Photogeology In Terrain Evaluation (Part - 1)

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Lecture - 19
Exercise on Stereoscopic Parallax

Hello everybody, as you know that this course Photogeology in Terrain Evaluation is taken over by professor Javed N Malik from Department of Earth Sciences, IIT Kanpur this is Absal Khan I am your TA teaching assistant in this course and I am going to help you in conducting labs and your related practical's. So, our today's topic is stereoscopic parallax.

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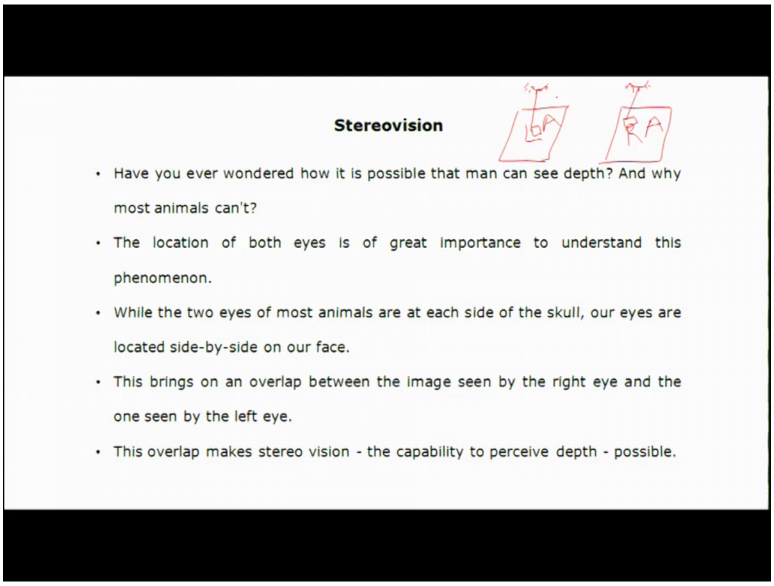

So, why we get parallax in our stereo pairs, in aerial photographs; So, have you ever wondered about this phenomena that animal can see the depth or not the depth perception is an important phenomena which the human have this ability because they are having their both eyes in the front of their skull, but in case of animals they are having their eyes; most of the animals they are having their eyes one eye on the right side of the skull and left eye on the left side of the skull.

So, that is why they do not have this ability of depth perception. We when we see some area or some object, we can define in our own terms in our brain that the what is the height of that object or a building and what is the relief over an area. So, this ability is we get on to see on the stereo pair of these aerial photographs.

So, when we see the left photograph with our left eye and right photograph with our right eye ok so the observation of the same area or the same point from different point of observations. So, here suppose this is a common point on these both photographs point A is common here also and here on the both photographs. So, but we are looking over point a from the 2 different point of observations. So, that is why we are able to see stereoscopic parallax over this stereo pair.

Because there will be relative changes in the positions of the objects.

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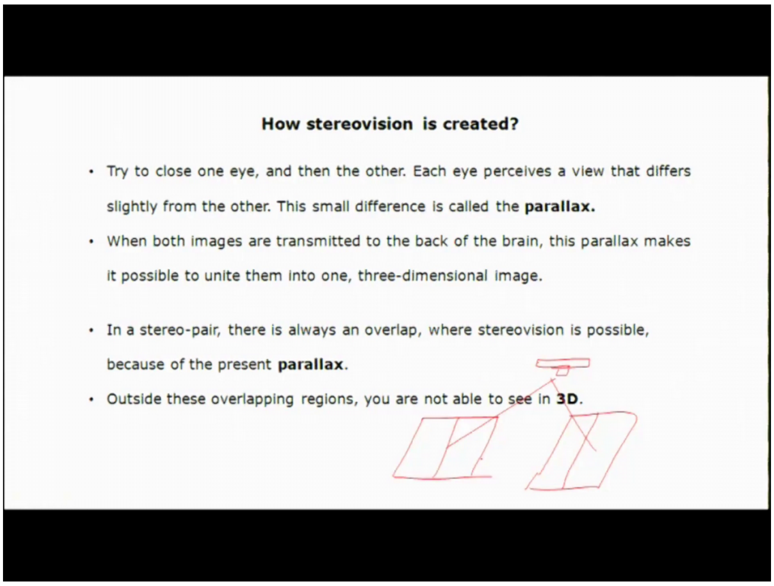

So, how stereo is done is created as you know that for creating a stereo vision we must have a stereo pair means the photograph the aerial photograph taken through some airborne sensor or a camera of the same area, but some overlapping part ok; this you know well.

So, this overlapping part gives us a stereo vision of an area. So, now, what we can do here? In a general case I can tell you suppose this is a pen in my hand. So, if I see background beyond this pen from one I will close my left eye; then I close my right eye.

So, what will be the changes in the background you can see; there will be a shift in position of the objects which are placing away from this pen beyond behind this pen. So, this is called the effect of stereoscopic parallax and this parallax of course, this is important for creating a stereo vision without the presence of this effect; you cannot see 3-D images of the 2 overlapping photographs or a stereo pair. So, what is required to make a stereo is impossible?

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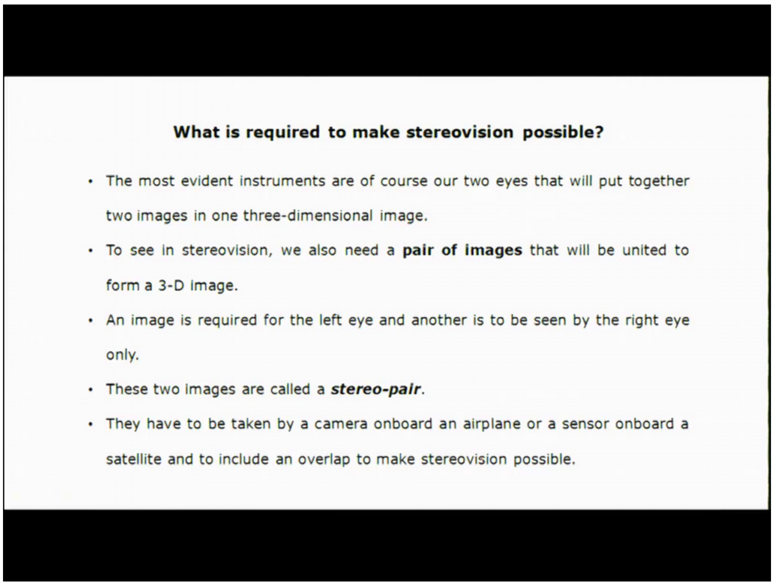

As you know that the most important thing is our eyes then we can have some aid like the stereoscope or some other technical equipment to see these stereo pair from with this instrument or equipment.

So to see the stereo vision of a stereo pair we also need a pair of images. So, to see the stereo vision we need a pair of images that will be united to form a 3-D image an image is required for the left eye and another image will be seen by the right eye. So, then there is possibility to make a stereo vision.

So, these 2 images are called a stereo pair you know them. So, they must have to be taken by a camera onboard up an airplane or a sensor onboard satellite and to include an overlap to make stereo vision possible.

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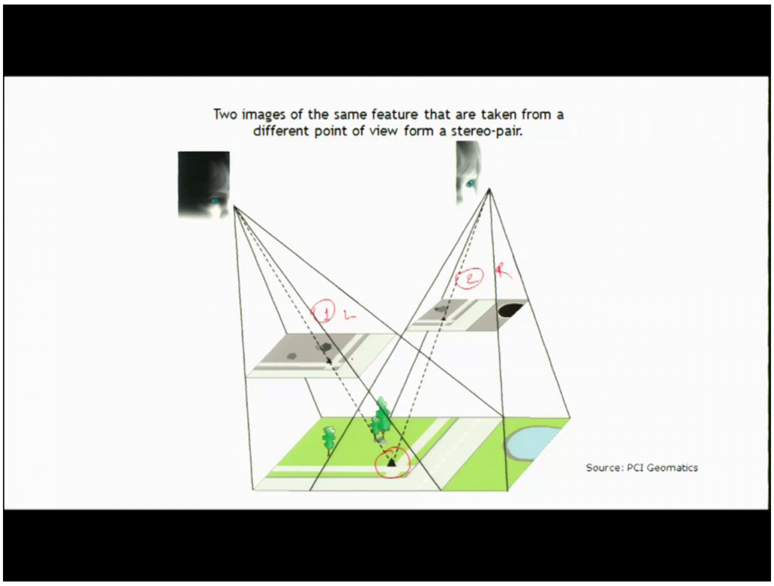

So, here you have an example in which the left eye is seeing looking over this area and the right eye also this common object. So, but we have 2 different photographs number 1, number 2 or you can say left or right ok, but we have this common object or building anything on these 2 photographs.

So, when we see from the left eye and the right eye on these 2 separate photographs, we can an image is created in the in our brain actually. So, that image is called the 3-D vision or this is that will be of course, an imaginary form of this object which you can perceive in 3-D into your brain here is other example.

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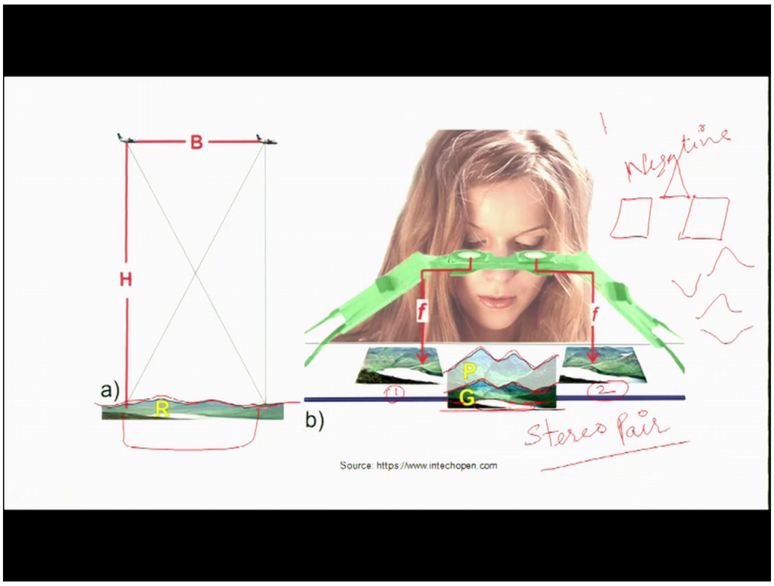

Suppose this is a terrain and undulating terrain of course, so, but how you can see the relief of this terrain? When you see the 2 different photographs of the same terrain taken by a camera onboard an aircraft; So, here these 2 photographs are the stereo pair; so, in this way you will have depth perception what is the meaning of depth perception?

On the single photograph you will also you will be able to see the undulations, but you will not have ability of depth perception until you have a 3-D image of that area.

So, these 2 photographs will give you 3-D image of this area and this part will show like here in this photograph this is a ground level or you can also say this is a datum plane in case of the photographic geometry and these are presenting the highest elevations in this area ok; you can say these are the peaks of hills. So, peaks and grounds you are able to see the depth in this area so, where; which point is higher, and which point is lower.

And this you will learn when you will do your practical’s in which you will learn how to orient the photograph. Because if you will orient correctly then only you will be able to see the correct depth perception; otherwise if you if suppose if you have oriented the photograph in the opposite manner so, then only you will see a depth perception which will be the negative of the real depth real ground variations.

Like in that case the valleys will be expressed in the form of hills and the hills will be expressed in the form of valleys. So, you can say the a negative depth perception negative depth perception.

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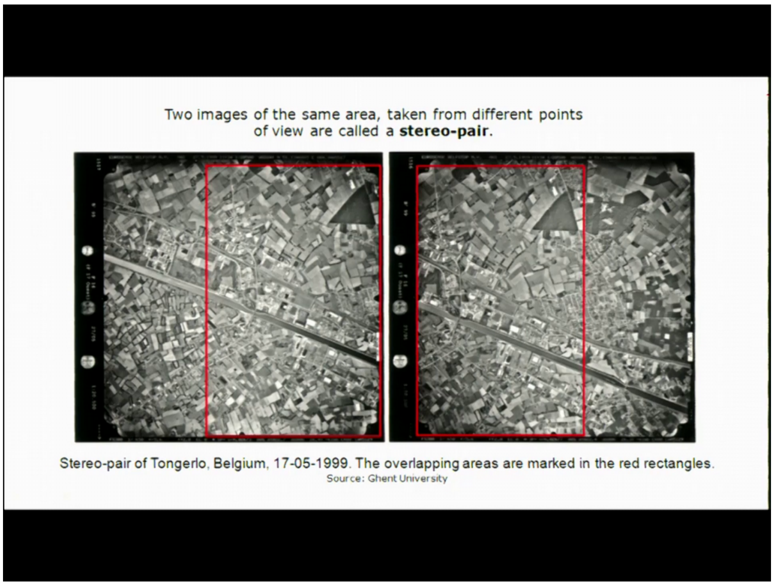

So, here a example of a stereo pair from Tongerio, Belgium. So, in this photograph you can see this much of area covered in the red colour rectangle is the overlap which you can see in 3-D and that is why these 2 photographs are called the stereograph.

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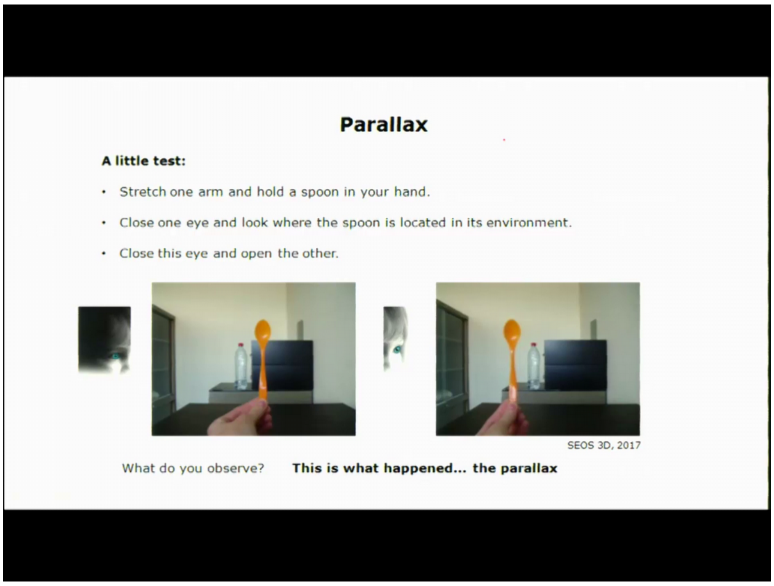

So, here is live practical in front of you; how parallax effect works. You can see when we see this bottle putting behind this spoon and stretch our arm and having this spoon in our hand ok. From left eye we will see that the bottle is on the right side and from right eye we will see bottle on the left side ok.

So, this is the effect of parallax only and this you can see in your daily life everywhere, anywhere. So, this is a very common effect, but most of us do not know ok

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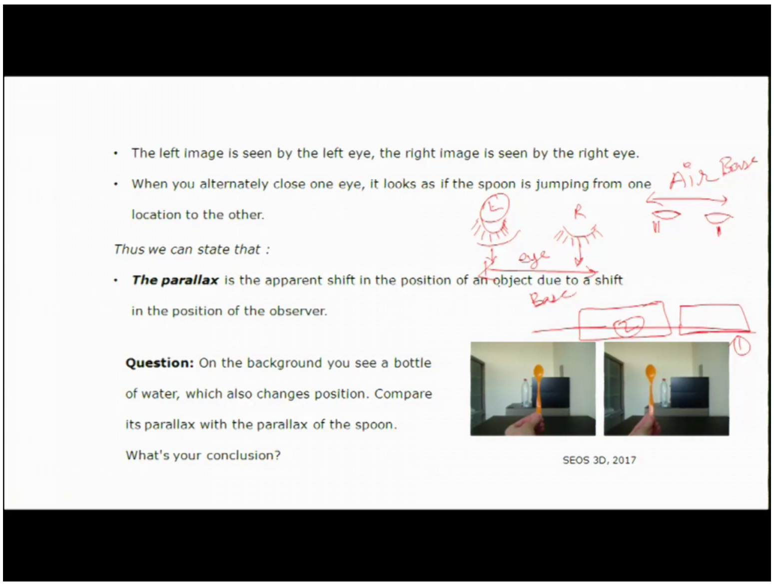

So, the left image is seen by the left eye and the right image is seen by the right eye. And when you ultimately close an eye, it looks as if the spoon is jumping from one location to the other; this is because of the parallax phenomena. So, the parallax it is the apparent shift in the position of an object due to a shift in the position of the observer because in this case; we are the observer we are looking over this spoon; so, we are the observer.

So, because there is a shift in the position of the observer so, in our case we are the observer, but in actual our eye is the observer. Suppose this is the left eye and this is the right eye. So, in this case of parallax phenomena these eyes are the observer. So, when we see on the single eye in that case this the left eye will be observer.

And we close our left eye; so, in that case our right eye will be observer. So because there is an apparent shift in the position of the observer; so, that is why it resulted into an apparent shift in the position of the objects which is putting behind that and why this is so? That I will tell you when conduct the practical's in which I will explain what is the eye base and what is the air base.

Suppose over an area a common area the first photograph is this and second photograph taken by the same camera is this; photograph 1, photograph 2, but at point when the camera was taking photograph on the lens the position of the lens were here, but at point at the time of taking photographs number 2; the position of the lens was here.

So, this is the result of this phenomena is resulted into the parallax because in this case this is the distance between the 2 lenses that if the same lens, but of course, from a different from 2 different positions.

So, in this case this will be your airbase and in this case when we are looking with our eyes left hand right eye, but from they are positioned at different places. So, that is why this is our eye base the distance between these 2 eyes is called the eye base. So, let us move ahead.

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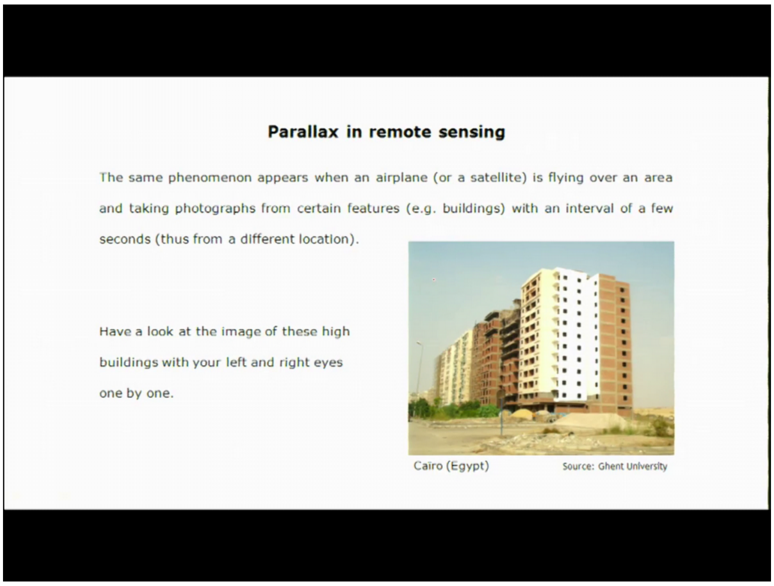

Here an example of a high building from Cairo, Egypt. So, this building; the same building was taken by Ikonos satellite from 2 different positions of its sensors ok. So, the same phenomena appears when an airplane or a satellite is flying over an area and taking photographs from certain features or buildings with an interval of a few seconds does from a different location.

So, there was an interval of only few seconds, but that gap has resulted in to difference in the position of the observer.

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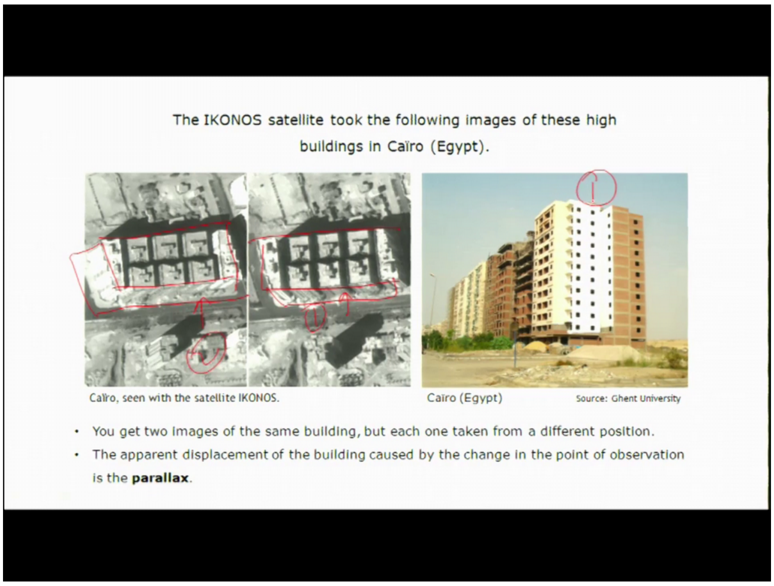

So, have a look over these 2 images taken by the Ikonos satellite sensor having a gap of few seconds, but from the 2 different positions. So, these 2 images; images number 1 and number 2 you can see both images are seen differently.

The shape of this building and the shape of this building is totally different. So, that is the, this is because of the parallax these are the 2 images of the same building here this high rise building from Cairo, Egypt. So, the apparent displacement of the building caused by the change in the point of observation is the parallax.

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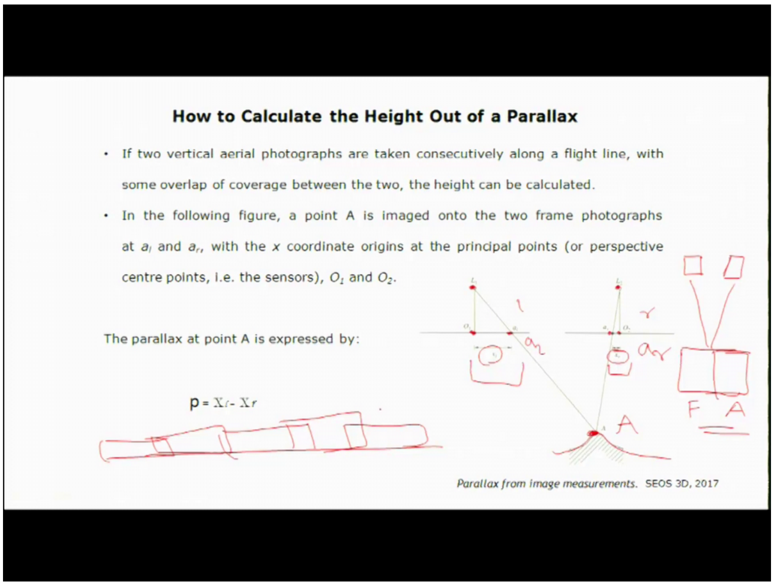

So, let us understand parallax in terms of geometry suppose this is a terrain and we are observing any object that is named as a here. So, we are observing is this object these are our lenses position of the lenses lens 1, lens 2. So, one thing you remember there are 2 types of photography in some kind of photograph is we have 2 cameras mounted at different angle.

So, they are taking the photograph of the same area, but from different positions because they are mounted at a distance over an aircraft. So, in that case we set 2 different photographs forward and afterward ok. So, and in other kind of photography there may be a single camera which is taking photograph of a same plane through flying over here, but with a single camera and it is, but it is having some overlap that is set with the camera aperture timing and the speed of the aircraft.

So, coming back to over this geometry suppose there is a point A object A which we have to observe over this terrain. So, these are taken by the 2 lenses lens 1 and lens 2 here. So, each 2 vertical aerial photographs are taken consecutively along a flight line with some overlap of coverage between the 2. So, then height can be calculated.

So, here in this case point A is imaged on to the 2 frame photographs at a l and a r al means this is for left this is for right al and ar. So, this is a r and this point is a l and these are having the X coordinate origins at the principal points or which is called the perspective centre or the sensors O 1 and O 2 O 1 and O 2; this you may call your principal point also because this is the perspective centre representing it.

In very simple terms we can calculate our parallax by the difference of these 2 points like the distance where this object A is imaged over a photograph here and here. So, in this photograph it is imaged over here and on this photograph it is imaged over here.

So, this is the distance from the your perspective centre or the principal point. So, this your X l and this your X r. So, simply by taking the difference of these 2 lens you can get parallax p is equal to X l minus X r.

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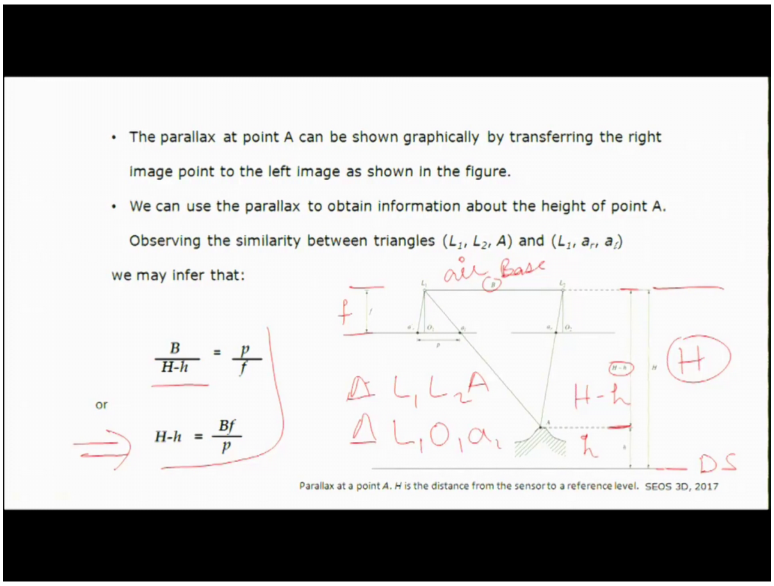

Another very in simple form if you want to have mathematical formula to compute heights or whatever is given to you like eye base or airways or you need to calculate the parallax then you can calculate by these 2 formulas.

Here you can see a very simple geometry which has created 2 similar triangles like L 1, L 2 and A and another triangle is your L 1, O 1 and a l. So, by these 2 similar triangles you can have this formula which is representing that the parallax at point A can be shown graphically by transferring the right image point to the left image as shown in the figure.

And we can use the parallax to obtain information about the height of point A; observing the similarity between triangles we may infer that B your as I explained earlier your B here is what? Airbase because this is the distance between the 2 lenses L 1 and L 2 this is your air base and this is the this H; capital H, you know well that it represents the altitude of the flight from the datum surface.

So, this is your datum surface here; so, this is H and this is the height of the object this h is small h. So, how we can get this length? By subtracting this H from altitude capital H minus h which is given here. So, by taking the similarity in the geometry of these 2 triangles, we can state that air base B by H minus h is equal to B is the parallax divided by focal length where is the focal length?

As you know that from the photographic negative to the distance up to the lens is known as your focal length small f. So, B by H minus h is equal to p by f. So, from here you can derive this formal also; suppose you have to calculate the height of the object in indirect case you can take it here and you can calculate accordingly.

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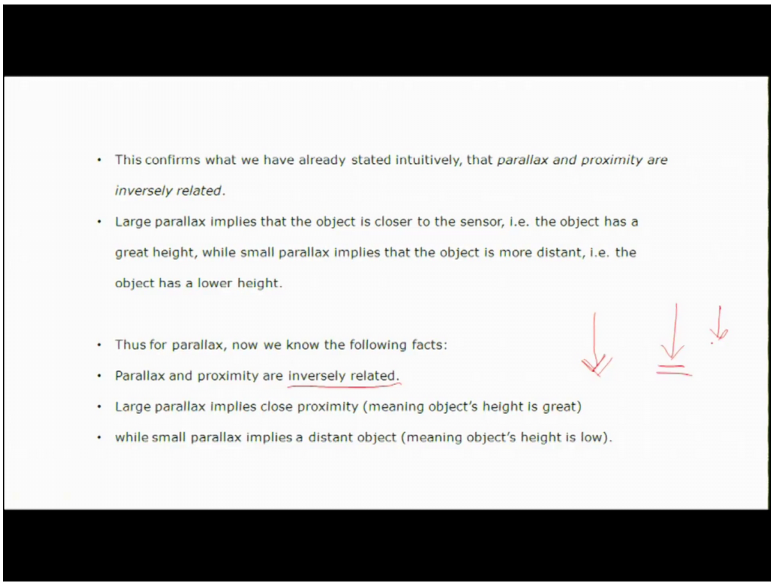

So, concluding this topic what we can do is like what we can conclude is this confirms that the parallax and proximity are inversely related. You know well proximity means the closeness of the object. So, these are inversely related the closer the less.

And the large parallax implies close proximity meaning objects height is great and by the small parallax implies a distant object. So, having an understanding of this topic we will move ahead to over practical's ok.

Thanks.