Visual Interpretation of Images

Using Saga

Tutorial ID: IGET_RS_003

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Visual Interpretation of Images by Using Saga

**Objective:** To identify features and extract the useful information from the remotely sensed images based on the visual interpretation techniques.

**Software:** SAGA GIS

**Level:** Beginner

**Time required:** 2 Hour

**Prerequisites and Geospatial Skills**

1. Saga GIS should be installed on the computer
2. Basic knowledge about the Saga GIS interface
3. Should have completed Exercise ID: IGET_RS_001

**Reading**


**Tutorial Data:** Tutorial data can be downloaded from IGET_RS_003
**Introduction**

Image interpretation is a powerful technique enable us to identify and distinguish various features in remote sensing images/Aerial photos and allows gaining the knowledge and information about them. As Discussed in previous tutorials, analysis of remote sensing image often involves identification of various features such as forest cover, water bodies, urban settlement, agriculture and range land etc. These features are identified by the way they reflect or emit radiations and also by their association and location. These radiations are measured by satellite/Aerial sensors and ultimately depicted in the form of satellite image or aerial photo. Identifying individual features from images is a key to interpretation and information extraction. Recognizing differences between feature and its background are generally based on some of these visual interpretation keys generally known *visual interpretation elements*, viz., shape, size, pattern, tone, texture, shadow and association. We will look into each of these elements as we progress through our tutorial.

In this tutorial we will use Landsat Thematic Mapper(TM) image of Pune. This image downloaded from the USGS earth explorer.

The following schematic diagram explains the order and methods of image interpretation.

![Image Interpretation using visual elements of Interpretation](http://gers.uprm.edu)

*Image Credit: http://gers.uprm.edu*

**Image Interpretation using visual elements of Interpretation**

To start SAGA, navigate to the SAGA folder, look for the *saga_gui.exe* and double-click on it.

1. To open the image, click on the 'Load' button in the toolbar, or open it via menu bar (File → Grid → Load). Load Band 5 from data given.
2. To view an image, double-click on 'Band5' under 'Data' tab. This will open an image window in the work area. The Band5 in Landsat TM corresponds to the shortwave infrared wavelength region.

3. Now we will discuss how can we identify different features from an image using elements of visual interpretation?

- **Tone**: The dictionary definition of tone is the particular quality of brightness, deepness, or hue of a shade of a colour. Therefore tone refers to relative brightness or colour of a feature on an image. The tonal variation makes it easier to differentiate between various features on an image. Shapes, patterns and textures on an image are identifiable mainly due tonal variation.

4. Zoom-in the above shown area (it is located on upper-right corner of the image). You can clearly exploit different shades of brightness which makes the image more understandable and easy to interpret. Such as Water body, mountain ranges, Grass land and Forest. Water absorbs most of the energy in Near and Shortwave IR region, because of this reason you can see the water body appeared as black and all other features viz., forest and range land are shaded from dark grey to light grey.

**Task 1**: Similarly try and identify different water bodies and other landuses using tonal variation.
- **Shape**: Shape refers to external form, outline or structure of a particular feature. In case of stereoscopic images height also determines its shape. The man made features generally have regular, symmetric or sharp in shape while all natural features like forest patches are irregular in shape. Most of the features can solely be identified using the *shape* element of visual interpretation.

5. Go back to the image in SAGA and zoom-in to the below shown area, it is located in centre of the image.

6. The shapes of these two features, *Race course* and *Magarpatta city* are so prominent that we can identify these features just from its shape and with the knowledge about the study area.

   For example, if you are not familiar with study area, then you might come to a conclusion, that the race course might be a foot ball ground or some stadium and the Magarpatta city as a township with huge buildings.

- **Size**: Comparing size of a feature in context with others in an image helps in better understanding and interpretation of an image. A quick approximation of size of a feature makes image interpretation process faster and convenient.

7. For a better understanding, zoom-in to just above the centre of an image using *zoom in* tool in menu bar. We can clearly see big white blocks kind of structures. The size of these individual blocks is larger than the residential blocks (for example building blocks in Magapatta city). There might be a possibility that, these building blocks whether
belongs to industries or warehouses. In our case the large building blocks are belongs to the TATA Motors Company. Therefore size of the feature often helps us in image interpretation.

- **Pattern**: Pattern refers to spatial arrangement of features. A repeated sequence of certain form or relationships is characteristic of many natural and constructed features which give an added advantage to the interpreter.

8. Zoom-in to the centre area of the image as shown below. We can clearly see repetitive patches of agricultural fields, with typically an orderly repetition of same tone and textures generally in rectangular form with different sizes. The pattern and shape of the agriculture fields enable us to discriminate it among forests, scrub and grass land. Often you can see some road patterns, which divides the urban area in to regularly spaced built-up areas is a good example of pattern.
- **Texture:** Texture refers to frequency of tonal changes in a certain area of an image. It is product of shape, size, tone, shadow and pattern of a particular feature. It decides upon the visual roughness or smoothness of an image. Abrupt changes in grey scale results in Rough texture while very minor tonal variations are seen in smooth textures. Texture is scale dependent, it gradually decrease with decrease in scale. Since our image has 30m resolution, the variation of texture is suppressed and is not readily observable.

9. In the following google earth image, you can notice the forest canopy has rough texture while the range land has smooth texture.

- **Shadow:** Shadow refers to a dark area produced by the features coming between light rays and surface. Shadows in remote sensing images have both advantages as well as disadvantages at the same time. The advantage is it provides certain relative height information of the feature and also an idea of the terrain profile which is an aid to interpretation while the features under shadows are not very well identifiable is a disadvantage. So due consideration must be given to shadow while interpreting an image. Particularly in microwave remote sensing shadows can be very well used in identifying topographic variation in landforms.

10. As we go onto the image in SAGA. Mountain ranges are very clearly identifiable due to shadow. Therefore the topography of an area can also be approximated by looking at the shadows.
- **Association**: Association is occurrence of certain feature in relation with other. Certain features are not directly identifiable by its appearance in an image but could be interpreted easily according to its relationship with the surroundings. For example association of boats with water, Aircraft with runway, playground with school etc.

**Visual Interpretation using colour composite:**

As seen in the previous section, image can be very well interpreted and analyzed using different structural or tonal variations in it. But very precisely identification of some features is difficult with help of one grey colour band. In such cases use of different colour composite images provides an aid for better and much faster interpretation. Colour composite images are displayed using different band combinations on three primary colours (Red, Green, and Blue), associating each spectral band of an image (not necessarily a visible band) to a separate primary colour.

In this section we will concentrate on generally used colour compositions in Landsat image interpretation. Firstly we will go through band details of Landsat TM satellite and further we will move on to band compositions.
Band 1, 2 and 3 of Landsat TM are in visible region of Electromagnetic spectrum i.e. Blue, green and red respectively; while band 4, 5, 6 and 7 fall in Infra-Red region.

<table>
<thead>
<tr>
<th>Band</th>
<th>Resolution</th>
<th>Wavelength μm</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30m</td>
<td>0.45-0.52</td>
<td>Blue</td>
</tr>
<tr>
<td>2</td>
<td>30m</td>
<td>0.53-0.61</td>
<td>Green</td>
</tr>
<tr>
<td>3</td>
<td>30m</td>
<td>0.63-0.69</td>
<td>Red</td>
</tr>
<tr>
<td>4</td>
<td>30m</td>
<td>0.78-0.90</td>
<td>Near Infrared</td>
</tr>
<tr>
<td>5</td>
<td>30m</td>
<td>1.55-1.75</td>
<td>Short-wave Infrared</td>
</tr>
<tr>
<td>6</td>
<td>120m</td>
<td>10.4-12.5</td>
<td>Thermal Infrared</td>
</tr>
<tr>
<td>7</td>
<td>30m</td>
<td>2.09-2.35</td>
<td>Short-wave Infrared</td>
</tr>
</tbody>
</table>

Table 1: Landsat TM band Details

- **Band Combinations**: Selecting the appropriate bands to use in the color composite does have a huge impact on which features can be seen / highlighted in a particular image. Determining which of the primary colours should be used to represent a particular band is largely a matter of how the image looks. Although this depends on individual perspective as some people are more sensitive to certain colors than others.

- **Band Combination 3,2,1**: All seven bands of an image including those that represents visible portion (blue, green or red reflected light) of an electromagnetic spectrum are in grey scale, until we assign a colour to that data. In this combination we will assign colour blue to the band that represents blue light, colour green to the band representing green light, and red to the band of data representing red light. This produces an image called a "true color" image, i.e. the colours of the resulting colour composite image resembles closely to what would be observed by the human eyes.

11. Load the remaining bands i.e., Band 1,2,3,4,6 and 7 to the SAGA GIS (Refer Step 1).

12. As discussed in *Introduction to SAGA* tutorial, SAGA cannot handle multi-band imagery. The layers have to be viewed individually or an RGB composite must be built as a separate image. To create the true colour composite use RGB composite from menu. ‘Menu → Modules → Grid → Visualisation → RGB Composite’.
13. Select band 3, 2 and 1 for Red, Green and Blue respectively. Select ‘create’ in composite to create a new composite and click ‘Okay’.

14. Once the composite is created, double click on ‘Composite’ to load it new map. Change the ‘Type’ of the colour of the composite from Graduated colours to ‘RGB’ and click on ‘Apply’.

15. The land use/cover in the composite image resembles similar colour as seen by human eyes. The true colour composite will be like below. You can notice the vegetation is in green colour.
16. Select the composite under ‘Data’ tab, goto the Object properties window and click on the ‘Settings’ tab, now change the name from ‘Composite’ to ‘321Composite’ and press ‘Tab’ from the key board now click on ‘Apply’.

**Task 2:** Describe the colours of various land use classes in the true colour image? What land use classes are readily observable in the true colour composite?

- **Band Combination 4,3,2:** One of the main advantage of remote sensing is, its capability to sense and measure the radiation beyond the visible range. We can use the images sensed beyond the visible range to create the ‘False colour composites’. These
false colour composites uncovers hidden information to our eyes. Most typical false colour composite is 4,3,2 and is known as **NIR false composite**. In this composition band 4 (Near IR) is assigned on the colour red, band 3(Red) is assigned on green colour and band 2 (Green) is assigned on blue colour. This combination is similar to 3,2,1; however presence of Infra-Red band makes land and water boundaries more clearer and also different types of vegetation are more apparent due to very strong reflection of vegetation in infra-red band. See the Spectral reflectance curve for details.

17. Create RGB composite with band combination 4,3,2 and name it to **‘432Composite’** (Refer Step-13 & 16)

**Task 3:** Try to correlate the 432 composite with 321 composite and write a short note on the pros & cons of each composite?
- **Band Combination 4,5,3**: This band combination excludes first two shorter wavelength bands thus making the image much crisper than previous two images. Variation in moisture content is also noticeable in this band combination thus making differentiation of various vegetation types much easier. This combination very clearly defines the various classes in an image so probably the most commonly used band combination for Landsat images.

18. Create RGB composite with band combination 5,4,3. The composite is as shown below:

![RGB Composite Image](image_url)

**Task 4**: Create a colour composite of 742 and described the various Land use classes in it and explain how it is useful than other composites?

19. Now save the project via the Menu (File → Project → Save Project As), In the ‘Save AS’ popup window browse to the desired folder to save, and enter the desired name i.e., ‘IGET_RS_003’ and click on ‘Save’. In the popup window check the Checkbox ‘Save all’ and click ‘Okay’.

Similarly various false colour compositions can be created and used depending on one’s personal colour visualisation capabilities to make analysis and interpretation of an image easier and faster. In this tutorial we learned brief techniques of visual interpretation of a satellite image.