Laboratory Practices in Earth Sciences: Landscape Mapping
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Welcome back. So, this was the last part which we were discussing in the previous lecture. So, as I said, you can even take the oblique low oblique photographs or high oblique photographs and do the mosaicing overlapping and that again which is helpful for viewing the terrain in 3D. So, we will slowly get acquainted with how this overall photograph helps us in viewing the terrain in 3D. So, again the horizon is not exposed. So, what you see is this one is your low oblique photograph.

So, as I said, we collected this photograph after the 2001 Pozsir earthquake in Kutch. So, I am just sharing with you the different types of photographs. So, we also did the ground check using this. So, the rectangle which has been marked here in red which shows that this portion is your ground photograph again the close up we have taken.

Again this is a low oblique aerial photograph and this one is your ground photograph of this portion which has been seen here and then third one is your this one here another photograph of the same portion. And this again partially we can say that this is a high angle covering a larger area and the horizon is seen. So, this is a high angle oblique aerial photograph and this is your ground photograph of the same. So, we are viewing exactly this portion not exactly over here this one is what is been seen here. And the hills over here you can see this one these are the hills here.

Now, easily you can identify and classify that this photograph is from Mandaman where the horizon is exposed. So, the horizon is there. So, this will be your high angle oblique photograph. Again, this is from the San Andreas fault system you can see the horizon. So, the advantage here of what we were talking about in the previous lecture is that you can cover a larger area.

Now, type of projection coming to that. So, you have a parallel. So, the projecting rays are parallel with the ground orthogonal if your projecting rays are perpendicular to the plane of projection and then third is your central. Projection is the starting point for all photogrammetry. Projection center or the prospective center.

So, if in this projection rays the rays pass through a point called the projection center or prospective center this we will see what is the prospective center and all that and partly we

have seen in the previous slides also. So, the image projected by a lens system is treated as central projection. Although it is in a strict sense it is not so and mostly as I was mentioning that we will be interested in this orthogonal projection. So, the pattern of the aerial photograph. So, for having the stereo vision capabilities one can design or you can say that initially you can plan your flying area and how the aircraft will fly or even your UAV.

Nowadays in UAV it is already programmed. So, once you put that in, it is going to take the photographs like ortho photographs, but in the given area and then the overlap has already been set. So, this shows that how many runs you will require for your if the area is defined that how many flights you will require in the sense to cover the area of your interest and with the overlaps. So, as I said that the overlap will be like if you are in the flight direction it will be like 60 percent of overlap and this will be the sideways is around 30 percent. So, this is your 60 percent in the line of flight and the sideways will be around 30 percent.

So, any photograph taken from a point in the air is generally taken in a straight run with each photograph overlapping the adjacent photograph by 60 percent and there is a 30 percent overlap between each run. So, this is again what has been shown on your right. So, this is your 60 percent and this is your 30 percent. Now, this is what I was talking about: that this overlap pattern will help to view the photographs stereo graphically since the same ground surface has been photographed from two different positions in the air. So, for example, if you take this one here.

So, this photograph has been taken and this one is the other one, but there is an overlap of this one. So, this portion will help you in getting the stereographic projection or you can say that in 3D view of this area. So, this is very much important. So, you can remember that along the flight and sideways it will be 60 percent and sideways overlap will be around 30 percent. So, this is what has been shown here in photographs 1, 2 and 3.

So, this will be your line of flight. So, with this if you are viewing this the aerial photographs with an overlap. So, the hatched area is the overlap area. So, that is what we call the stereographic coverage and that helps you in viewing the terrain in three dimensions. So, you may ask what is going to happen because of this area and this area.

So, the adjacent photograph will also have the overlap of this portion. So, that will help you. So, the next photograph will have an overlap over here. So, that will help you in viewing this portion of the area. So, this is what we need.

We will come to this PP1 and PP2 here at CP2 and CP1 and CP2. We will come in a few slides and you will be able to understand that. So, the advantage of the stereo photos is that

the ground surface and the topographic features then appear in three dimensions. So, this is important. So, you can view the area in 3D with a sense of depth perception.

So, you have if you are having undulating terrain. So, you will be able to see this in three dimensions. So, one can also if you have all the information available like the flying height and the datum and the focal length of the photograph one can easily calculate the height also of this feature. So, two such adjacent aerial photographs are known as stereo pairs. So, these are termed as stereo pairs and that helps us in having the terrain in three dimensions view the terrain in three dimensions.

So, what information has been recorded in such aerial photographs? Usually if we are taking a very systematic way then all aerial photographs will have this information, which can be like through the frame it has been kept along the negative. So, that imprints are there on the negatives and that when you develop it that information comes. For example, if you are taking the photographs with the digital camera you have an option to put the date time and all that. So, that sort of information will be available in the photographs. But here in the aerial photographs you have the marks which have been kept, which we call as in fiducial marks.

And these are important. So, for example, if you are having a photograph like this, then you will have some sort of a mark at the edges here. So, these have been termed as fiducial marks. So, these are all these are termed as your fiducial marks. Then you can also have the altimeter recording to find the flying height.

So, this is the fiducial marks are important for identifying the principal point and that is what we were talking about the PP. So, we will talk about later in the coming slides. Then you can have altimeter recording to know the flying heights at the time of the exposure, watch recording giving the time of the exposure at what time you have exposed that that can also be a level bubble whether the camera axis has tilted or not it remains almost vertical. And if it is within the permissible limit of the vertical photographs to be classified that is less than 3 degrees that can also be there. Principal distance for determining the scale of the photograph and that is your it again you can talk about the height and all that in this.

Number of photographs because this is again important. So, you can have the number of photographs printed on that. And that is helpful in easy handling and indexing. Number of cameras to obtain camera calibration report. That is because you need to have what type of camera you have used and what is the focal length of the lens which has been used here.

Date of the photograph again can be printed on the aerial photographs while collecting the

data. So, these are the few pieces of information which are available, but once you know if you are using the UAV again it will record all this and its data file which will give you the coordinates which will give you even the date and the time also. But they may not be printed on that, but usually the aerial photographs which we use look something like this. So, you have over here all the information which has been printed here and then you have some dots here which are your footage marks here. So, these are being put as a frame within the close to the negative so that that you can do.

And if you connect this axis, if you can say that this is the flying line of flight, I would say that this is line of flight, then this is your x axis and this is your y axis. So, if you connect this or you take the diagonal centers or diagonal marks here that are your footage marks, then that will help you in identifying the point here that is your principal point. And principal point usually is considered that if you are having for example, if this was your negative here. So, this is the center here and then you have the positive over here and that goes through and that will be you on the land surface. So, this will be your principal point if you are having the almost vertical axis.

So, this will be marked as a principal point or if you can say that this is if it is almost vertical or nearly vertical then we call this as in another point. Now, why this is important we will come to that. So, you can have even that what we were discussing in the previous one. You can have black and white photographs or panchromatic photographs or you can have the colored photographs also. Again, this has all the information about the altimeter and all that and the time at which the photograph was taken and also the number of the photograph. So, these are the numbers which are for indexing and if you connect this mark here like this.

Then this will be your principal point considering that this is an ortho photograph then you can say that this is your another or you are having the exactly the center of the photograph is your principal point. Now, terms which have been used this is already we have discussed about the the fiducial marks and how you can draw the fiducial axis and based on the fiducial axis the intersection of this fiducial axis that is your x and y that you can get if you are taking the the center or you are taking the diagonal that will give you the intersecting point and that point is your principal point. So, this is again another photograph which shows the number here. So, this is the number of the photograph here and here in this these are the fiducial marks. This is 1 here, this is 2 here, this is 3 and this is 4.

So, if you connect this then you will have the center of that. So, this is what has been marked here. So, you have these are the fiducial points. So, if you connect this and this one here. So, this is your fiducial axis and this point will be your principal point.

You can also do this if you are not having the clear cut fiducial mark. So, you can connect this diagonally and that will be your principal point. And this is why we are so keen in talking about the principal point you will learn later that if you want to calculate the height of any object then this is important. Because from this point the distance at which the object is lying and for and we want to have the height of that will be helpful actually. Now, this is again a satellite photograph, this is a corona satellite photograph as I was mentioning and this again in a high resolution one.

But here what you see is that we have done mosaicing of the strips. So, these are like strips here one, then there is another one, there is another one here, there is another one. And these strips again have overlaps. So, now, like point is that one is your fiducial marks you have connected and you have obtained the principal point, but not necessarily that the the flying direction or the flight direction is in the same direction as the y axis has been projected.

It can be slightly different. So, the adjacent photograph should be taken into consideration and that is all. The principal point of the adjacent photograph should be connected with a line with the first photograph and that will give you the direction of flight. We will see that. But for example, if you are having the flight which is or the photograph which has been taken at a slight angle, then also the exactly from the camera lens to the ground the line will be the point which is intersecting this or that will be your principal point. So, this part I will just cover later on also, but here this is what we have already discussed. This is you from the exposition to the negative point here to the exposure center. Here this will be your focal length. And the point here which is crossing through the exposure center and here will be your principal point.

So, this will be the principal point provided it is vertical then we call this as a principal point here. So, I will come to that part later. So, the conjugate principal point is the principal point of an aerial photograph represented on an adjacent aerial photograph. So, this part we will also talk about is why it is important for this because this will help us in identifying the line of light. Another point is a point at which a vertical line through the prospective center of the camera lens pierces the plane of the aerial photograph or the point vertically beneath the camera at the time of the photograph when the photograph was taken.

Isocenter the point that falls on a line half way between the principal point and the Nadir point. So, if your photograph is not vertical exactly or ortho photograph then the Nadir point will be different actually. And the principal point will be different and the isocenter how the isocenter is the almost we can say that is an almost equal angle you can draw a line in between that will give you the isocenter. So, let us see that.

So, if you are having an incline. So, if we would have been having the flight almost vertical then the line which is coinciding here. So, this will be your Nadir point and this will also be your principal point, but since it is inclined this is inclined. So, this will be your principal point and straight vertical that is what we also call the perpendicular here this is your Nadir point. And the isocenter will be this one here.

And the angle will be the same as this. So, it is we can say the or we can say in a simple mathematical language this is a bisector here. So, this will be your isocenter of the photograph. So, for the definition of the photograph, if we take vertical photographs, we have already discussed that it is photographs taken with the optic axis coinciding with the direction of the gravity that is your plumb line. What is the plumb line? We will quickly look at it, but we have also briefly looked at the slides before or in the previous lecture. The tilted or near vertical photograph taken with the optic axis unintentionally tilted from vertical by a small amount that is usually less than 3 degrees then we consider this as a near vertical or tilted photograph slightly, but mostly this is a permissible limit.

Focal length distance from front nodal point to the plane of the photograph. This is your focal length. So, from near the nodal point to the image plane. Exposure center which is also termed as L position of frontal nodal point at the instant of exposure. The flying height elevation of the exposure station above mean sea level and above selected datum.

So, if you note the datum that you can also use as a reference and then you can calculate the flying height. So, these are what I was talking about. You have the negative here and this is your positive. So, this will be your exposure center and this is the from the negative to the point here that will be your focal length of the camera and all that. And then you have the height and as I told in the previous one that this will if you take from the datum to the ground this will be a small h and small h part we will talk about why it has been important and that. So, if it is as I was told repeatedly that if you are having a vertical photograph and having less than 3 degrees of the tilt and the nadir point and the principal point is the same, otherwise you need to project the nadir point and also you will talk about the isocenter.

So, this is the overlap which has been shown here that if you are having an undulating terrain then what sort of an overlap you will see in the line of flight along the line of flight that is 60 percent. So, you have this is your f and this is your H capital H and this part here what we were talking about from the datum. This will be your small h here. So, if in terms of the scale if you want to identify the scale usually it has been expressed as s equal to f by h that is your f is the focal length and h is the height that is your flying height because you are taking the height from at the point of the exposure center this one is your exposure center. So, for example, if the f is 6 inches and height is 15000 then you get the one which

is like the scale will be 1 is 0.

5 feet by 15000 feet. So, for example, what you see here is 1 is to 30000 scale this will be a 30000 scale and this is what the way it has been projected the this is known as the ratio fraction or it is termed as representative fraction. We will come to the next slide and I will explain what exactly this represents. So, for example, the scale determination you are having this one is the f and this one is your h and this is h by because this one is your small h. So, this portion is you from the terrain or the ground level you are having this is h by h minus h small capital H minus small h.

So, if you know this and this L is your exposure center. So, scale as we have discussed in the previous one this can be represented as f this if you are talking about the ground level. So, you need to subtract this height from this one. So, that will give you the elevation of the ground. So, f is the focal length of the camera lens h is the elevation of the camera or the flying object above the mean sea level and small h is the elevation of the terrain above mean sea level. So, simply if you have the data which has been given here you can identify the scale here.

Now, what that means is that one unit of horizontal distance. So, if you are having this scale which is coming out then you say that one unit of horizontal distance on photograph is equal to x number of same units on ground. That is 1 mm of the photograph is equal to 9600 mm on ground. So, this way you can calculate the scale of the photograph. So, as I said, this can be also termed as the ratio fraction or representative fraction mainly used for the photographs and also for the topographic maps.

So, with this we will stop here and see you in the next lecture. We will discuss more on the importance of the elevation and how we can use that to calculate the height. And that is what we call relief displacement. We will talk in the next lecture in detail and then further we will get into the different types of photographs we are using and how we are going to generate the 3D model and all that. So, thank you so much. See you in the next lecture. Thank you.