

# Exercises in Digital Image Processing

## Exercise 3

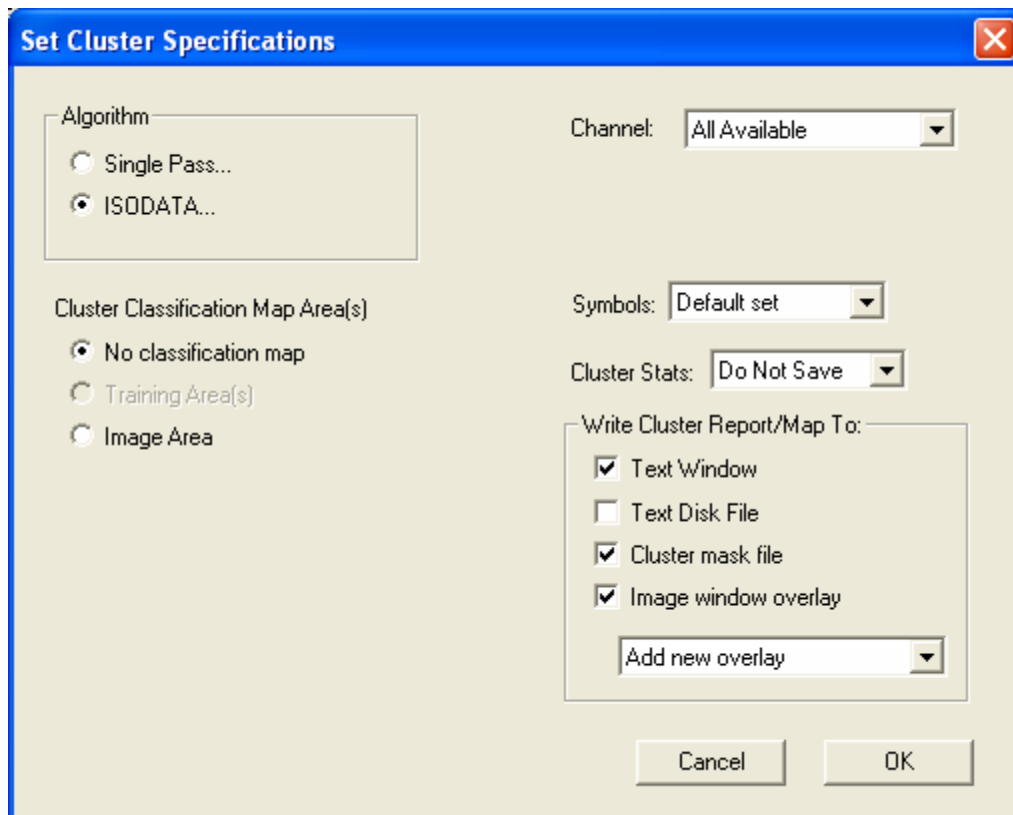
### Unsupervised Classification (Cluster Analysis)

**Requirements: MultiSpec application and image titled “aligarh.lan”.**

Two Clustering algorithms are available in MultiSpec. They are useful in grouping similar pixels in the image into clusters or categories. One algorithm implemented is a simple one-pass type. The second is an iterative type called ISODATA. We will use the ISODATA algorithm for this exercise. A cluster analysis will be run on the “aligarh.lan” image file.

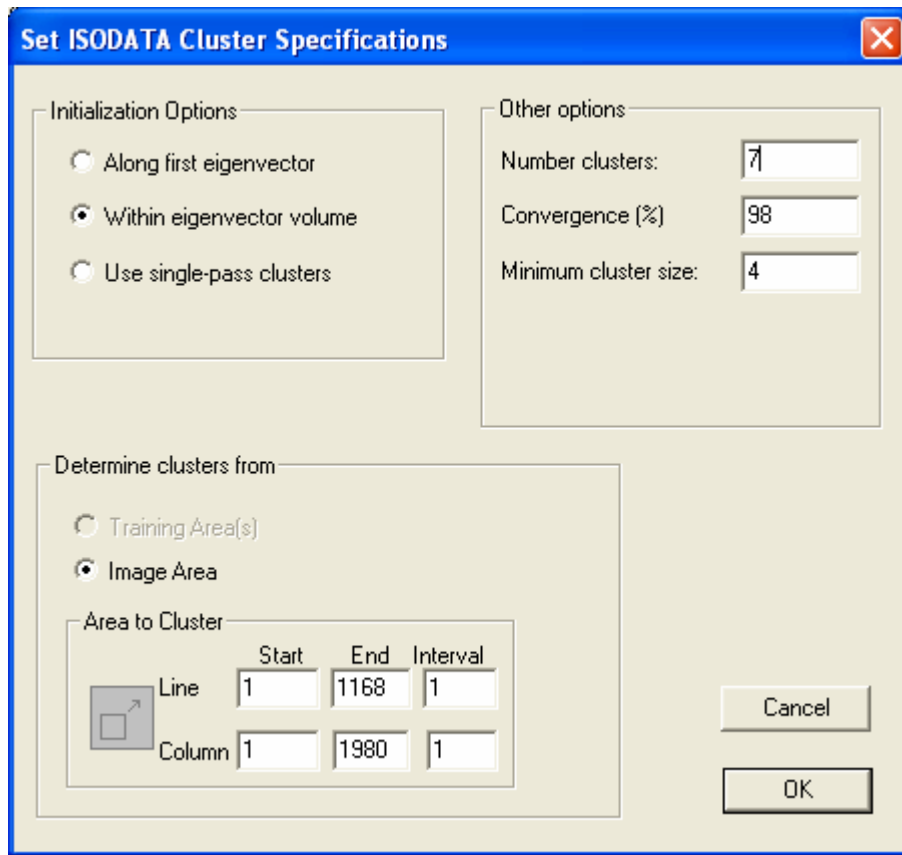
Open the image if it is not already displayed in a multispectral image window following the guidelines given in exercise 1. If the image is already displayed in an image window, clear any selections in the image window by striking the “Delete Key”.

- 1.1 From the **Processor** menu, select **Cluster...** to bring up the cluster specifications dialog box. Select “Do Not Save” in the Cluster Stats: popup menu. Select “Cluster mask file” under the “Write Cluster Report/Map To” group. Select “Image window overlay” under the “Write Cluster Report/Map To” group.



This will cause a cluster map to be created as a thematic image disk file and displayed as an overlay on the multispectral image window.

1.2 Then select “ISODATA...” This will cause the ISODATA Specifications dialog box to be displayed. Enter 7 for the number of classes, 100 for the convergence percentage and set the line and column intervals to 1 (if needed) and then click **OK**.



1.3 You are now back to the Cluster Specifications dialog box. Click **OK** to close this dialog box and start the clustering operation.

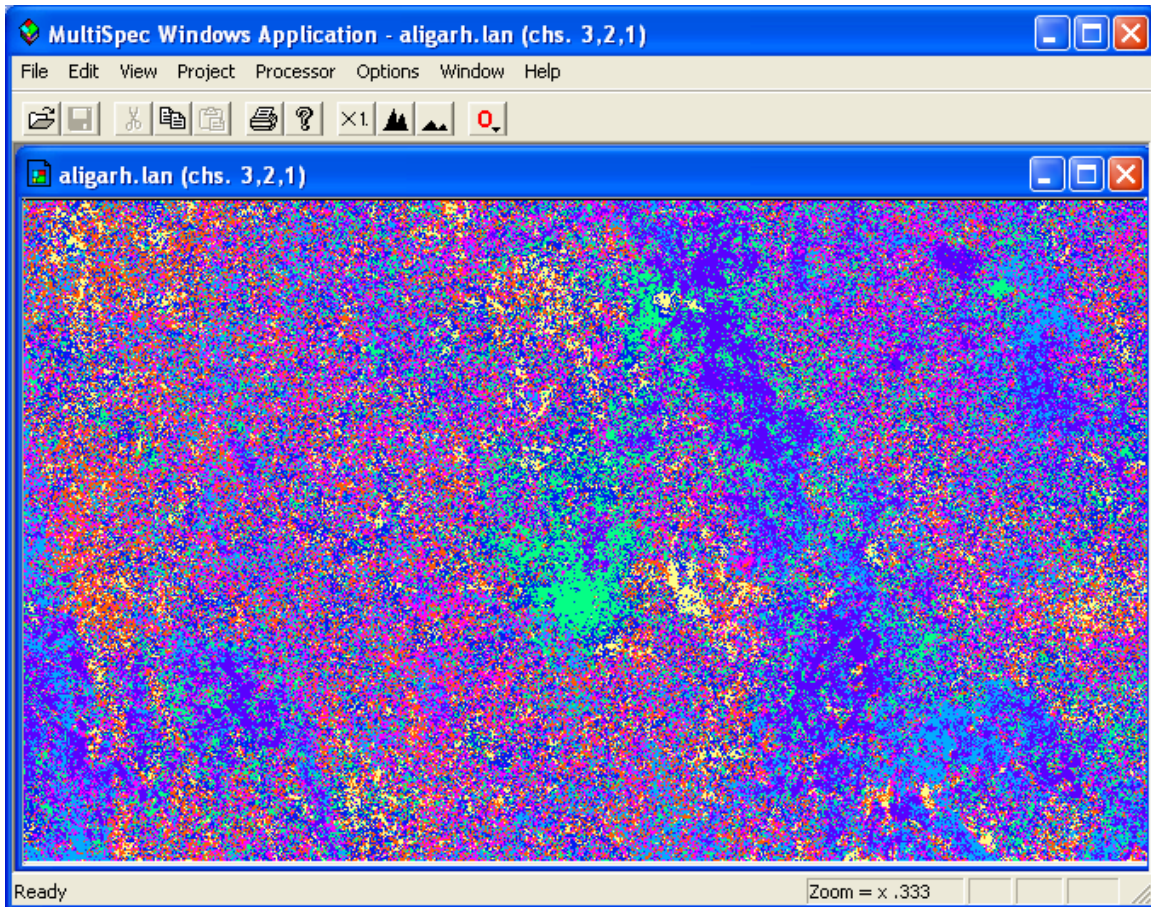
You will be prompted to enter a name for the cluster map disk file and where to save the file. Just use the defaults by clicking Save in the Save Cluster Map dialog box.

A cluster map will now be created with around 7 classes in an unsupervised manner. You will notice the colors change in the image window as the pixels are sorted into cluster classes during each iteration. After the final iteration, a thematic image file with a map of the cluster classes will be saved to disk.

The text output for the cluster operation will be at the end of text output window. The information includes the mean values for each of the channels for each cluster for both the initial condition and the ending condition. If the map information is available for the image, the final area for each cluster is listed in the units specified in the coordinate view for the image window.

Usually the convergence is set for 98 or 99 percent. We used 100 in this example so that you have a chance to watch the pixels change cluster classes which illustrates the nature of the ISODATA algorithm.

The cluster map overlay on the multispectral image window will look similar to the following.



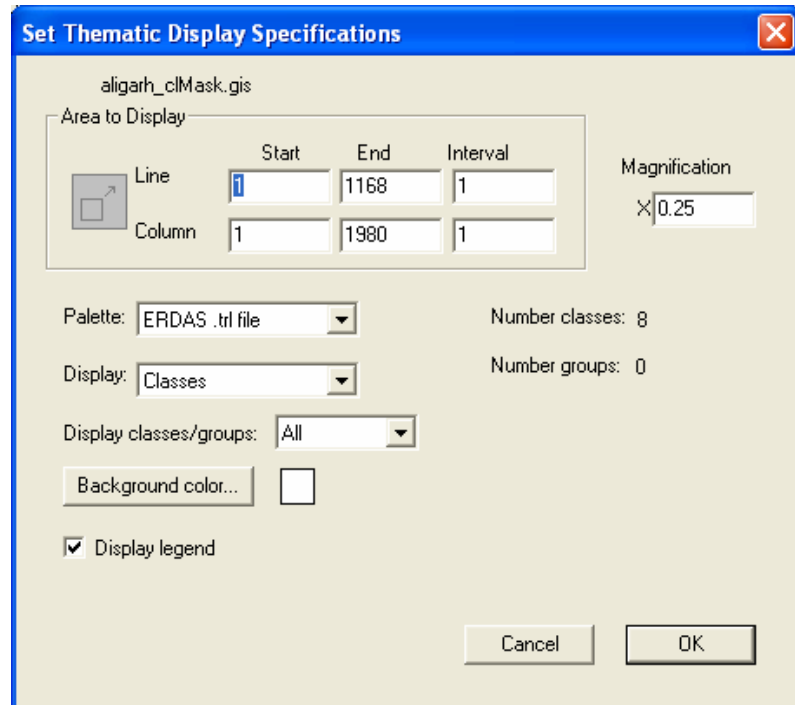
You can turn the overlay on and off by using the “Red O” popup menu button in the toolbar to the right of the “small mountain” zoom button.

1.4 Now open the cluster map thematic image file. This will be the same image as is shown in the overlay above but you will have more control over the cluster classes. From the **File** menu, select **Open Image...** to bring up the open image dialog box. You may have to change the “Files of type” popup to All Files or Thematic Files. Then select “Aligarh\_clMask.gis” and then click **OK**. You may need to select “Thematic” for the *Files of Type* popup menu.

The Thematic Display Specifications dialog box to the right will be displayed.

The default settings are fine; click OK in Display Thematic Image dialog box. This opens a thematic image window.

1.5 In the thematic image window, the cluster class legend is on the left. If you hold the shift key down and move the cursor over the color chips you can blink the color when clicking the left mouse button.



Compare the Cluster map with the original image window. Note clusters that represent trees, sparse vegetation, thicker vegetation, different soil colors and shadows.

There are several things you can do to evaluate the image. you can move the cursor over a color chip, hold the shift key down (cursor will change to an open eye) and click the left mouse button down and up to cause the colors for that class to blink on and off (alternate between white and the color). If you hold down both the shift and ctrl keys and then click the left mouse button, then all the other classes will blink on and off. These procedures are helpful in understanding the extent of the classes in the image.

You can also change the class color by double clicking on the color chip. You can change the cluster class names by double clicking on the name to the right of the color chip. (The list of interpreted cluster names that you may assign are: Lighter soil, Medium colored soil, Sparse vegetation (weeds), Darker soil, Dense vegetation (trees, wheat, weeds), Shadowed trees, Image blank.

1.6 You can also group the cluster classes together in information groups by selecting Classes/Groups in the drop-down menu above the legend. Then drag the cluster classes into similar information group categories. Again one can double click on the group name to change the name. For example one could change the appearance of the thematic image to represent Bare Soil, Vegetation and Non-image informational classes. The popup in the legend allows one to display the original cluster (spectral) classes.

**Concluding Remarks:** This exercise is adapted from <http://cobweb.ecn.purdue.edu/~biehl/MultiSpec/tutorials>. There are many other operations that you can do with MultiSpec including several Reformatting processes. See the other exercises or the MultiSpec Introduction at the MultiSpec web site for more information. The MultiSpec web site is: <http://dynamo.ecn.purdue.edu/~biehl/MultiSpec/>.