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Hello everyone and welcome to 16th topic of digital image processing of remote sensing data course in this particular lecture we are going to discuss the principles of a image interpretations and so far several times I have mentioned in the during the course of a this course basically that ultimate aim for image interpretation all processing which we are going for better image interpretation so then we can do the reliable interpretations and can make inferences out of these images.

Especially I am talking about satellite based remote sensing images so there are different ways of doing interpretation but there are some fundamental we say interpretation keys which are there so we will discuss each keys one by one and then we will see some examples as well, so the different principles of image interpretation this is mainly about I am talking about visual interpretation classification.

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Principles of Image Interpretation

- Visual interpretation of satellite images is important in Remote Sensing and GIS for different applications

- Visual interpretation is the skills that an image interpreter apply equally to an image

Techniques which you be we have just discussed in the previous lecture is for the compute based sort of interpretations but here I am talking about visual interpretations which is some many times it is much more reliable and when we did not have digital image processing based or computer based classification techniques we used to do on visual interpretation is still very useful, very reliable and ultimately even on the computer based classification techniques one as to perform visual interpretations.

So visual interpretation of satellite image is important in remote sensing as well as in GIS for different applications and this is the skill more you interpret images different images of different areas more you learn and later on you apply those that experience to some new image which are presented before you, so there are different types of data which we use on which we have to do image interoperations earlier we use to have photo aerial photographs sometimes they are in black and white.

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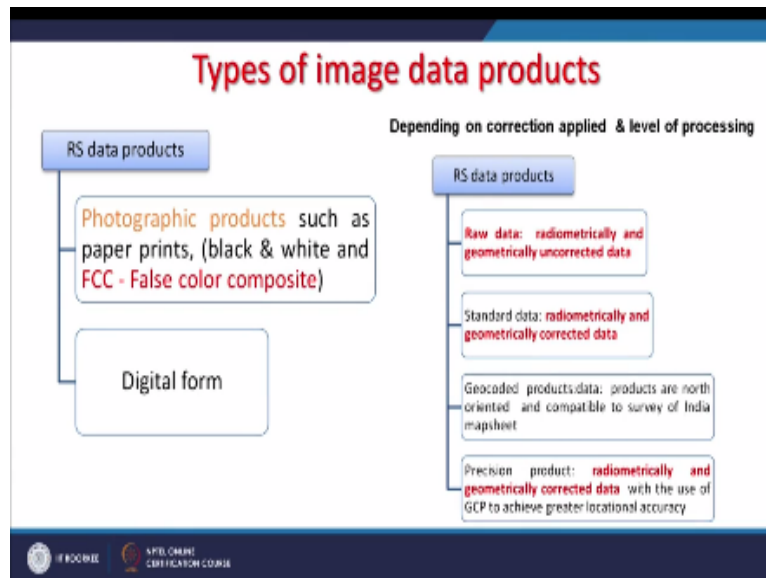
Or false color composite same with the satellite images you may have a single band image in gray scales or you may have color composite or false color composite in 3 colors or may be a composite of principle components composite. So that is also false color composite but interpretation about especially about colors is going to be different so visual interpretation and most of now these images are in digital forms so we try to perform interpretations on it is screen itself in digital form.

So depending in correction applied and level of processing the different remote sensing data like raw data which mainly having radio metrically and geo metrically and corrects so if we make interpretations then different types of errors may be introduce but the after the all kinds of processing we can do this processing so there are different products which are available to us which are in digital form for raw data may be standard data may be geo coded product precision product geo coded products are more those products in which geographic coordinate have been added that means they are geo differenced images and a standard data products are where radiometric and geometric corrects have been performed.
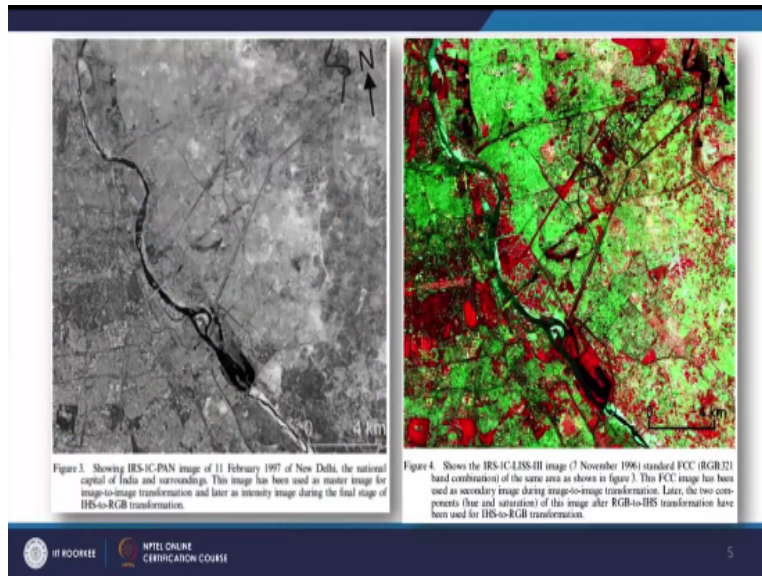
And precision product are those which are radio metrically corrected geo metrically corrected and having your geo graphic coordinate and using use of GCP is ground control points of some libraries and create like our national remote sensing agency they have having as per mind testing they are having 30000 ground control points collected from different parts of the country using a

differential GPS techniques so there ground control points are very precise they look the corresponding ground control point of that area in that single image.

And do the geo referencing and then it is called the precision products so different kinds of products are available on which but the interpretation keys interpretation and the way it is done it is going to be almost same weather you say uncorrected image or corrected image put you have to remember that which kind of product on which you are this thing if you are doing on false color composite then one as to remember the color that vegetation will healthy vegetation will appear in red color.

But if it is a different color composite may be a true color composite may be a true color composite then vegetation will appear in green color so that one as to remember that is why this side is being shown you might be having one more type of product which is a merged products so image emerging image fusion that we will see but this is how that these products are when you are having a in one image you are having high special resolution in another false color composite.

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Figure 3. Showing IRS-1C-PAN image of 11 February 1997 of New Delhi, the national capital of India and surroundings. This image has been used as master image for image-to-image transformation and later as intensity image during the final stage of IHS-to-RGB transformation.

Figure 4. Shows the IRS-1C-LISS-III image (7 November 1996) standard FCC (RGB 321 band combination) of the same area as shown in figure 3. This FCC image has been used as secondary image during image-to-image transformation. Later, the two components (hue and saturation) of this image after RGB-to-IHS transformation have been used for IHS-to-RGB transformation.

You are having color information and you are looking to come mind or extract the best out of these two input image and put any one product so that we calls merge product or spencer product and this is one example of daily where less 3 pan data is there 5.8m especial resolution and corresponding image this is less 3 and less 3 data this is the on data of 5.8m resolution less 3 as 23. 5 m resolution.

So here on the right side the resolution relating is courser but you are having color images where as pan image is having a higher special resolution but it is black and white and you can see that interpretations on both these images is going to be different because color images are more easier for interpretations than black and white images but we can create a product.

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Image interpretation strategy

- Visual image interpretation : Process of indentifying what we see on the images and communicate the information obtained from these images to others for evaluating its significance

- Includes relative locations and extents

- Use of data products like Satellite single band image, FCC for performing image interpretations to extract thematic information for subsequent input to GIS
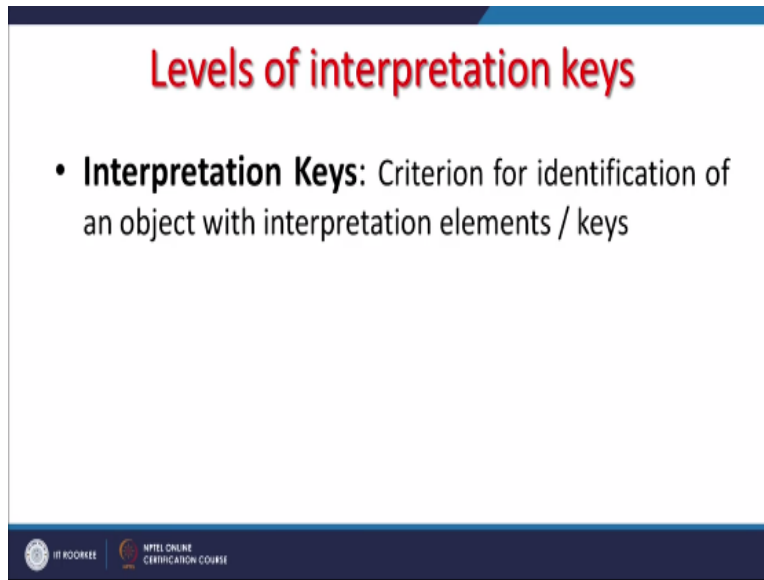
Also a merged one fused one of spencer on which we can do the image interpretation so different products are available and therefore the strategies for interpretations have to be little different one that, now visual image interpretation that process of identifying what we see on the images and the communicate the information obtained from these images to others for evaluating it significant and the this includes relative location and extent with each object is a located in a specified location generally like beaches are located along the sea over in a large along a large lack on just a all of a sudden on land you may not have beach.

So the location is very relevant as well as the extent how they are extending in a linear fashion round fashion then we will allow us to do the interpretation all these things the logic about each ground features is there always so use of data products like satellite single band image false color composite performing image interpretation to extract thematic information for subsequent input to GIS.
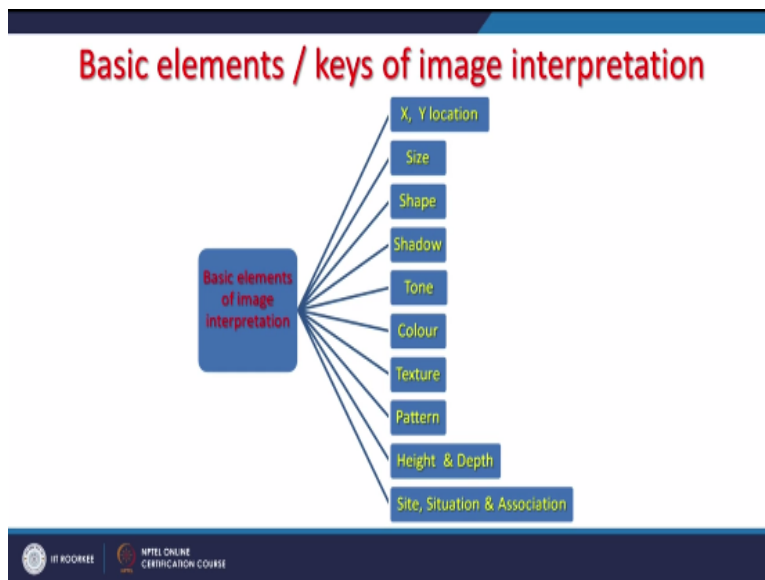
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Or creating some new products so what are the interpretation keys or these are the criteria's basics so criteria for identification of an object with interpretation elements are keys are that you are the location example I have just given the size of an object.

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Basic elements / keys of image interpretation

Feature, how big, how small that will also give you once you understand the special resolution then you may decide that okay this object is there but this might be this object because the size matches with your experience of in on the real on the ground itself so size is important shape of the objective is important, shadow because most of the images which we interpret belongs to the day time images.

And generally in with sun icon satellites are remote sensing satellite the images are acquired generally in the morning hours and then there will be shadow generally in such images there will be shadow in the north west direction so shadow can also be exploited to understand a ground feature or make better interpretation tone what that is a dark tone light tone depending on the type of image if you are having black and white image then do not place very important role.
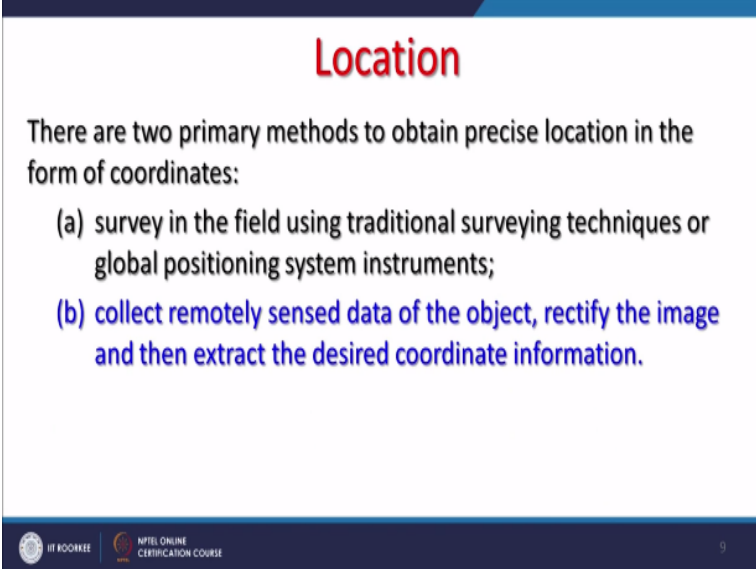
But if you are having color image then you the colors plays very role then you are having texture what is weather is spicily texture or you know some other textures are there which you will decide see small agriculture land will have a different texture as compare to a deciduous forest a coniferous and there will be forest will have a different texture so there is one texture is then pattern is their how thinks are there if there is fuel river in a plane area then you will see miyandari kind of pattern or might be in some other features will have a different patterns.

So pattern also placed while doing image interpretations heights and depths height as indirectly as come in the shadow but depth also can play very important role sight were it is located

situation and association as I said beaches are associated in large water hither seas or big lakes so that is the association in beach can be moved the on simple ground.

So that one has to remember and based on all these interpretation keys that one individual makes a visual interpretation so we will see one by one all theses so location that is there are two primary methods to obtain precise location in the form of coordinates so the survey in the field using tradition survey techniques so global positioning system is too much.

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And there may collect remote sensing data of the object rectify the image rectify means here that differencing and the extra desired coordinated information so because we need the location information so that has top come from in some way hither directly from field or from edge transfer image.

And the most user most remote sensing scientist users use relatively in expensive gps instruments in the field to obtain desired location of a object but I gave the example like NRIS they have collected very precise gcps and that is why when the product you created or the edge differencing is done based on the precise gcps why it is precise because they have used differentiate gps techniques invisible in precise and your procedure includes improve significantly of your location.

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Size

- The size of an object is one of the most distinguishing characteristics and one of the more important elements of interpretation.
- Most commonly, length, width and perimeter are measured. To be able to do this successfully, it is necessary to know the scale of the photo. Measuring the size of an unknown object allows the interpreter to rule out possible alternatives.
- Most commonly measured parameters:- length, width, perimeter, area and occasionally volume

And therefore the jeo referencing of really you get of high order now size also play size of an object on the ground that will give you the idea of what object it is so the size of an object is one of the most distinguishing characteristics and one of more important elements of image interpretation.

And most commonly the length width and perimeter are measured to be able to do this successfully it is necessary to know the scale of the photo and what the scale the image is being displayed because we are talking now interpretations on screen itself so when you zoom in zoom out the scale changes one has remember it what is the scale you are saying for example.
Let me give you the example like if I know that is a real width track so I am having some idea on size broad gave railway will have this much of width may be not along the rails but the total area involve may be 2meter or 3 meter so I am having now the width of the railway track the idea about the width of the railway track and if I find this is a linear passion and bends are not very sharp then I can identify where it is that the railway track.

But if I find sharp bends some crossing and very wide compare to railway track no single track or rails available then I may be say that these may be the road network and so on so the size is important size would be decided based on the scale on which we are making interpretations on digital one has to little careful when displaying zoom in and zoom out because the scale will change.

And most co0mmonly measured parameter as mentioned earlier there also length width perimeter area and occasionally volume, volume little difficult to measure you required the third dimension information but with the ability of digital information model this two has now become possible to measure.

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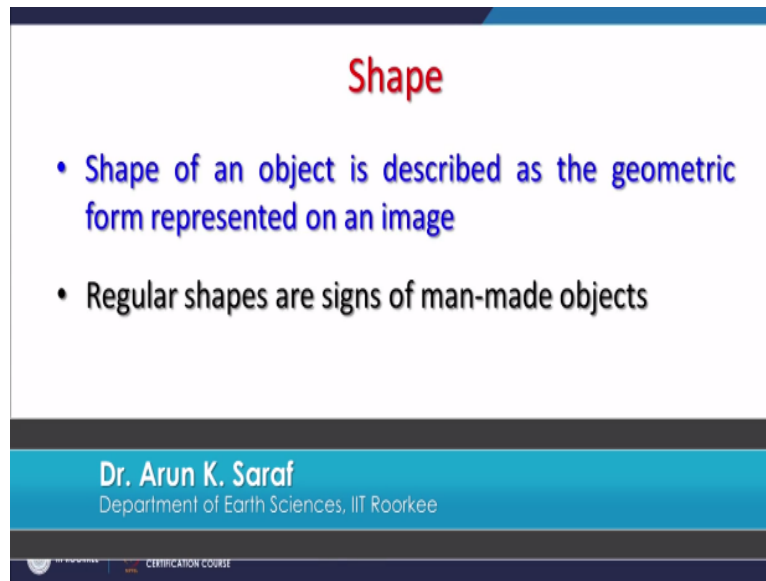
Now the third in the interpretation elements or keys is the shape, shape plays very important role shape of an object it described as the geometric form represented on the image regular shapes are signs of man-made objects like houses or buildings so there it is these are regular shapes they may be rectangular or in squares in shapes originally this is how we see and large colonies are having there or multistore building these are having the fixed shapes kind of things.

So regular shapes are science of man-made objects and irregular shapes with no distinct geometrical pattern are signs of a natural objects so we can identify the on certain size images that which one are in regular shapes are then we can identify that we know that theses might be the man made shapes man-made structures and the build of plant like we can classify or clear that this is the built of a plant or a city or a town and so on.
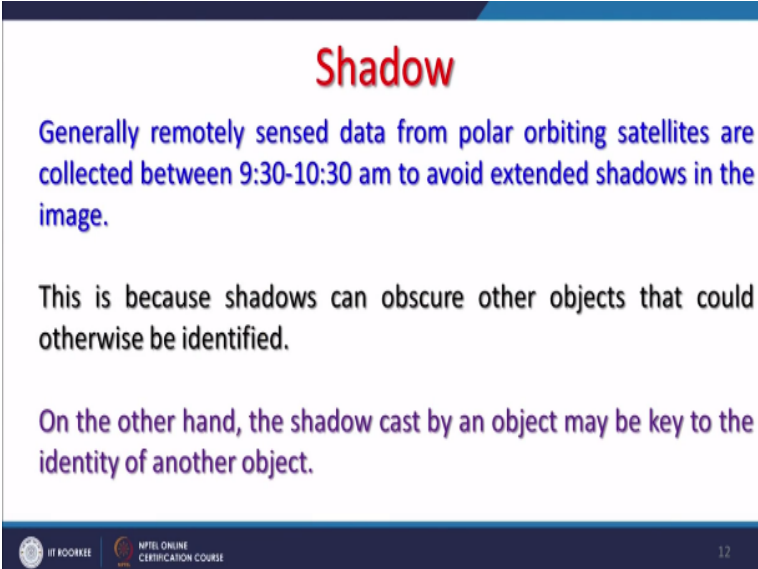
Whereas irregular shapes like a river, river will have irregular shape with no distinct geometrical pattern or sign of a natural environment earlier also I have mentioned the role of set one in some certain lights that date as required mostly between 9.30 to 10.30 and that time sun is in the south

east recorded and therefore the shadow would be in the north west recorded of the objects which are having some height.

If it is completely flood like river will never have the shadow but tree will have a shadow a building will have a shadow and spacely I have talking about mountain regions there are wells so half of the valleys will be covered under the shadow during the time and date has been required so based on the shadow lot of interpretations are made generally remote sensing data from satellites collected with 9.30 to 10.30 is I have just mentioned to avoid extended shadows in the image.

And this is because shadows can obscure other objects that could otherwise we have rectify so sometimes the other objects goes in the shadow is the dark they become darker and therefore there identification interpretation becomes difficult.

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On the other hand the shadow cast by an object may be key to the identify of another objects sometimes it becomes advantageous as well.

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A example is this Washington monument example is here on the left side which you see the photograph taken from the ground and this is taken by satellite so on the ground when you have taking photograph you are not seeing the shadow the shadow will be seen once you have seeing from the top or on some oblique photograph here the image and this is the shadow.

As I were seeing that the image the sun must have been here and if it is the north this is the shadow and shadow will give you the idea of the width of an object as well as take for example this Washington monument in Washington D.C while viewing this from above it can be difficult to discern the shape of the monument whereas in the grounds this is how but with shadow cast this process becomes much easier.

It is good practice to orient the photos so that the shadows are falling towards the interpreter that is also because there highly if you do not orient your image properly then you are bound to away

falls to photographic perception and the result of this would be that the valleys will appear as resist as wealthiest.

So while doing that interpretation take care about this because the shadow is basically this which we have given name false photographic perception phenomena can be produced if the shadow is oriented away from the observer and this happens when low point appears out and high point appears low this valleys will appear as resist and resist will appeared.

Now shadow gives height information about towers or tall buildings so if you know the position of the sun that means the illumination source angles especially the angle I can even we can estimate the height of the tower using the shadow even in an single image so this is a simple trigonometric solution is there as ca example is soon satellite is taking data from here

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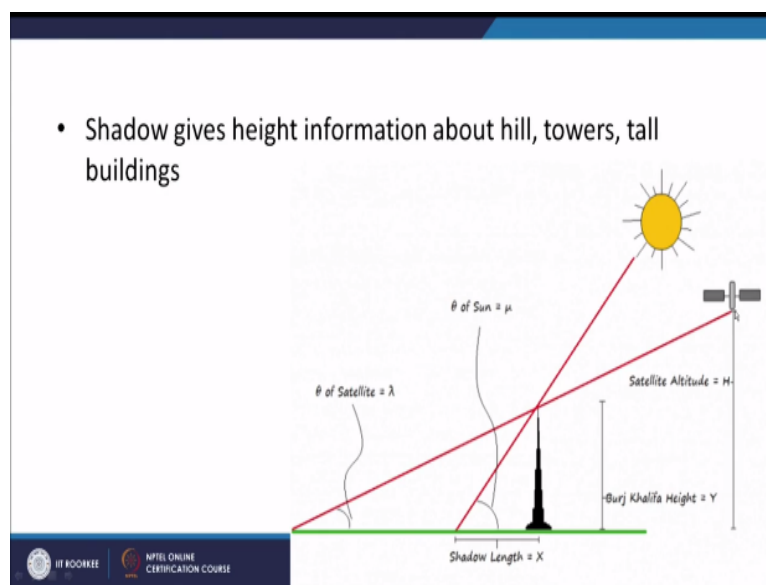
And from here this is the height and this things so the if this is the tower then it is having then shadow of this one so this is simple trigonometric solution can be there and the example is given about the world highest building which is bridge and example is here so the shadow gives height information about hill towers tall buildings and so on.

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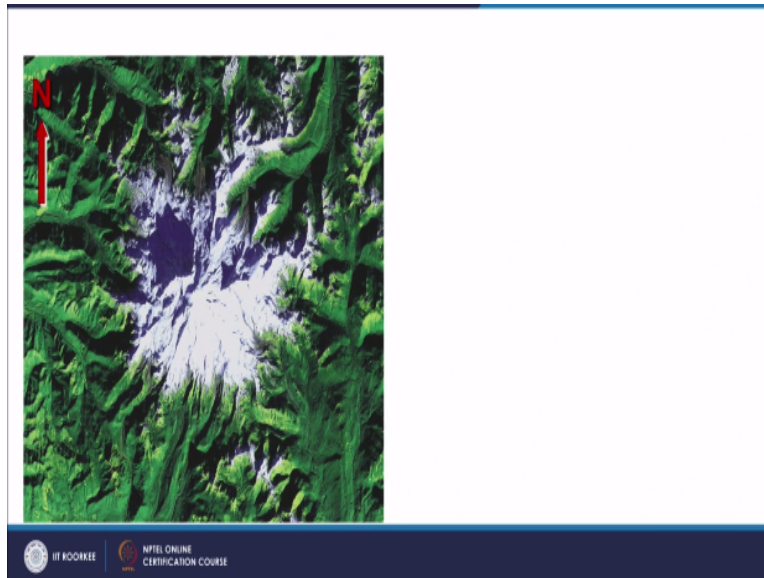
This is what I have mentioning about false photographic perception phenomena that means I am having this single image but still I am seeing different perception, so this is also we can put them as a pseudoscopic but for y falls studio scope presumption phenomena. Now shadow is applying major role here because as I mentioned when this image was acquired that time the sun was in the south east corner.

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And when I keep the north up board then I am seeing the snow covered peak in depression and we know it is not correct, the peak as to be really a peak, that it should appear not a impression but as a mountain. So because of the shadow there is a inversion there or false presumption is there but if I rotate this whole image by 180 degree that means I am forcing the sun, instead of in south east cordon, I am forcing the sun to go to the north west cordon by rotating by 180 degree like this. Now I get the correct presumption.

So there is no change no manipulation, no image processing technique here implied, just physically rotated the by the 180 degree or here digitally rotated image and now we are seeing in the correct presumption. The problem here that if the rumination source and the interpreter that is viewer, if they are in the same hemisphere and in this case southern hemisphere, so your son is also in the south east cordon, the observer always assume himself in the southern hemisphere, north is abort, and this arrangement is there the light is taken in the photograph from or the image is taken from the top.

You are bound to see the false photographic presumption phenomenon but when you rotate this image you are virtually forcing the sun to go to opposite to viewer or interpreter and when these are two different hemisphere leaves the elimination source and the interpreter then the false photographic presumption phenomenon is gone and therefore you see the things in correct presumption. There is a separate discussion on and this one what I wanted to discuss over here,

so shadows play very important role, especially of reason or where you are having large shadows due to buildings or mountains and other things.

Now the other important keys or elements of interpretation after shadow are tone and colors. Tone basically for black and white images.

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The band of EM spectrum recorded by RS system may be displayed in shades of grey ranging from black to white, in grey scale. So two extreme black and white two extremes and in between you are having grey images, so this we say tone. Tone is continuous grey scale varying from white and black, for digitally the values are changing one after another for us we can only distinguish 16 sides of grey maximum, our eyes are only sensitive but computers can generate even 250 sides of grays.

Two extreme members black and white, that continuous grey scale varying from white and black and in between you are having grey, so when we are having a lighter shades of grey, then you call it light tone, otherwise if it is darker then you call it dark tone. So it refers to relative brightness or colour of objects in an image, so vegetation water and bare soil reflect different proportions of energy in the blue, green, red and infrared portions of the electromagnetic spectrum.

For example infrared band, infrared part or electromagnetic spectrum vegetation reflection is always every high, healthy vegetation reflection. Whereas water body will appear completely dark toned because in that part EM spectrum infrared energy is completely absorbed by water bodies and then the reflection region do not reach the satellites, hence it records very dark tone. Whereas infrared band light tone help the vegetation I am talking. Similarly for different objects they will record differently, depending on their shades we say light tone is dark tone.

An interpreter can document the amount of energy reflected from each at specific wavelengths to create a spectral signature and these signature understanding about different natural objects will allow us to make better interpretation. Say training the first image is given to you is image interpretation, you would find very difficult to interpret ate initially, but once you start interrelating and realizing and then comparing the ground features. Slowly you can do much reliable interpretation at a very high speed because it is a self learning.

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Tone and colour

- These signatures can help to understand why certain objects appear as they do on black and white or colour imagery.
- These shades of grey are referred to as tone.
- The darker an object appears, the less light it reflects.
- Colour image is often preferred because, as opposed to shades of grey (humans differentiate 40- 50 individual shades of grey) whereas humans can detect thousands of different colours.
- Colour aids in the process of photo interpretation.

Now in this one these signatures can help to understand why certain objects appear as they do on black and white or colour imagery, like in the false colour composite because for infrared channel, you have a you assigned red colour and the vegetation is reflection is high in infrared channel therefore false colour composite will appear as red. If the vegetation is not healthy then it will not appear red, it will have different colour may be yellow or so on.

So these shades I mean if black and white you are having grey shades of tone and darker an object appear the less light it reflects. I am talking about the mainly in the visible and infrared part, where in thermal infrared part it is not the reflection, it is the emission which is recorded by the sensor, so the image interpretation thermal images is completely different then the reflected images, one has to remember while doing the interpretation of different parts of images EM spectrum.
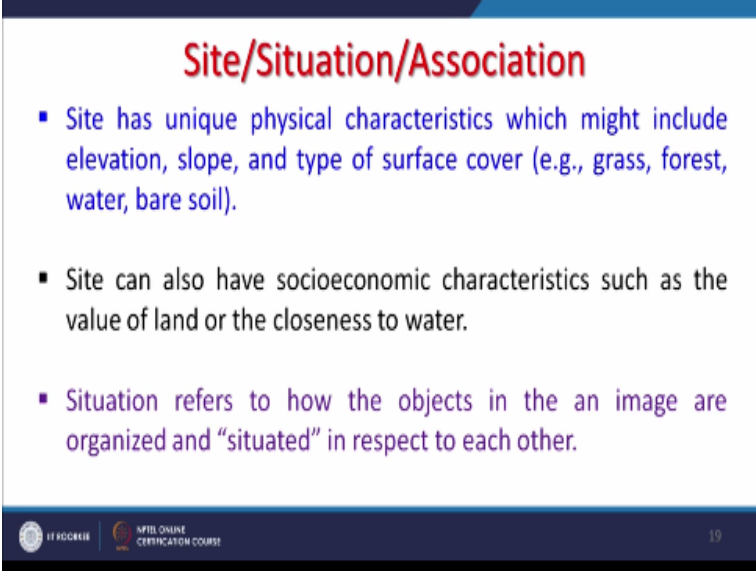
So colour images is often preferred by women is because, as opposed to shades of grey, humans differentiate 40 50 but it is even, if I tell you in real 15 16 maximum we can bear, whereas human can detect 1000 of different colour. So the colour detection of human eye is much more compared to black and white and grey and colour aids in the process of photo interpretation, so always colour images are more soothing more comfortable for our eyes for interpretation.

Because the most of the time we seeing the real world in colour in normal eyes condition. Now next stage is the texture, next characteristics or elements is the texture and texture is the characteristics placement and arrangement of repetitions of tone or colour in an image, that will give you the texture and the visual impression of roughness or smoothness of an image region, a part of image, how it is appearing? Whether it is very smooth or very rough? The next another one is the pattern.

How things have been arranged in a area? So the pattern is the spatial arrangement of objects in the landscape. The objects may be arranged randomly or systematically. They can be natural, as with a drainage pattern of a river, or manmade. Like drainage systems are always having the pattern depending on the land and the ethnology or auto grapy. So while identifying those pattern we can inform the land or the ethnology something like this.

Whether we can first we can different which is harder optical or alluvial, if it is hard which types of rock are present, some interpretation can be made, based on the tone just looking at the drainage pattern. So this kind of patterns is very important in image interpretation and other

objects which we describe. It can be used like pattern we say random systematic, circular, oval, linear, rectangular and curvilinear to name a few. Like a river in the flat area, almost the flat area may have a pattern helical and river in the mountains region may have a very straight kind of or maybe a sharp bend because of hard rock's present there.

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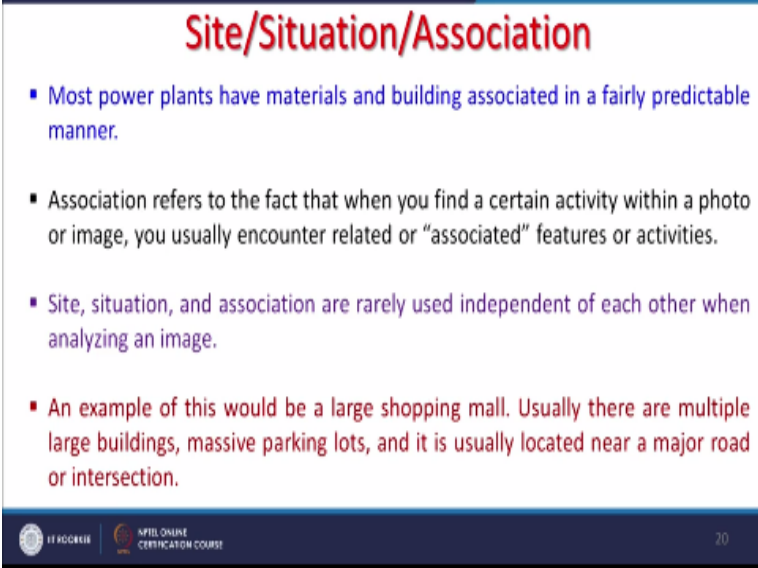 Now sight situation or association, now these are linked keys are there, association the sides has unique physical characteristics which might include elevation, slope and type of surface cover that is grass, forest, water, bare soil. For example if I am seeing a cone shaped very light toned area, I cannot say it is landslide area for a flat area like area like a pluvial plane. But if I see the similar these like kind of cone.

At triangle any reason I may suspect might ne the land. So this because of the site, where it is located situation mine expectations should be accordingly. So this understanding is developed

after doing interpretation on some images. Site can also have so socioeconomic characteristics. Such as value of land or closeness of water and situation refers to how the object and in the image or organize in situated in respect to each other.

And this most power plant a materials and a building associated in a purely protected in manner so based on the satellite images and if we are spends more time and we know from our knowledge. That how cement a plant will look because there will be a raw material might be some products and how chimneys and other things are arranged. We can say the proudly this the cement plant or it is fertilizer plant or may be a sugar gain plant or sugar factory or may be thermal power plant.

So depending on the situation association of all surrounding we can identify an object or interpreted object. Association refers to the fact when you find a certain activity within the photo or an image. Now it is most of the time we are doing the image interpretation that to on the screen. You usually counter related to associated to the features or activities. Side situation are really used in dependent on each other when analyzing an image or interpreting an image.

And an example of this would be a large shopping mall. Usually there are multiple large building, massive parking lots, and usually located near or a major road or intersections. So we say if be find of arrangements and situation a site or association of different thing like road junction large buildings massive parking load. Probably we say that this might be a mall.
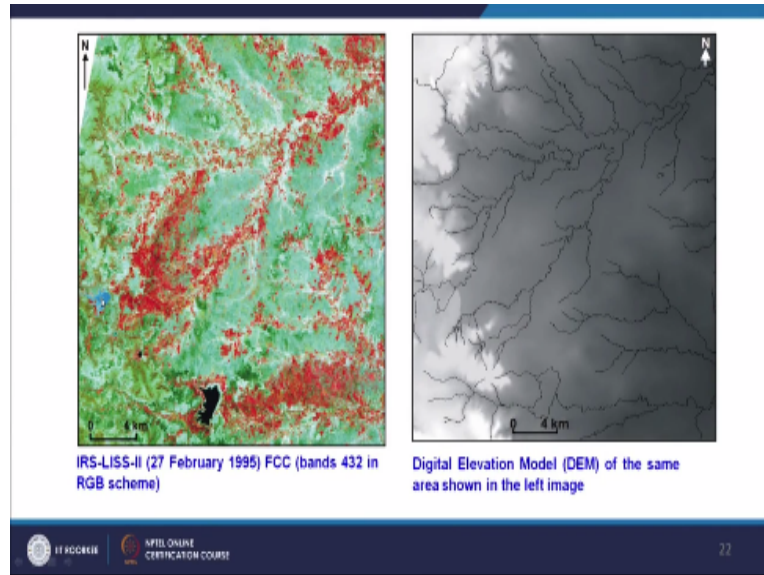(Refer Slide Time: 33:23)
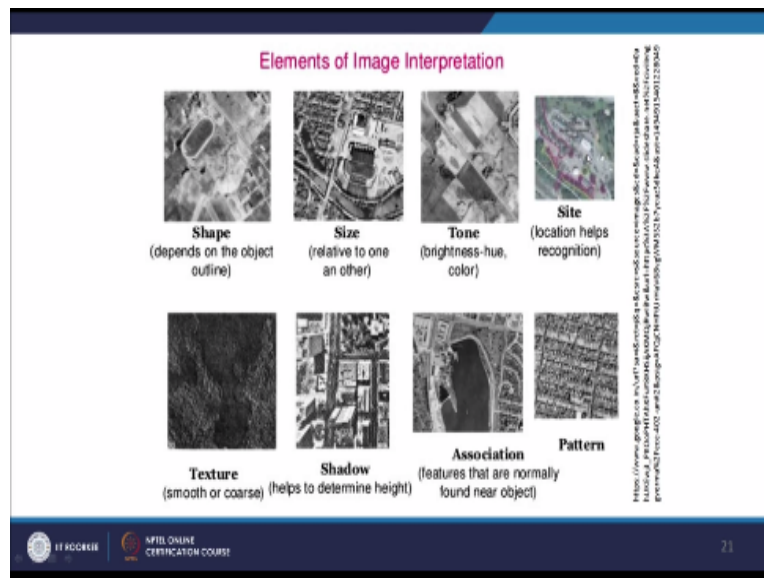
Some examples are given here, the real examples like shape. If I see the shape like this I may say this might be a stadium or if I am seeing like golf cores then I will see a different type of shapes and greens and holes and other things. The size also two matters size depending on its skill but it still in relative sense it matters then tone, dark tone light tone depending on which channel I am using. So the visitation of an visible channel will appeared in the dark tone.

Where visitation in infra red channel will is appeared brighter with that depending on the band then site location helps reorganization where it is located? So same body will located along with the large water body. This is the site. Now the texture it tends for as it conic for forest and the situated for as different textures. So we can identify similarly for recapture lands pr agriculture fields different crofts will have different textures.

And based on that we can identify different features they are. Same with the shadow associated with the different objects will be—will help us to find out. Because the sharp shadow is where with corners and other things seem to way a manmade objects rather than nature. Associations like bridge will be associated on the route. On either crossing may fly over on a river. So that is

the association and way ended we can identify. Wavy pattern of cities of block by and so on so for. So it is very easy to identify.

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IRS-LISS-II (27 February 1995) FCC (bands 432 in RGB scheme)

Digital Elevation Model (DEM) of the same area shown in the left image

Now I am giving you some real examples here like there is a water body this falls color composer so we can say this might be the agricultural land. Or agricultural fields are here. Because there is a water body and there is a supply of water and they are getting water these formers in growing in different crops here. So this is a association of a texture, color, tone everything is played while doing this kind of interpretations.

Where is other area do not have meditation. So we call them as bear, also been wholes is differ data set like a if a digital elevation model. Now I am having hide information, here I do not hide information with the satellite image. If I am having digital elevation along with me I can now say this receive wire too small. It located in higher grounds, because you are it is having pixel values and where is the receive wire is located on the lower ground because it is dark tone.

 So I am now having the hide further interpretation that is there is receive wire and another one is receive wire in blue color. This receives wire in red color. That means this receive wire on higher grounds but a probably might be having turbidity in it or in the depth of water column the thickness of the water column might be very less therefore the bottom is reflecting in life and in the false color composite generally fresh water body should appear completely black or very

dark like this one ,whether this one is appearing down ward ,so here one canorous might we polluted or might we complete clean.

New turbidity and the four it is appearing the dark so now when we want to make sure 100% what is really on the ground then that time as to change on the ground after the checking the ground if you are seeing the similar current the correct in the similar other with the wide and then one develop in the appreciation and then the skills and then we can make the better interpretation and the images and then comes then the inferences so one can.

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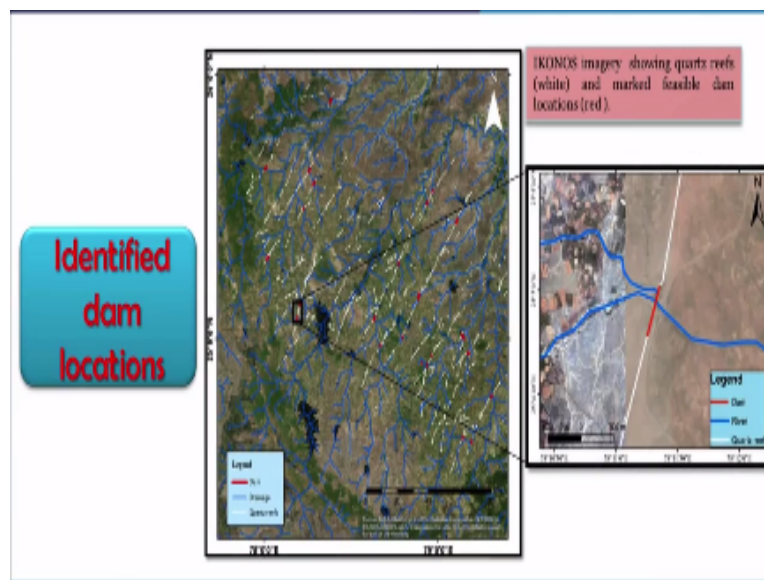
Identify these don't and this understanding or the knowledge one can identify for develop that interpretation to stay were we you start making inference and some thinking some about the feature so you know that the if there is the some areas which are having the higher grounds and the across like a codger and there is river which is going at the cause that is equally having the ground water problem then we do that if I block that created them using that the quarterly as the domains block.

That the area then I can reserve a area and that will reach you the charge the ground water receive so this is coming directly through image interpolation and likewise one can perform lot of the image interpolation and later on in fences and then think about the solution of an area where we might be having the problem of water are agriculture or some other things so this brings to the end of the image interpolation thank you very much.

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