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7. Image Interpretation

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Abstract:

In order to analyse remote sensing data, different targets must be found in the image. These targets might be natural or man-made elements that are made up of points, lines, or regions. It is possible to categorise targets based on how much radiation they reflect or emit. An image product, such as an air picture or a satellite image, is finally produced by measuring, recording, and depicting this radiation. The components of visual interpretation are the most fundamental of these ideas. They are: site/situation/association, height/depth, size, form, shadow, tone/color, texture, pattern, and location. When reading an aerial photograph or studying a satellite picture, these are frequently employed.

The use of aerial pictures and images obtained by remote sensing employing aeroplanes or spacecraft as platforms is widespread. An interpreter with extensive experience in his field can learn a lot by studying the qualitative as well as quantitative aspects of images captured by various sensor systems, such as aerial photographs (black-and-white, black-and-white infrared, color, and color infrared), multiband photographs, satellite data (both pictorial and digital), including thermal and radar imagery.

Keywords:

Elements, Visual interpretation, Aerial photograph, Classification.

7.1 Image Interpretation:

Two key methods of data analysis to extract resource-related information might be visual interpretation and digital image processing, either separately or in conjunction with other data. The classic techniques for information extraction have been visual interpretation approaches based on the target features on aerial photography or satellite imaging. A human interpreter interprets things, events, spatial and spectral patterns, etc. using different object recognition characteristics.

"The art of examining images for the purpose of identifying objects and judging their significance" is how image interpretation is described. In order to discover, identify, categories, measure, and assess the importance of physical and cultural objects, their patterns, and spatial linkages, interpreters analyse remotely sensed data. A complicated series of physical and physiological processes that start with the detection and identification of pictures and end with their quantification make up image interpretation.

Below is a simplified list of several components of visual interpretation, most of which serve similar purposes. The discovery and identification of objects, characteristics, occurrences, and processes is the interpreter's main responsibility.

This activity primarily involves stimuli and reaction. By labelling, the interpreter expresses his or her sentiment. Frequently, these descriptors are described in qualitative words, such as "likely," "possible," "probable," or "certain." Therefore, it is a process of using interpretation techniques to "pick out" object elements from the photograph or picture. It may involve the identification of a point, a line, or a polygon, such as a tube well, a dug well, a field of crops, a settlement pattern, or a network of roads.

A. Detection and Identification:

In order to discover, identify, quantify, and assess the relevance of environmental and cultural artefacts, patterns, and spatial linkages, an interpreter analyses remotely sensed data. It is a method of information extraction. An interpreter is a person who studies a photograph or other visual material to identify an image. A soil scientist, geologist, hydrogeologist, forester, or planner who has received training in image interpretation will be able to recognise the vertical view provided by the ground objects on an aerial shot or a satellite image, allowing him or her to identify numerous small or subtle details. As a result, an interpreter is an expert with training in both his or her own field and the study of pictures or photographs. The approaches of visual interpretation, the use of various equipment, and the extraction of information are the key topics of the current discussion.

B. Recognition:

It is a categorization procedure or an attempt to separate an item based on features or patterns that are recognisable from the image. It came before the detecting procedure. It is also known as photo reading when applied to things like built-up land, aquatic bodies, and vegetation. Analysis is the process of isolating or resolving a group of features or objects that have a common set of traits. When groupings of items are analysed, "lines of separation" are drawn between them, and the accuracy of these lines may also be determined, for example, by contrasting greenery with built-up land, water bodies with wastelands, etc.

C. Classification:

It is a technique of classifying through analysing and classifying items or traits. It puts "recurrence features" in the same class or group as the feature to which they belong. Any incorrect identification and analysis can frequently result in classification errors.

D. Deduction:

Deduction may be used to sort various categories of items or components and infer their significance from supporting evidence. The majority of the data comes from visible items or unseen components, which only provide limited details on the nature of some correlative signals.

Without thorough pre-interpretation tests in the field, deductions made on the identification of objects may frequently be deceptive and lead to incorrect classification. Therefore, it is advised to separate under this method in cases of complex interpretation and to postpone determining the identification until after the explanation.

E. Idealization:

The technique involves using standardised symbols and colours to create an ideal or stand ard representation of what has been recognised and deduced from the picture or map.

7.2 Elements of Visual Interpretation:

The secret to interpretation and information extraction is target recognition. Comparing various targets based on some or all of the visual characteristics of tone, form, size, pattern, texture, shadow, position, association, and height allows one to notice the distinctions between targets and their backgrounds. The basic or first order elements (tone), the second order (texture, form, size, pattern), and the third order (location, association, shadow, and height) are some of these interrelated elements that are categorized into three orders. Whether we are aware of it or not, visual interpretation employing these features is frequently a part of our daily lives. Visual image interpretation is sometimes used to track high-speed pursuits from a helicopter or to examine satellite photos on the weather report. We may further understand and analyse remotely sensed photos by identifying targets based on these visual components. Below is a description of each of these interpretation aspects along with an illustration of what it looks like.

7.2.1 Basic, First Order Elements of Image Interpretation:

A. Tone/Color:

The relative brightness of items in a picture is referred to as tone. Generally speaking, tone is the key component for identifying various targets or characteristics. The distinction between an object's form, texture, and pattern may also be made because to variations in tone. Each distinct variation on a picture created by a wide range of hue, value, and chroma combinations is referred to as a color. Tone is a term that describes the relative brightness or color of items in a picture. The color or tone of features or objects captured on photographic emulsions is influenced by a variety of variables. Human interpreters are able to detect many more hues than ten to twenty different degrees of grey. According to several writers, interpreters are able to discern at least 100 times more variances in color-on-color photography than in grayscale images. Tone is the relative brightness of the grey level in a color or F.C.C. image or a black-and-white image. Tone is a unit used to describe the strength of radiation that terrain objects reflect or emit. Higher reflected items look brilliant, whereas lower reflected things appear comparatively dark. denotes a band imaged in the electromagnetic spectrum's near-infrared range. Rivers are non-reflective in the NIR area and seem black, whereas vegetation is very reflective and appears brilliant. Only 16–20 different shades of grey can be detected by our eyes in a black and white image, compared to hundreds of different shades of colour in a colour image. The best three bands are employed in multispectral imaging to create colour composite images.

For visual interpretation, NIR, red, and green are most frequently used in False Colour Composite (FCC). NIR band travels via red channel in a typical FCC, red band travels through green channel, and green band travels through blue channel. Since vegetation reflects heavily in the NIR part of the electromagnetic spectrum, it looks red in normal FCC imagery, which is more useful for identifying vegetation.

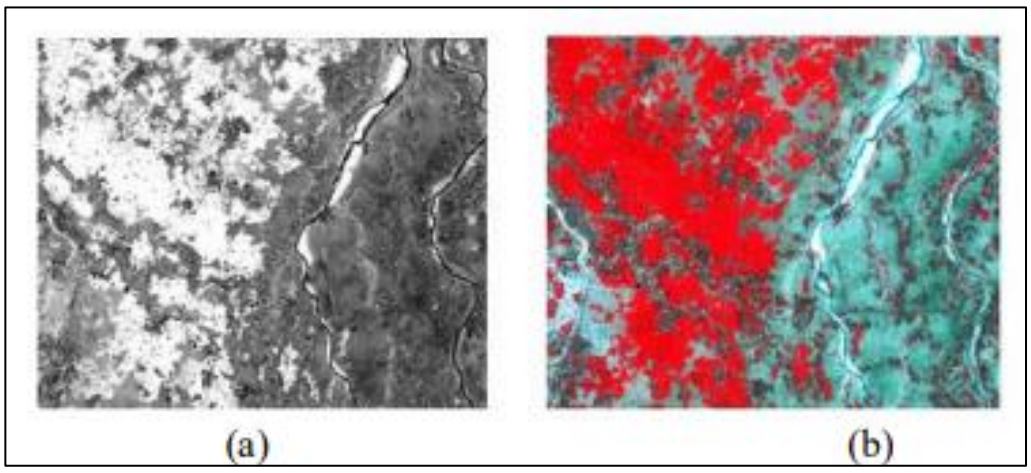

Figure 7.1 Tone Color

7.2.2 Second Order- Geometric Arrangements of Objects:

A. Size:

When deciding between different items and characteristics (such as single-family homes vs multi-family buildings or scrubland versus trees), the size of the thing might be crucial. Both the relative and absolute sizes of objects might be significant when using size as a diagnostic feature. The significance of objects and features can also be determined by their size, with the size of trees relating to the board feet that may be cut, the size of agricultural fields relating to the use of water in arid regions or the quantity of fertilizer, and the size of runways indicating the types of aircraft that can be accommodated. In order to help in the interpretation, it is crucial to consider both the target's absolute size and its size in relation to other items in the scene.

The scale or resolution of the picture must be taken into account when determining the size of things on the photographs. To help in the perception of a target, it is crucial to consider both the target's absolute size and its size in relation to other items in the scene. Direct interpretation to the right outcome may be made more rapidly with a brief approximation of the desired size. The criteria that are most frequently measured include length, breadth, perimeter, area, and on occasion volume.

For instance, if an interpreter needed to discern between different land use zones and had located a region with a number of buildings, large structures like factories or warehouses would imply commercial property, while smaller structures would suggest residential usage.

Figure 7.2 Size

B. Shape:

Shape describes the overarching shape, framework, or contour of certain items. A highly definite indication for interpretation may be found in shape. Natural features, such as woodland borders, are normally more asymmetrical in shape, with the exception of areas where humans have carved out a road or clear cuts. Straight edge shapes typically symbolize urban or agricultural (field) objectives. Similar to how train lines cannot turn at a straight angle, vehicles may. Playgrounds, big buildings, parks, etc. all have distinctive forms and are simple to recognize. Shape is the general arrangement, shape, or form of a certain thing. One of the most crucial elements for identifying an object from a picture is its shape. Regular patterns like squares, rectangles, and circles often indicate man-made items like houses, roads, and cultivated fields, whereas irregular shapes denote a natural setting like a river or forest. highways may make quick curves and join perpendicularly, while rail lines cannot. This is a common misconception between highways and railway lines. The dark-blue item in the accompanying photograph may clearly be identified as a river based on its form.

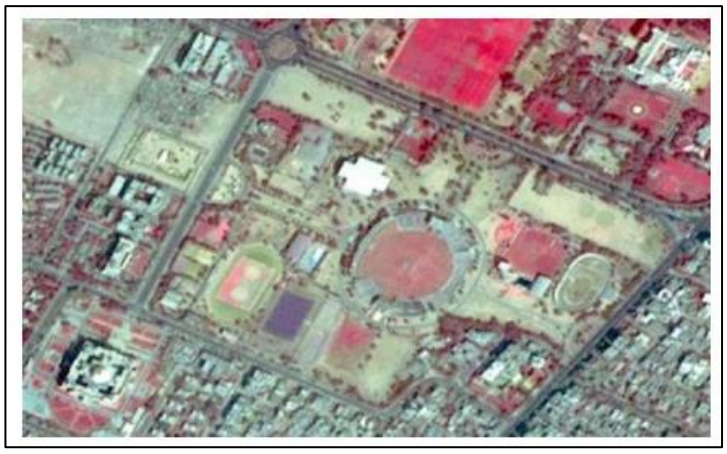

Figure 7.3 Shape

C. Texture:

It describes how tonal variations are distributed and how frequently they occur in specific regions of an image. In picture interpretation, the perception of an area's smoothness or roughness can frequently provide important cues. Smooth textures would have relatively little tonal fluctuation, while rough textures would have a mottled tone where the grey levels rapidly shift in a tiny area. Most frequently, regular, even surfaces, like fields, asphalt, or grasslands, provide smooth textures. A rough textured look is produced by a target having a rough surface and an uneven structure, like a forest canopy. Similar to this, varied scrub vegetation densities exhibit diverse textures. Smooth texture is produced by uniform water bodies, crop fields, etc. By texture, we mean the regularity of tonal variation in image. A group of characteristics that may be too tiny to be clearly seen separately on the image combine to form a texture. It is based on the form, scale, pattern, and shadow of the topographical features. Texture is constantly influenced by scale or resolution. Similar items that are reflected may have different textures, which aids in their identification. For instance, in a high-resolution photograph, the crowns of a grassland and a tree have a similar tone, but the grassland has a smoother texture than the tree. In images or a photograph, rough texture denotes rapid tonal fluctuation whereas smooth texture denotes less tonal variation.

Figure 7.4 Texture:

D. Pattern:

Pattern is the spatial arrangement of objects. Pattern can be either man-made or natural. Pattern is a macro image characteristic. It is the regular arrangement of objects that can be diagnostic of features on the landscape. Arrangements of complex drainage in the form of ravines can be identified easily. Likewise, the network or grid of streets in a sub- division or urban area can aid identification and aid in problem solving such as the growth patterns of a city. Pattern can also be very important in geological or geomorphological analysis. Drainage pattern can tell the trained observer a great deal about the lithology and structural patterns in an area. Dendritic drainage patterns develop on flat bedded sediments; radial on/over domes; linear or trellis in areas with faults or other structural controls. Pattern refers to the spatial arrangement of the objects. Objects both natural and manmade have a pattern which aids in their recognition.

The repetition of certain general form or relationship in tones and texture creates a pattern, which is characteristic of this element in image interpretation. In the Fig it could be easily understood that at the left bottom corner of the image, it is plantation, where the tress are nearly equally spaced. Whereas at the upper right and bottom right corners show natural vegetation.

Figure 7.5 Pattern

7.2.3 Third Order- Location or Positional Elements:

A. Shadow:

It is useful in interpretation as it may provide an idea of the profile and relative height of a target or targets which may make identification easier. However, shadows can also reduce or eliminate interpretation in their area of influence, since targets within shadows are much less (or not at all) discernible from their surroundings. Shadow is also useful for enhancing or identifying topography and landforms. Shadow is a helpful element in image interpretation. It also creates difficulties for some objects in their identification in the image. Knowing the time of photography, we can estimate the solar elevation/illumination, which helps in height estimation of objects. The outline or shape of a shadow affords an impression of the profile view of objects. But objects within shadow become difficult to interpret. Shadow is also useful for enhancing or identifying topography and landforms, particularly in radar imagery.

Figure 7.6 Shadow

B. Location:

The arrangement of things in relation to one another or to other topographical elements might help with interpretation. The interpreter should employ distinguishing aspects such as aspect, topography, geology, soil, vegetation, and cultural features such as salt pans, villages, industrial operations, etc. on the landscape while studying a location. Depending on the local circumstances, the relative weight of each of these criteria will change, but they are all significant. Similar to how certain plants flourish in marshes, some do so on sand ridges. Certain environmental factors may favor agricultural crops. In addition to being on hills or rivers, man-made structures can also be located there, such as an observatory or a radar installation. Site is a topographical or geographical reference. When objects cannot be readily recognized using the preceding parts, it is also a crucial component of visual interpretation. In Kerala, one cannot assume that a feature with a very high reflectivity is snow; it might be cloud or snow.

C. Association:

It considers how the target of interest is related to other recognizable characteristics or objects in the area. Identification may be made easier by identifying features that one would anticipate to be connected to other features. Some things are connected to one another so often that identifying one usually reveals or proves the presence of another. Coal-fired power station with smokestacks, step buildings, cooling ponds, transformer yards, coal heaps and railway tracks. A playa-like water body surrounded by salt ponds and salty patches and arid landscape, basin bottom position, highly reflective surface, and salt producing equipment. One of the best indicators of man-made installations is association.

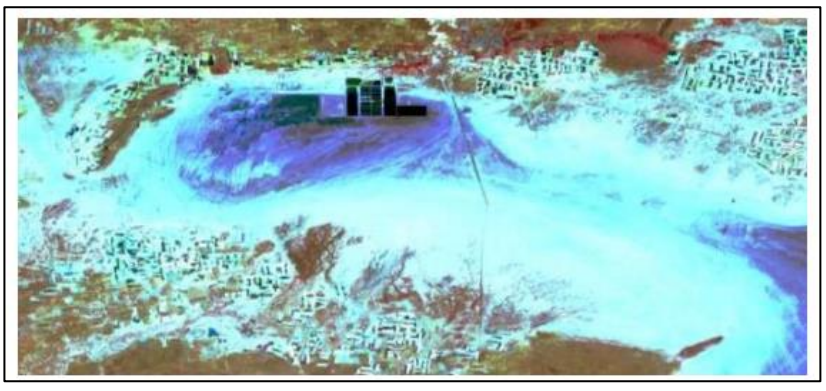

Figure 7.7 Association

Electrical energy is needed in vast quantities for the production of aluminum. The absence of a power source could make this enterprise impossible. Rotary kilns are used in cement factories. Different levels of schools often have a recognizable parking lot, playing fields, and building complex in an urban setting. The recurrence of specific characteristics in relation to other items in the imagery is referred to as association. Smooth vegetation patterns in metropolitan areas often allude to grassland or playgrounds rather than agricultural land.

7.3 References:

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