EXERCISE 14  DIGITAL CLASSIFICATION
(UNSUPERVISED)

Structure
14.1 Introduction
   Objectives
14.2 Requirements
14.3 Importance of Image Classification
14.4 Steps
   Applying Classification on Single Band Image
   Applying Classification on Multispectral Image
14.5 Home Work: Do It Yourself
14.6 Further/Suggested Reading

14.1 INTRODUCTION

You have learnt to visually interpret aerial photographs and satellite remote sensing data in Exercises 12 and 13. The process of image interpretation can be carried out through software also and is known as digital image interpretation. In this exercise, you will learn the process of image classification and to apply them on single band and multispectral images. You will learn to classify a single band image by applying density slicing. You will also learn to generate an unsupervised classified image by applying unsupervised (clustering) on a multispectral image.

Objectives

After doing this exercise, you should be able to:

- apply density slicing on a single band image; and
- perform unsupervised classification on a given image by clustering method.

14.2 REQUIREMENTS

In order to carry out this exercise, you need to have following:

- a computer with ILWIS software, and
- sample satellite data.

14.3 IMPORTANCE OF IMAGE CLASSIFICATION

You have learnt while studying Unit 7 of MGY-002 and performing Exercise 12 and 13 that image features are identified and interpreted based on their unique spectral signatures. Spectral signatures are manifestation of Earth's surface features response to light in different wavelength regions. The spectral signatures are represented in image in terms of DN values in different image bands. Hence, there is a relationship between the DN values and the characteristics of features present on the ground. While analysing the DN values you can find the relationship between the two and extract information about the Earth surface features. The process of finding the relationship is termed as classification. In other words, image classification is the process of assigning spectral classes (i.e. groups of pixels) present in an image into information classes (i.e. name of the feature) present on the ground. The resultant classified image is a thematic map of the original image wherein each pixel belongs to a particular theme/class.
Digital image classification is time effective as it saves time taken in image interpretation and generating thematic map.

14.4 STEPS

Image classification can be applied on either a single band image or multispectral image; however, the process of image classification for the types of images is different. You will learn to apply image classification on the two types of images as explained in the next two sections.

14.4.1 Applying Classification on Single Band Image

There are several approaches of classification on a single band image such as density slicing, segmentation, etc. In this exercise, you will learn to apply density slicing. As you know that in an image histogram, the DN values are distributed along the horizontal axis. You can divide the DN values into a series of intervals or slices. The process of dividing the DN values into a series of intervals or slices is known as density slicing. Number of slices may vary from image to image but all the DN values falling within a given interval/slice is displayed as a single class in the classified image.

In this exercise, you will learn to apply density slicing on an image and create a classified image with two classes. Data used for this exercise is the raster map *tmb4*.

Before a slicing operation is performed, let us first learn to manipulate the representation, which shows a map, as if it was classified. Follow the procedure given below to apply interactive slicing on the *tmb4* image:

1. Switch on your computer.
2. Open a catalog window of ILWIS.
3. Open the raster map *tmb4.mpr*, the band 4 (i.e. NIR band) of sample TM data with default Gray Representation.
4. Visualise different features present within the image and note down values of water and land pixels in your notebook by preparing a table.
5. You will observe a clear distinction between the land and water pixels. However, there may be some overlapping in some area for some features.
6. Go to Operation-Tree tab, expand Create and double click New Representation. The Create Representation dialog box opens up as shown in Fig. 14.1. You can also open the dialogue box by selecting Create and Representation from File menu. Fill the Representation Name box as *tmb4l* as shown in Fig. 14.1.
7. Click on OK button. It will open the Representation Value editor as shown in Fig. 14.2.

8. Go to the Edit menu and select Insert Limit which opens Insert Limit dialogue box as shown in Fig. 14.2. Enter the limit you have noted down in the table you have just prepared to differentiate land from water. Select the colour as Blue.

![Representation editor dialogue box](image)

**Fig. 14.2: Representation editor dialogue box**

9. Similarly, insert the other limit also and select the colour as Green for it.

10. When you click the word Stretch between the two limits a list box opens. Select Upper.

11. Do the same for the other limit also.

12. Now see the map with new representation by clicking the Redraw button in the map window.

13. If you are satisfied with the result, close the Representation Value editor otherwise again edit the representation until you find the best boundaries for the classification.

In the above steps, you have learnt the process of interactive slicing by performing the above steps. The representation can be edited and also the result shown on the screen, which allows you to interactively select the best boundaries for the classification.

Now, you will learn to apply density slicing on a single band image.

1. Go to Operations menu, select Image Processing and further select Slicing. It opens the Slicing dialogue box as in Fig. 14.3. You can also open the dialogue box by going to Operation-Tree tab and selecting Slicing under Image Processing.

![Slicing dialogue box](image)

**Fig. 14.3: Slicing dialogue box**
Remote Sensing Data Handling

2. Select *tmb4* in the *Raster Map* list box, type *Slices* in the *Output Raster Map* text box and type *Classified TM* image in the *Description* text box as in Fig. 14.3.

3. Click on the button located next to the *Domain* box. It opens *Create Domain* dialogue box as in Fig. 14.4. Type *Slices* in the *Domain Name* text box and make sure that the *Group* check box is selected as in Fig. 14.4.

![Fig. 14.4: Create Domain dialogue box](image)

4. When you accept all other defaults by clicking the *OK* button, the *Domain Class* editor is opened as in Fig. 14.5.

![Fig. 14.5: Domain Class editor](image)

5. In the toolbar of the *Domain Group* editor, click on the *Add item* button. It opens *Add Domain Item* dialog box as in Fig. 14.6.

![Fig. 14.6: Add Domain Item dialogue box](image)
6. Type the value in the Upper Bound box from the table you have prepared, type water in the Name text box, fill up other boxes and click OK.

7. When you click OK it gets listed in the Domain Class editor.

8. Enter other upper boundary and name in the same manner. It will also be listed in the Domain Class editor. You can edit the inserted values by clicking on the listed entries.

9. Press the Open Representation button in the toolbar in the Domain Class editor. The Representation Class editor opens as shown in Fig. 14.7, which shows the groups/classes that are present in the domain with different colours.

![Fig. 14.7: Representation Class editor](image)

Density slicing divides the DN's distributed along the horizontal axis of an image histogram into a series of user-specified intervals or slices. It will give reasonable results only when DN values of the classes are not overlapping with each other.

10. Select any predefined colour by double clicking a colour box or you can also create your own colour. You can choose blue colour for representing water and gray colour for land.

11. Exit the Representation Class editor when you are satisfied with your selection of colours and also exit the Domain Group editor.

12. Click Show button in the Slicing dialog box. It will create map slices and open up the Slices raster map in a map window.

13. Open the original raster map and compare the values of the original map with the names in the classified map.

If you are not satisfied with the end result, perform the exercise again with a new set of boundaries or by editing the existing slices.

### 14.4.2 Applying Classification on Multispectral Image

The approaches used to apply classification on a multispectral image can be termed as unsupervised or supervised classification depending upon on the level of input and direction from the image analyst. Unsupervised classification is generally performed when you are not having much knowledge about the relationship between spectral classes and ground features. However, the unsupervised classification approach is not fully automatic because you need to provide some information about the number of classes (i.e. clusters), etc.

In this exercise, you will learn how to apply unsupervised classification (clustering) on an image. Data used for this exercise is the subset raster map
Remote Sensing Data Handling

of Khambhat. Follow the steps given below to apply unsupervised classification (clustering) algorithm on the multispectral image:

1. Go to Operation-Tree tab and select Cluster operation under Image Processing. Double clicking the Cluster opens the Clustering dialogue box.

2. Select the number of bands as three and choose the corresponding first three bands of the multispectral image. Give number of clusters as 10.

3. Type Unsupervised as the Output Raster Map name. Clear the Output Table check box.

4. The unsupervised map is calculated and after the calculation the map is displayed.

5. Visualise the classified map and make a comparison with the multispectral image.

6. Close the map windows after finishing the exercise.

**After completing the exercise submit the following to your instructor for evaluation:**

1. Snapshot of the multispectral image used.

2. Snapshot of the unsupervised classified image output.

### 14.5 HOME WORK: DO IT YOURSELF

1. Explore how can you apply the piece-wise linear stretching method and make a note of how is it different from the density slicing approach.

2. Check how you can change the colour representation of the classified maps.

### 14.6 FURTHER/SUGGESTED READING