

**Photogeology In Terrain Evaluation (Part - 1)**  
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**Lecture - 16**  
**Determination of Flightline (Lab)**

Welcome to the photogeology in terrain evaluation course. As you know that this course is carried by; Professor Javed N Malik from department of earth sciences IIT Kanpur. I am your teaching assistant in this course, and I am going to help you for conducting your labs practical's and whatever you learn in this course. I am going to present some practicals of that. So, before delivering the practicals, I would like to share some information with you which is very much important, and will help you a lot in smooth conduction of the labs.

So, I am going to start with the determination of line of light on aerial photographs. It is basically associated with the vertical aerial photograph.

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**Stereo-photography**

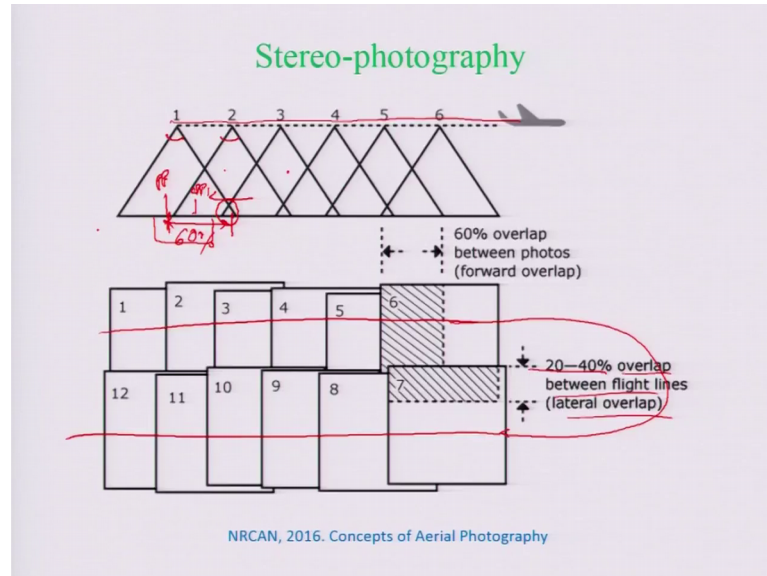
- Adjacent but overlapping aerial photos are collected during a flight run
- The two overlapping photographs are called stereo-pairs or stereo-photos
- Required to generate stereo model of the area covered for 3D viewing

So, this associated with the down stereo photographing in which the adjacent, but overlapping aerial photos are collected during a flight run.

And these two photographs which are collected by 60 percent overlap, or with some side lap these photographs are known as stereo photos or stereo pairs. And these photographs

are required to generate stereo model of the area, and with these types of photographs you can your area in a 3D, the area covered in this flight line.

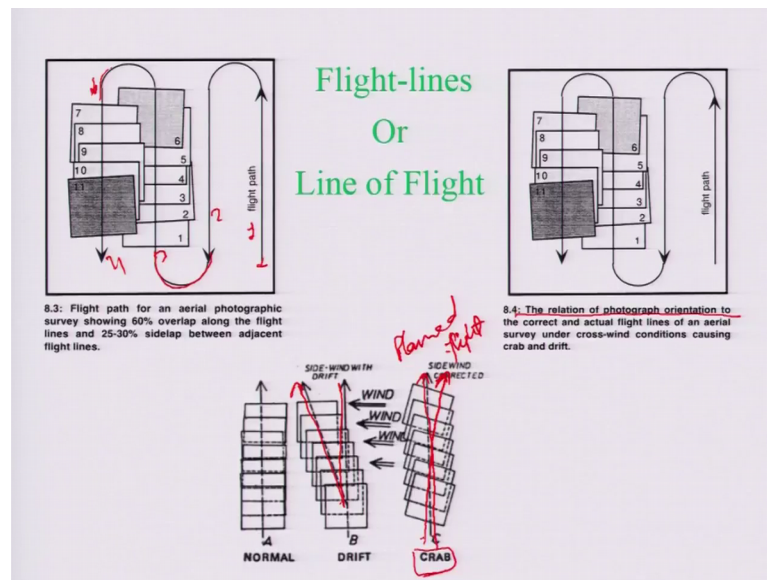
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You can see here, this is your flight line from photo number 1 to 6. So, this is a single coverage over a photograph. This is the coverage for the second photograph. And you can see here this part is called overlapping area. This is basically taken as 60 percent, which is as good as must to view a terrain in 3D ok. So, but in if you see the 3 successive photographs, photograph 1 2 3.

So, this area this we will be common in between these 2-3 photographs. So, during our flight line, you must have a 60 percent overlap between the photos, which is also known as forward oh overlap. And this is the lateral overlap ok, between the flight lines. So, your flight is going like these, then coming back like this. So, this is your first track, this is the second track of the flight is I am going to show you in the next slide.

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When we plan a survey over an area, we first put some flight lines over there ok. So, our flight will follow the tracks, which are pre planned. This is the track number 1 2 3 and 4. The photographs 1 2 6 are collected here, and then the flight turnover here, and then it will collect from photograph 7 to 12 and vice versa. So, this is required to map an area to view in 3D. So, but there are some errors, which may be due to wind or drift as an action of wind, your flight may have deviation from it is original path, it is pre planned path and it may go like this.

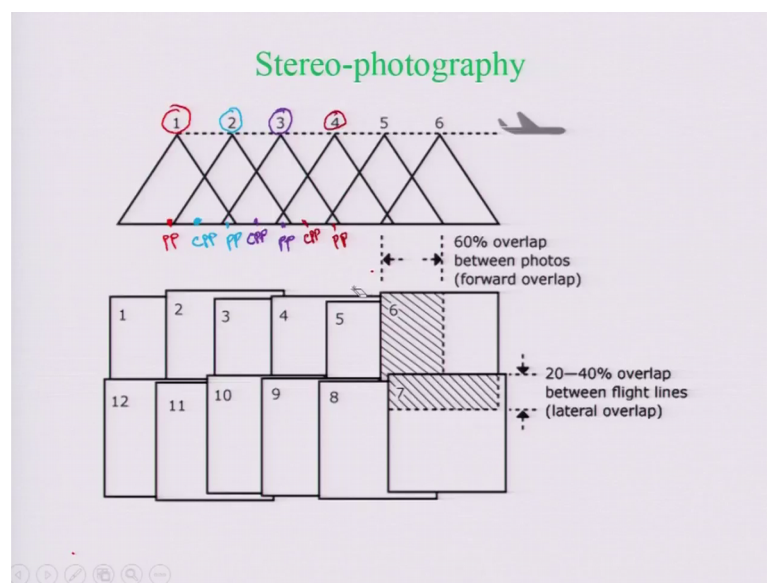
So, then this is called drift effective. And another effect is known as crab. You know that this is the this was the planned flight, your planned flight path flight line, but this flight as collected it is photographs in somewhat these trend. So, this was the error in this photograph as you can see here.

The relation of photograph orientation to the correct and actual flight lines; on an aerial survey under crosswind conditions causing crab and drift so, how we plan over a aerial photography? So, this is an important aspect of stereo photography so, first while we are preparing our aerial photographic survey. So, this is stage involves stereoscopy examination of stereo pairs, in a series of each run and selecting and marking several reference points; such as principal points, conjugate principal points, wing points, and ground control points. So, accuracy in the work is one of the important requirements to

accomplish a successful plot. Slight errors on each photograph may lead to an accumulation of errors on the last photograph.

As you can see, in these figures, if you have error in your first photograph, then you will have; obviously, you will have a large number of errors in your last set of photographs. So, due to this error, actually what happen these cause problems in matching the plot with the pre-established ground control points ok. So, in the first step the photographs in serial numbers of a run are examined under mirrored stereoscope and the radial centres.

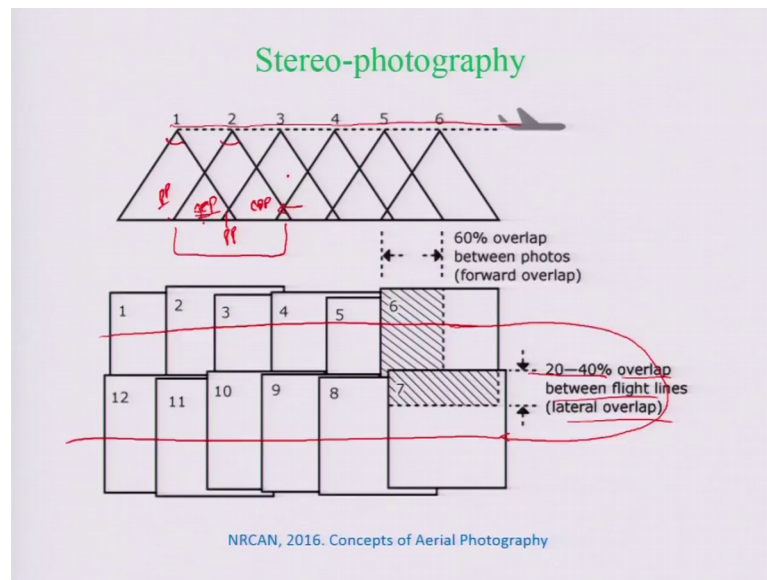
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And these 4 points can be joined by a pencil. Thus, each photograph in a run except the first and the last will have 3 radial centres corresponding to one principal point and 2 conjugate principal points. So, what I am saying is in this you will have in this photograph, first you will have it is own principle point. Then you will have the conjugate principle point of the next photo ok.

And then, these 2 points you will have on the first photograph. But in the successive photograph, you will have 3 radial centres; like, the first you will have the cpp of this principal point because this was the principal point of the first photo.

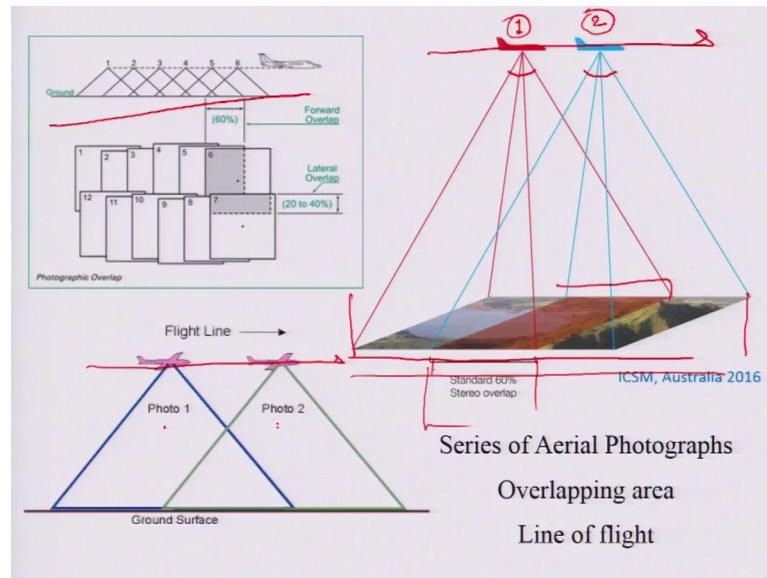
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So, you will have conjugate principal point of the first photograph, then it is own principal point then the conjugate principal point of the next photograph. So, in this way on the second photograph, you will have 2 conjugate. Principal point and one principal point, understand? So, this you will have for all the photographs in between the first and the last photograph. The first and the last photograph we will have only 2 points. One will be the principal point like this, and other will be the conjugate principal point of the second photograph.

In this way, these points transferred from the succeeding and preceding photographs respectively. So, the lines joining the principal point and conjugate principal points will define the azimuth line which is also called the flight line for a particular run. So, what is the flight line? Now I will show you how this area looks like, when we collect it in an overlap of 60 percent.

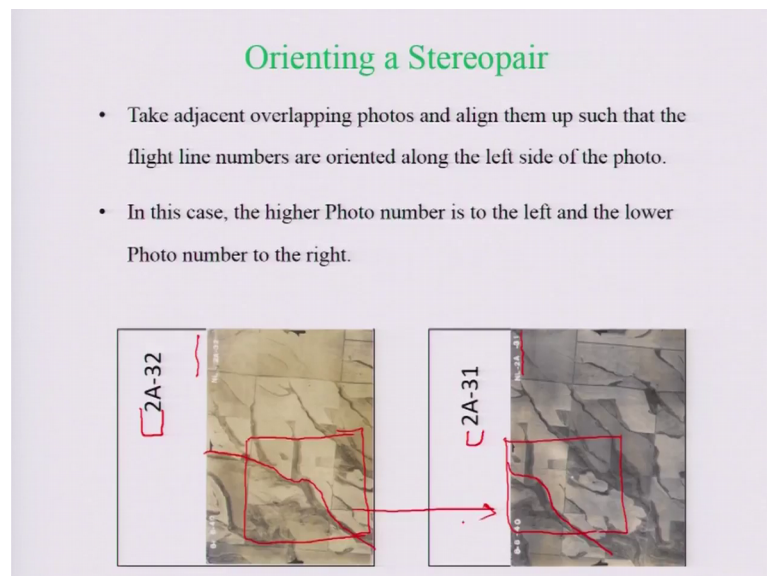
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So, this area in colour, you can have an idea of the overlap part. This was the exposure of flight position one; this was the exposure angle at flight location 2. So, from two different positions, this flight is taking the same area ok, taking the photographs of the same area.

But with overlap this is called the standard stereo overlap. So now, what will be your flight line? This is your series of aerial photographs ok. This picture is showing the overlapping area. And what will be the flight line? This will be your flight line.

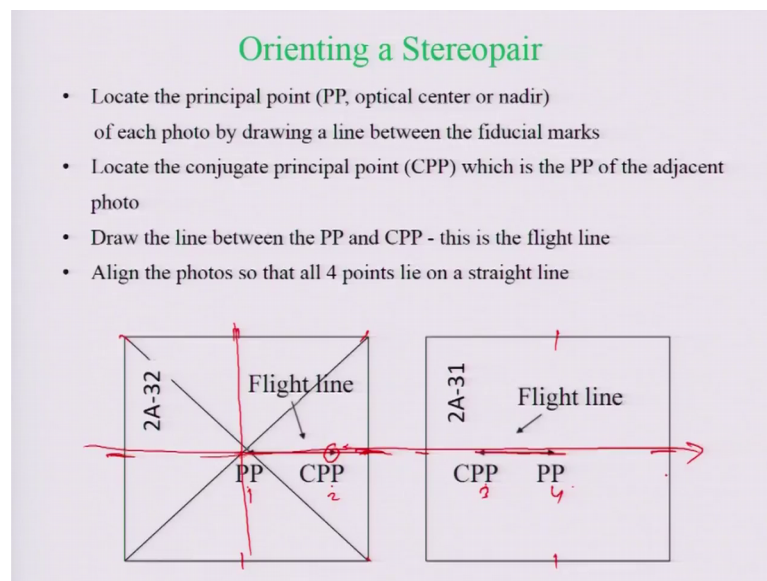
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So, here I will tell you how to orient the stereo pair. This is the important part. So, first take adjacent overlapping photos and align them; Such that the flight line numbers are oriented along the left side of the photo. So, these are the flight numbers. Suppose, for this photograph and for this photograph. So, it should be oriented like this that should be on the left side. This is your photograph number 1 photograph number 2; you can see these numbers scripted over the photograph this information you will find scripted.

Over all type of aerial photographs. So, this will show you the photograph number, photograph number 31 and 32. These two photographs were taken in a series 2 successive photographs. These two photographs you can see here that this area, you can see here also and yeah this much you can see, which is clearly visible and you can see that this area looks similar ok.

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So, you can have an idea that this should be the overlap area. So now, how to orient the stereo pair? You have a stereo pair means one left photograph one, right photograph and you have to orient it. So, first locate the principle point. After orienting the two photographs in this manner like, you can see that these two features like whatever the features you can look on these photographs. At least you can orient these two features in the same line. The features which are clearly visible you can orient those features in a same line.

So, at least you can do it first. Then locate your principle point as, you know that your photograph has some fiducial marks ok. Like these like this. So, first you have to locate your principal point. You know, it has been turn in the lecture at principal point is the intersection of the line is crossing the fiducial marks.

The principal point, you can get the principal point by drawing these two lines, joining the fiducial marks. So, fiducial marks may be in the mid line also and in the corners also. So, then you can locate the conjugate principal point, which is the principal point of the adjacent photo. So, here in this case this is the conjugate principal point. Then draw a line from principal point to conjugate principal point and this line the line joining the principal point and conjugate principal points on both the photographs. Means, you can say the line joining these 4 points. Point number 1 2 3 4. This will be your flight line.

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In the next slide, it is very easy for you to understand; what is a flight line. First look at these 2 successive photographs.

These 2 aerial photographs having overlap of an area as you can see here, this is photograph number 1 31, photograph number 32. So, first you look over the fiducial marks. These are the fiducial marks ok. This black half arrow shows the fiducial marks. So, first you can you have to generate your principal point by joining these 2 fiducial marks on both the axis. So, the intersection point will give you the principal point this ok. And similarly draw a principal point for other photograph also for this one. You can



join the interest in the 2 fiducial marks on both the opposite sides. And then the lines joining these fiducial marks will give you an intersection point, this will be your principal point in this case also.

Now what you have to do is; you have to now locate your conjugate principal point what is a conjugate principal point? In the principal point of one photograph will be covered on the adjacent photograph also the point which is located on the other photograph representing the principal point of the previous photographs, will be your conjugate principal point. In this case in this photo your conjugate principal point will be located here.

At least you can see the features which are very obvious on the photographs; you can see these features are very obvious on these photographs. So, you can easily locate your principal point of first photograph on the other photograph. The location of this principal point will give you your conjugate principal point. Similarly, you have to generate the conjugate principal point for your, this principal point, principal point of the other photograph. So, this point you can see you can draw this feature, for your ease.

And you can see that this point is lying here, the principal point of the other photograph mark in yellow colour is can be located on the first photograph here. So, this will be the conjugate principal point for the second photograph. So now, what I said earlier, the line joining these 4 points will give you the line of flight or flight line ok.

So, let us see what happen finally, determining the line of flight, we can join these 4 points like this. And this will give you the line of flight. So, we will conduct this lap hopefully you can understand it more clearly while we are going to do our practicals with same kind of photographs.

So now, let us move to our practicals whatever you have learned in the lecture, like determination of the line of flight. So now, you are going to do some practical's so, on it. So, the two photographs which I have shown in the lecture are shown here on the screen. So, these two photographs I am going to show you now.

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So, there are sets of 3 photographs. So now, we are having these photographs photograph number 31, 32, 33. As I told you that we have to orient our photographs like this that the photographic number should be on your left side. And other think is that you have to take the orientation of these photographs like this, that the higher number of the photograph should be on your left side.

So, suppose if I am going to arrange my photographs in order; so, then I will put this the waste number on the right, and the highest number of the photograph on your left, as I showed you in the screen ok. So now, you know that these are the fiducial marks scripted over the photographs, and these are some information like photograph number some date. The information which are covered generally only aerial photographs. So, so, such information is covered on these photographs.

So, these are the fiducial marks the marks which are located in the mid-way of their axis. So, you would first you have to do so, first thing you have to do is to mark the principal point. So, for marking the principal point, you should have some tracing sheets like here. We are having two types of tracing sheets, tracing papers one is of A-4 size another is of A-3 size.

So, depending on our requirement or the size of the photographs, we can use any of them. So, here we know that this, the size of the photographs is with this A-4 size of tracing sheet. So, we take one tracing sheet, and put it here, anyhow on anyhow in the

photograph. Suppose we take this photograph first. So, what we do generally while we are taking the measurements on the photograph, we should remember that our photograph should not be moved from its place. So, in this way, you will be able to avoid a number of errors in your measurements. So, take this white tape and fix the corners of the photograph so that it remains steady.

So, now what you have to do is first you put your tracing sheet over this photograph, one thing you can simply do is you can mark at least the principal point by joining the fiducial marks of this photograph. Fix it also because it should not be displaced from its place. So now, put your scale and a pencil, you can see your first fiducial marks are these and the opposite fiducial marks are these.

So, put your scale at like this on the half arrow, and then draw a line joining these two fiducial marks. Similarly you can do the same job for these two opposite fiducial marks. ok. And for your information, you can put a mark over here so that you can have an understanding of the boundary of the photographs. So, the line joining the fiducial marks is the axis. And the intersection of the two axes in this way is called your principal point. So, here this point pp is your principal point for this photograph.

Let us say this is pp 1. Because this is photograph number 31 let us say this is pp one. And what you have to do is in this exercise, because first I am telling you the direct method of determination of the line of flight. Direct method means without orienting your photographs you can determine the line of flight. So, what you have to do is, take any feature which is common on both the photographs.

As you can see here with actually this photograph represents some incised channel. And here you can see there is a difference of height from here to here. When you see it in 3D under a stereoscope so, these two photographs, you have to see, you have to look for a common feature. So, as I can see this feature is common on this photograph also and on this photo also, like this. So, what I will do is I will trace this feature you can use a coloured pencil also for this exercise for the exercise related to aerial photographs we generally use the colour pencils ok, here are some examples.

But you have to use a sharp point pencil. So, trace it like this. So, this is in this exercise you will determine the line of flight without orienting your photograph ok. What I taught you in the lecture that one of the exercises, where you

have to first orient your photograph, then mark the principal points then conjugate principal points then only you can mark the line of flight. So, in this way, you can mark the line of light directly without orienting your photograph. So, first now you have trace one of the common features which is present on all the photograph the succeeding photograph successive 31 32.

So now, remove your tracing sheet from here, and now you have to fix this photograph, the successive photograph. On this photograph now, you are going to take measurements this way. So now, what you have to do first? Do not mark the principal point for this photograph. You just coincide this feature what you traced on the first photograph. So, try to coincide it with the feature which is present on the second photograph. So, as you can see that the tracing which is shown here is given here ok. It placed on this photograph. So, what we will do is, we can match our tracing match our tracing with this common feature, geomorphic feature you can say.

Now at this stage, then you have done the fixing then paste your tracing sheet ok. So, this is this will be the place, where you will measure your the principal point for the second photograph. Now your tracing sheet is fixed, that you will do this, now you will take to the principal point for this photograph. So, for this photograph this is the fiducial marks this is the in the opposite one, now put this scale and line joining these two marks.

And as in the earlier photograph, just mark the boundary of a photograph for the sake of (Refer Time: 27:14) similarly, do it for the other pair of fiducial marks. Because your tracing sheet is placed here. So, do not turn on the photograph to avoid the damage to in the photograph. So, just draw on your tracing sheet because we had the idea that this line is going to join on the opposite fiducial mark.

So, the line of intersection is here traced here. So, this is your line of intersection for the second photograph. So, this is your pp 2, this was your pp one and pp 2. So, in this way what you will do you simply join these two, the line joining these two principal points will give you the line of light.

So, you simply draw a line, joining these two principal points and the line of flight or flight line. And where will be the direction of flight, because the photograph which is having the lower number will be taken first, then after this photograph the photograph number 32 will be taken by the air craft. So, the direction of flight will be from here to

here, as I showed you on the lecture slide. So, this will be your flight direction. And this will be your flight line. So, this is the first method.

Thanks very much.