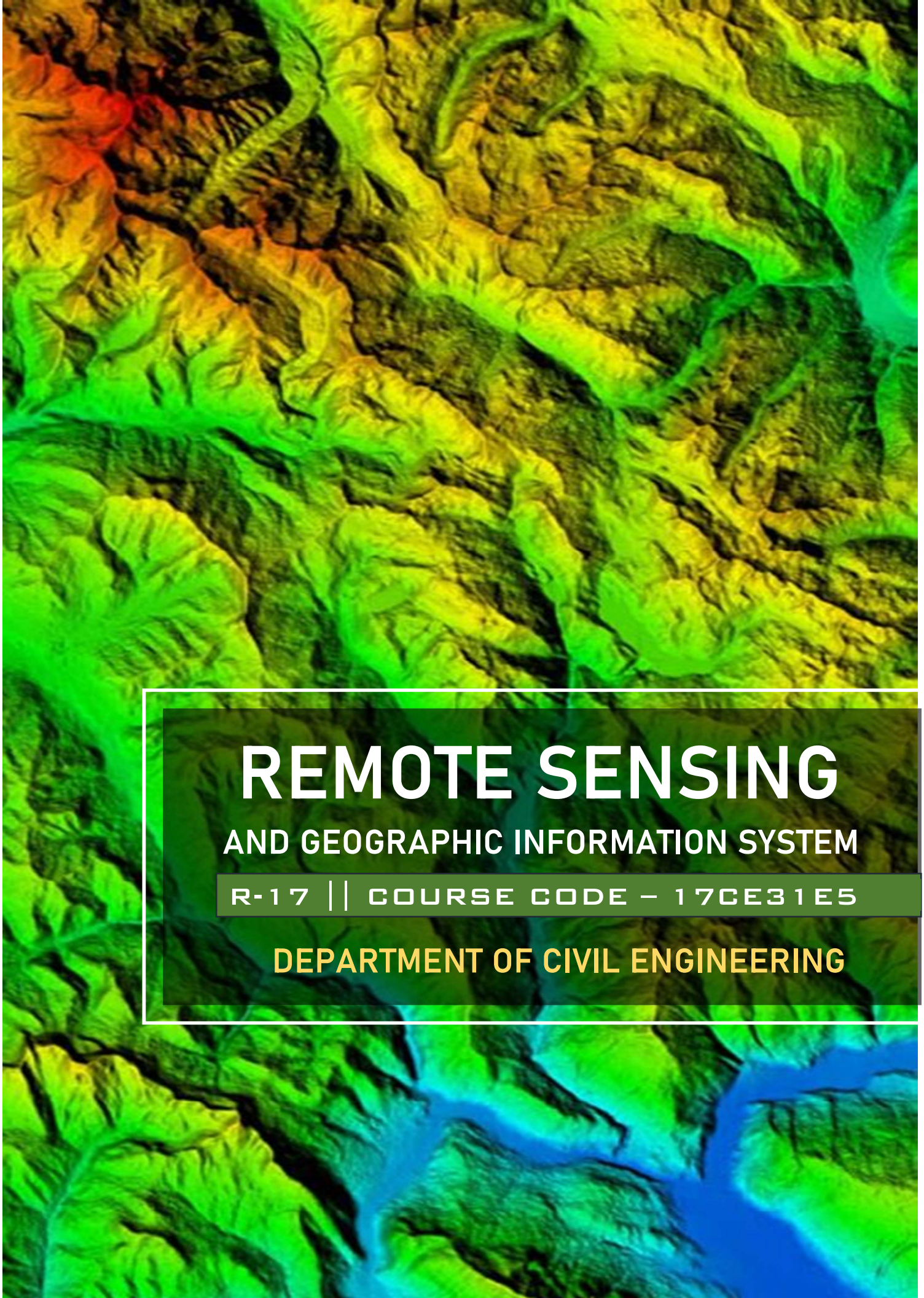


REMOTE SENSING

AND GEOGRAPHIC INFORMATION SYSTEM

R-17 || COURSE CODE – 17CE31E5

DEPARTMENT OF CIVIL ENGINEERING

MODULE – III

VISUAL DATA ANALYSIS

Course objective	To learn concepts of visual and digital image analyses.
Content	**VISUAL DATA ANALYSIS:** Introduction – Types of data products – Image interpretation techniques – Detection, recognition, analysis, classification, deduction and idealization – Elements of image interpretation – Keys.
Course outcome	Compare different types of data obtained from a remote sensing network with tools specifically designed for the purpose.

INTRODUCTION:

- In order to make good use of remote sensing data, we must be able to extract meaningful information from the imagery.
- Remote sensing data has been divided into two different classes:
- **Biophysical** : Biophysical data are directly measured by the remote sensing systems without using other data.

  Ex: temperature, atmospheric conditions and elevation etc.
- **Hybrid**: Hybrid data are created by systematically analyzing more than one biophysical variable such as detecting vegetation stress generally includes absorption characteristics of chlorophyll, temperature etc.
- Visual Image Interpretation may also be performed by examining digital imagery displayed on a computer screen. Both analog and digital imageries can be displayed as black and white images, or as colour images by combining different channels or bands representing different regions of the electromagnetic spectrum.
- When remote sensing data is available in digital format, digital processing and analysis may be performed using a computer. Digital processing may be used to enhance data as a prelude to visual interpretation.
- Manual interpretation and analysis is the traditional method of remote sensing for air photo interpretation. Digital processing and analysis is m

ore recent with the advent of digital recording of data and the development of computers.

REMOTE SENSING DATA PRODUCTS:

- Remote sensing data products are available in a wide variety of media and formats. The classification of products is generally based on the following: (i) level of processing (ii) output media
- The raw data acquired from satellite has radiometric and geometric distortions. This is corrected by processing the data on the computer system. The corrected data is then put in the required media. The different levels of processing are as follows:
- **Raw data**: No processing is done and the relevant scene is extracted and put on the media. Generally, raw data are available only as digital product, because photographic printouts of uncorrected images are not interpretable.
- **Partially processed data**: Radiometrically corrected and geometrically un corrected data or vice-versa.
- **Standard data**: These data are both radiometrically and geometrically corrected.
- **Geocoded data:** These products are north oriented and compatible to the survey of India map sheet. It means, that overlay of this data with survey of india map can be performed.
- **Orthorectified data**: orthoimages are geometrically corrected products with corrections for displacement caused by terrain and relief. In other words, it is an image prepared in such a manner that the perspective aspect of the image has been removed.
- **Special data products**: Besides the above data, National Remote Sensing Centre(NRSC) and other agencies also offer certain special/custom

products to suit user requirements. These include mosaiced, merged and extracted data from different sensors in suitable scales.

- Remote sensing data products are available on photographic and digital media. Photographic products can be supplied as films (negative) or paper prints in black and white or colour composites. For single band data from multi-spectral sensors are called as PAN data and photographic colour products, called colour composites, can be provided for multi-spectral data.
- Digital data products are available on CD-ROMs or DVDs, magnetic tapes, multiple floppy disks, or any other digital storage device.

IMAGE INTERPRETATION PROCESS:

- Image interpretation or analysis is defined as the "act of examining images for the purpose of identifying objects and judging their significance".
- The image interpretation is a complex process of physical and psychological activities occurring in a sequence of time. The sequences begins with the detection and identification of images and have overlapping functions.
- These aspects are Detection, Recognition and Identification, analysis, classification, and Idealizations.
- **Detection** is a process of picking out an object or element from photo or image through interpretation techniques. It may be detection of point or line or a location, such as agricultural field and a small settlement.
- **Recognition and Identification** is a process of classification or trying to distinguish an object by its characteristics or patterns which are familiar

on the image. Sometimes it also termed as photo reading of water features, streams, tanks, sands etc.

- **Analysis** is a process of resolving or separating a set of objects or features having a similar set of characters. In analysis, lines of separation are drawn between a group of objects and the degree of reliability of these lines can also be indicated.
- **Classification** is a process of identification and grouping of objects or features resolved by analysis. This is the most important aspect and the conceptual view of digital image classification.
- **Idealization** is a process of drawing ideal or standard representation from what is actually identified and interpreted from the image or map, such as a set of symbols or colours to be adopted in waste land maps and geomorphic landforms.

ELEMENTS OF IMAGE INTERPRETATION

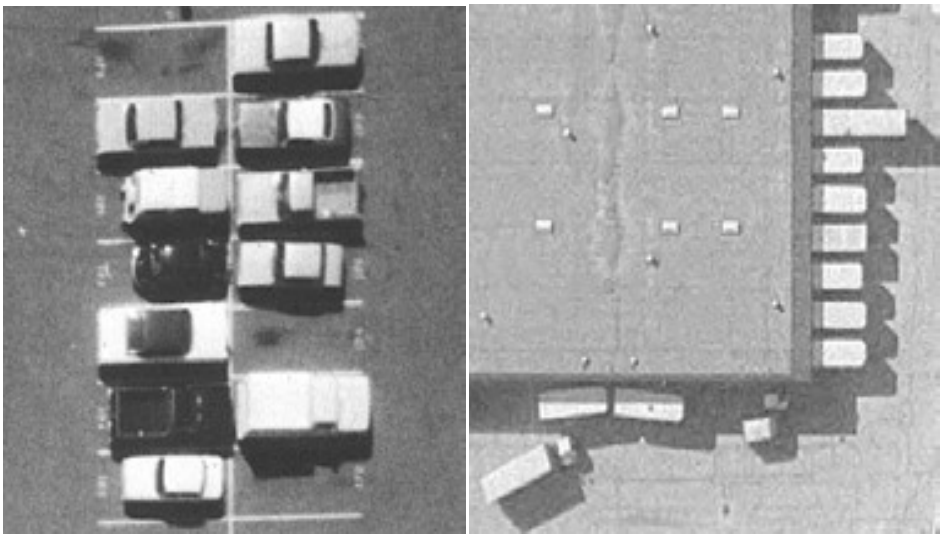
- While interpreting imagery, there are a number of characteristics that enable the viewer to detect, recognize or even identify objects from the imagery.
- The recognition elements are: shape, size, pattern, shadow, tone or colour, texture, association and site. Visual interpretation using these elements is often a part of our daily lives, weather we are conscious of it or not.
- Examining satellite images on the weather report or following high speed chases by views from a helicopter are familiar examples of visual image interpretation. Identifying targets in remotely sensed images based on these visual elements allows us to further interpret and analyze.

Location:

- There are two primary methods of obtaining precise coordinate information about an object: (i) survey it in the field using traditional surveying techniques or global positioning system(GPS)

  instruments or (ii) collect remote sensor data of the object, register the image to a base map, and then extract the coordinate information directly from the rectified image.
- The rectification is generally performed in computer. However, we can extract coordinate information manually for a given point, if we know co-ordinates for a few points on the image and scale of the image.
- The coordinate information can be obtained by measuring the distance of desired point from the known points. Photogrammetric techniques are also used to extract 3D coordinates of allocation from overlapping stereo images.

SIZE:

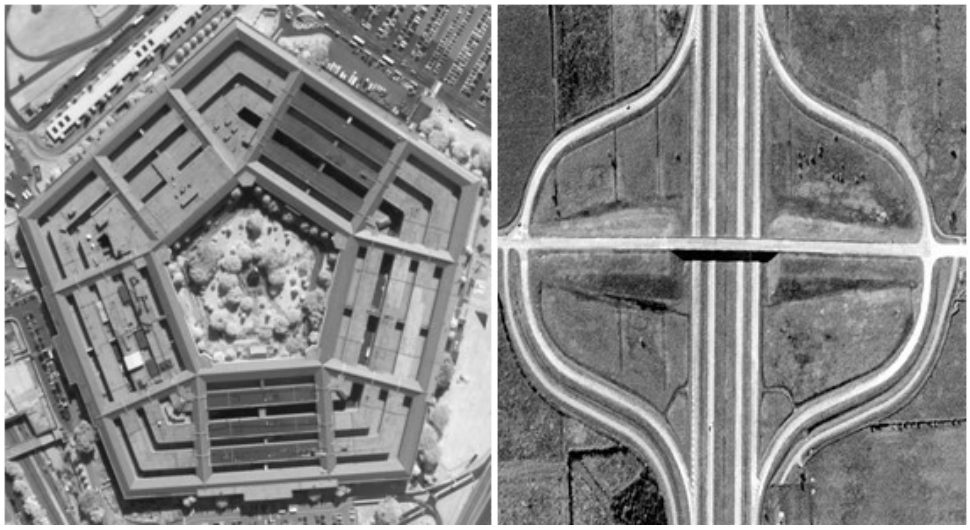


- Size of objects in an image is a function of scale. A proper photo-scale should be selected depending on the purpose of the

interpretation. The size of the object is one of its most distinguishing characteristics and one of the most important elements of image interpretation. The most commonly measured parameters are length, width, perimeter, area and occasionally volume.

- Approximate size of an object can be measure by multiplying the length on the image by the inverse of the photo-scale. It is important to assess the size of a target relative to other objects on the imagery, as well as the absolute size, to aid the interpretation of that target. Relative size is also important in differentiating between objects of the same shape.
- A small fishery boat and a medium-sized ship may appear similar on an image since both show a regular spatial pattern, shape, and association. In this case, relative size difference can help us in identifying.

SHAPE:



- Shape of an object is described as the geometric form represented form represented on an image. Regular shapes like squares, rectangles, and circles are signs of man-made objects. Irregular

shapes with no distinct geometrical pattern are signs of a natural environment.

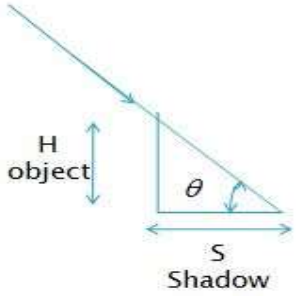
- Shape can be a very distinctive clue for interpretation. Straight edge shapes typically represent urban or agricultural field targets, while

natural features such as forest edges are generally more in irregular in shape, except where man has created a road or clear-cuts.

- The specific shape of an object as it is viewed from above will be imaged on a vertical photograph.

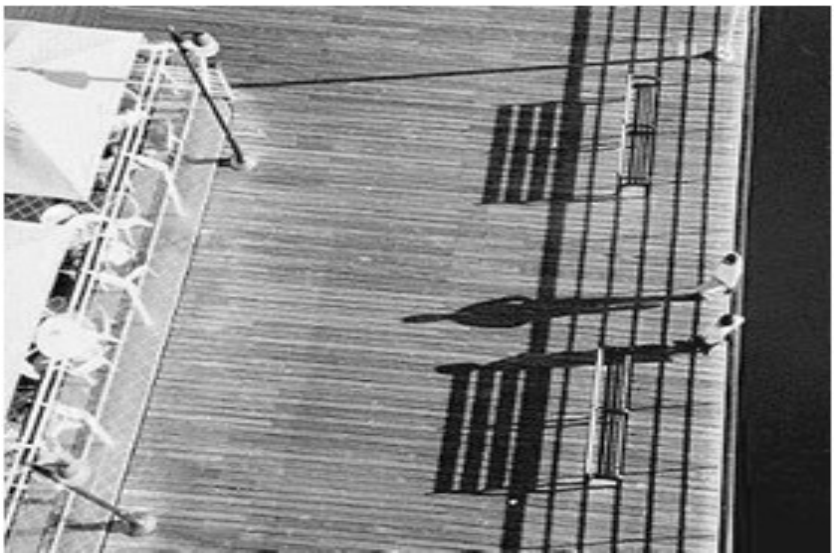
SHADOW:

- Shadow is usually a visual obstacle for image interpretation. However, shadow can also give height information about towers, tall buildings, etc. as well as shape information such as the shape of a bridge. Sometimes the shadows in the image actually provide more information than the objects.
- Shadows cast due to low sun angle are important to imagery interpretation because their shapes provide profile views of certain features that can aid their identification.
- In dense urban environments, for example shadows might hinder the identification of certain shapes and patterns. On the other hand, shadows might aid the identification of certain objects like bridges, transmission towers, and water towers.
- In certain instances, shadows can provide clues about the height of an object when the image interpreter does not have access to stereo imagery. The height of an object, H, may be computed by measuring the length of the shadow cast, S on vertical aerial photography.



$$\tan\theta = \frac{H}{S}$$

- Shadow is also helpful in interpretation as it may provide an idea of the profile and relative height of a target or targets which may make identification easier. Shadow is also useful for enhancing or identifying topography and landforms, particularly in radar imagery.



TONE:

- A band of electromagnetic spectrum recorded by a remote sensing system may be displayed in shades of grey ranging from black to white. The continuous grayscale varying from white to black is called TONE.
- Tone refers to the relative brightness or colour-intensity of objects in an image. We often say " this part of an image has a bright tone, this area

has a dark tone and this feature has an intermediate grey tone. Of course, the degree of darkness or brightness is a function of the amount of light reflected from the scene within the specific wavelength band.

- Difference in tone may vary in different bands of multi-spectral images. variations in tone also allow the elements of shape, texture, and pattern of objects to be distinguished

- Human beings can differentiate between approximately 40-50 individual shades of grey in a black-and-white photograph or remote sensor image. However, it takes practice and skill to extract useful information from broad-band panchromatic black-and-white images or black-and-white images of individual narrow bands of multi-spectral images.

COLOUR:

- Colour images can be obtained by using colour films or colour infrared film. We may use colour-combining techniques to create colour composite images from the individual bands of multi-spectral digital image data. Much more visual information is present in the colour composites.
- Colour is more convenient for the identification of object details. For example, vegetation types and species can be more easily interpreted by less experienced interpreters using colour information.

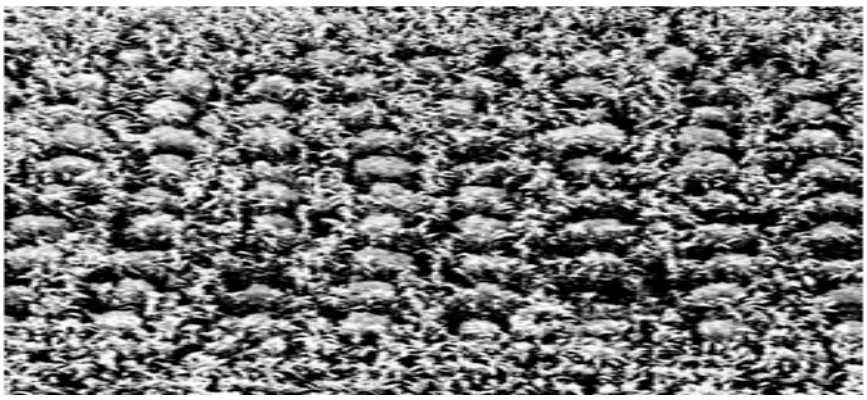
TEXTURE:

- Texture is the characteristic placement and arrangement of repetitions of tone or colour in an image, refers to the visual impression of the

roughness or smoothness of an image region. Texture is often used to identify objects that are too small to resolve individually, tree leaves and leaf shadows.

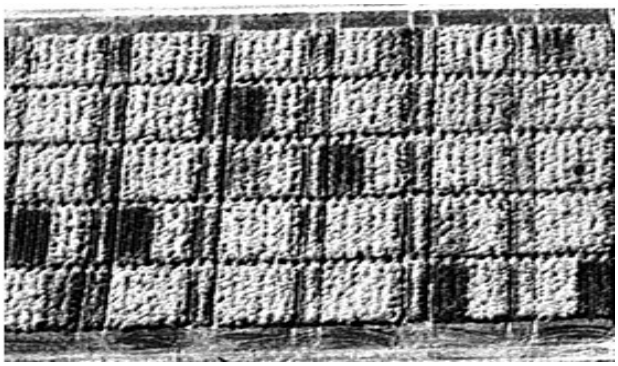
- Texture is particularly important in interpreting vegetation types. Not only is it possible to distinguish between broad forest classes such as deciduous vs coniferous forest, but an experienced interpreter can also distinguish varieties of trees based on the texture of the image.

- Rough textures would consist of a mottled tone where the grey levels change abruptly in a small areas, whereas smooth textures would have very little tonal variation. Smooth textures are most often the result of uniform, even surfaces, such as fields, asphalt, or grasslands



PATTERN:

- Pattern refers to the spatial arrangement of visibly discernible objects, refers to the type repetition of some form over space. The objects may be arranged randomly or systematically.
- Pattern on an image usually illustrates ' A functional relationship between the individual features that compose the pattern'.
- Patterns can help to identify agricultural and urban features. In urban landscapes, patterns help to distinguish between residential, commercial, and industrial areas and may even differentiate residential area based on their age.



- **Site, situation and association** characteristics are very important when trying to identify an object or activity.
- **Association** refers to the fact that when we find a certain phenomenon or activity, we almost invariably encounter the related or associated features or activities. Identification of certain objects is usually accomplished through their association with other known objects.
- **Site** has unique physical and socio-economic characteristics.
- **Situation** refers to how certain objects in the scene are organized and oriented relative to one another.
- These elements take into account the relationship between other recognizable objects or features in proximity to the target of interest. Often, certain raw materials, buildings, pipelines and finished products are situated in a logical, predictable manner. The identification of features that one would except to associate with other feature may provide information to facilitate identification.
- A specific combination of elements, geographic characteristics, configuration of the surroundings on the context of an object can provide the user with specific information for image interpretation.
- Many types of features can be easily identified by examining the associated features. For example, a primary school and a high school may be similar flat roofed building structures but it may be possible to

identify the high school by its association with an adjacent football field track.

INTERPRETATION KEYS:

- The criteria for identification of an object with interpretation elements are called an **Interpretation key**. The image interpretation depends on

  the interpretation keys which an experienced interpreter has established from prior knowledge and the study of the current images. Generally, standardized keys must be established to eliminate the differences between different interpreters.
- The eight interpretation elements (size, shape, shadow, tone, colour, texture, pattern, and associated relationships) as well as the time the image is taken, season, film type, spatial resolution, and band combination and photo-scale should be carefully considered while developing interpretation keys. Keys usually include both a written and image component.

- Different types of keys are as follows:

  - **Item key**
  - **Selective key**
  - **Regional key**
  - **Elimination key**
  - **Subject key**

SELECTIVE KEY:

A selective key is also called reference key which contains numerous example images with supporting text. The interpreter selects one example image that most nearly resembles the feature or condition found on the image under study.

ELIMINATION KEY:

An elimination key is arranged so that the interpretation proceeds step by step from the general to the specific, and leads to the elimination of all features or Conditions except the one being identified. Elimination are also called dichotomous keys where the interpreter makes as series of choices between two alternatives and progressively eliminates all.

Regional key:

An regional key is arranged so that the visual interpretation is done by a region wise located areas in the images. As far as location is done to visualize in thematic maps.