. The contiguity of the pixels is not used in defining its class, **only their spectral characteristics**. The method of clustering can be specified as either ISODATA (Iterative Self-Organizing Data Analysis Technique) or RGB. In the ISODATA method, clustering is done by a process whereby the computer selects initial classes based on statistics, classifies the pixels, and then modifies the criteria for each class. This process repeats iteratively until the spectral distances are minimized. In RGB clustering only three-bands of data are used. The positions of the pixels in the three-dimensional space are plotted and the classes defined according to the clustering of these points.

Supervised

In supervised classification you select pixels that represent patterns or land cover features that you recognize or that you can identify with help from other sources. You then instruct the computer to place these pixels, and ones with similar characteristics, into a classification associated with a particular land cover.

Each class defined in either supervised or unsupervised classification will have a signature associated with it. The signature assigned to each class is either **parametric** or **non-parametric**. A parametric signature is based on the statistics of the pixels that are in the cluster (unsupervised) or in the training sample (supervised). It uses the mean and covariance of those pixels. A non-parametric signature is based on an area defined within a **feature space image**.

A **feature space** image is a graph of the data file values of one band against another (basically a scatterplot with a dot for every pixel in the image). The pixel position in the feature space image is defined by the spectral values for the two chosen bands. The feature space image is shown as a raster image and has a color associated with each pixel. The colors (or grayscale intensity) represent the cumulative frequency (i.e. the number of pixels in the original image which have the given (x,y) combination). Bright tones represent a high density of points, dark tones represent a low density. (The pixel values can also be colored according to thematic layers assigned to the same image.)

Classification decision rules

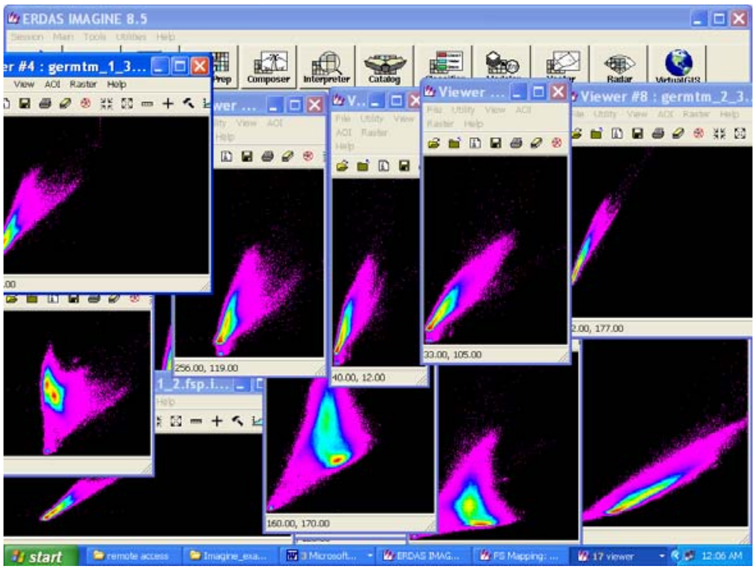
A decision rule is a mathematical algorithm that is used to put pixels into distinct classes once the signature for each class has been decided upon. When using parametric signatures the mean and covariance of every pixel in the data file is used and so every pixel in the file is assigned to a class. With non-parametric signatures, the decision rule must decide whether or not a pixel is located inside the signature boundary.

<u>Exercise</u>. Create a feature space image for use in classification.

Before you proceed further with the set of classification exercises, you will need an image of an area with which you are familiar. This should be the subset of the area that you downloaded or a subset of the Los Angeles image provided. The area should be a few square miles. Try to include some different land types in the area – eg. at least one water body, some area of grass, urban, natural land etc. Call this file "xxxxxxxx_subset" or an appropriate name.

You will create a feature space image of this subset file. This is a plot of the intensity values in one band vs the intensity values in another band. Even though there are 7 bands available for the Landsat 7 data, we can only plot one against another in a single feature space image. Each different 2-band combination will produce a different feature space image.

To create the feature space image, choose the Feature Space Image button in the Classification menu. When it has been selected a dialog box will appear with "Create Feature Space Images" at the top. Select your subset image as the Input Raster Layer and make sure the Output Root Name is similar to the raster layer **and the directory path is correct**. Under “F S Image” select the band pairing that you would like to see. You can select as many as you want – or if you select none, all the feature space images will be created. Click OK. When the processing is complete open a new viewer and view the output images (eg. **xxxxxxx_subset_1_3.fsp.img)** as the raster layer. Note that the 1_3 (and other combinations) represent the bands that are being plotted in the image. In this case layer 1 (band 1) will be displayed on the x-axis and layer 3 (band 3) on the y-axis.



Now link the cursors in the image (xxxxxxx_subset) and the feature space (xxxxxxx_subset_1_3.fsp). To do this, open the image in viewer1, and open a new viewer (2) containing the feature space. Open the signature editor (under “classification”) and select feature->view->linked cursors. The linked cursors dialog appears. Set the viewer to 2 (to select the window where the feature space appears). Then click link. Then click inside the image window. In this way you can move the cursor over different landcover in the original image (e.g. over the water) and see where this corresponds in feature space. Drag the inquire cursor around and see where certain land cover types appear in feature space. (You can also experiment with creating feature spaces using different bands, and with the different bands displayed in the original image. You can create the feature space for every possible pair of bands!

1. Turn in a screen dump showing your image and one of your feature space images with the cursors linked. Place the cursor over some area of distinguishable land cover in your image and comment on the position of the cursor in the feature space image.

2. How many possible feature space images are there and why?

3. Explain what a feature space shows. Explain what the red “center” in the feature space shows.

4. In your feature space images (and in the ones shown above) there is a general trend of the pixels to lie along a line running at around 45º to the x and y axes. Why might you expect that the pixels from an image of the earth might tend to fall along such a line?

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