Laboratory Practices in Earth Sciences: Landscape Mapping

Dr. Javed N Malik
Department of Earth Sciences
Indian Institute of Technology, Kanpur

Week- 08
Lecture- 37

Welcome back. So, in our previous lecture we discussed what is the basic principle behind the GPR technique and different components of GPR, the penetration depth of GPR and now I will be discussing how we can acquire the data into the field. So, currently we will do a 2D profile. So, it is very important before getting into the 3D profile. It is very important that we should take several 2D profiles to get the overall idea of the region. So that we can accurately decide the 3D grid where we have to take the data and where we have to map the subsurface near the subsurface region. So, now as you can see we have adjusted the parameters.

So, now as you can see we have adjusted the parameters the mode is 2D and now we will just click on the start scan. So, we will be taking a profile of around 10 meters from here. So, we will take a vacant space, a chamber , and a vacant chamber within the subsurface. So, we will try to target that currently.

So, we will take a 2D profile while going from here and while coming back from here. So, from there. So, there will be 2 profiles. So, we can correlate the data of both the profiles and we can verify that if the data is not due to some other kind of noise or any kind of other feature. So, we will take 2 profiles while going from here and from by while coming back from there.

So, now as so I will start the profile by pressing the start scan. So, you can see now the real time mapping of the subsurface has been stopped and you can see this is the horizontal distance that is the distance of the ground that we can see this is 0 1 2 3 4 that will be the data that we will be acquiring while creating the while taking the profile and this is the depth. So, we have taken it up to 4 meters. So, now I will have to always keep in mind that you have to push or take the GPR unit very slowly. So, that the transmitted and the received data can be caught by the receiver otherwise if you move it very quickly or fast then the transmitted electromagnetic waves will not be able to be detected by the receiver.

So, it is very important that you move very slowly while taking the GPR survey. So, now I am just. So, now you can see as I am moving the cart the data is being acquired. As I am moving the GPR unit the data is being acquired. So, this is the real time data that you are

able to visualize and as we will cross this chamber.

You can see. So, as soon as we have crossed the vacant chamber you can see that this is the portion where the empty chamber is present. So, you can see on the screen that part of this air-filled chamber that is vacant is shown by a black region throughout the depth. So, we will repeat the profile by taking it once again in the reverse manner. So, I will stop the scan here.

Here where there was the start scan there is also a tab of stop scan we can I will press this. So, this profile has been stopped. So, we have taken one profile while coming from the initial point. It is very important that you mark the initial and the final position while taking the profile. So, now, I will replay the profile that we have taken. So, we will click on the playback mode and you can see that we have taken one profile.

So, I will check on this folder and press the tick button. So, you can see the overall profile has been taken. So, from there from the initial point to the final point it is around a 9-meter profile and at the horizontal distance of around 5.2. So, if you touch the screen,

So, if you can, just the crosshair will be shown and you can easily know the depth and height depth and the horizontal distance that you want to see. So, the horizontal distance from the initial point is 5.15 for this airfield chamber and the width of the chamber is around 3 meters approximately and other than the chamber we can also identify and identify few other utilities. So, as you can see there is a hyperbola that we can see over here. So, you can see a hyperbola that is this hyperbola.

So, this hyperbola actually gives the signature of the underground pipe that we can encounter. So, similar hyperbola we can also find here this is also hyperbola which is also for this we can also interpret as a pipe. So, there are two pipes that I can see as of right now and there is a gas field chamber. So, the hyperbola signature for the cylindrical pipe is like when. So, the hyperbola the logic behind the hyperbola signature for the cylindrical metallic pipe is that when the electromagnetic waves propagate from the pipe.

So, suppose this is our cylindrical pipe and we are crossing the GPR unit across this. So, the electromagnetic waves at the side of this pipe will take a higher time duration than the central portion. So, this will take more travel time to reach to the receiver and the crest part of the pipe will take a short time. So, the travel time is based on the travel time you can get a hyperbola symbol on the radar gram. So, that is why we are getting a hyperbola signature for which we can interpret as a hollow cylindrical pipe within the radar gram and this whole this is a chamber that we can encounter.

So, now I will repeat the same profile while going from the final position to the initial position and thus the profile that we will correlate from the profile that we took previously. So, to confirm the presence of the utilities. So, I will stop the playback and now we can go to the collect mode. So, we will get back to the collect mode in which we can acquire the 2D data. So, this is the collected mode.

So, you can see that now real time data will be taken through this mode. So, now as soon as I press the start scan the scanning that the scanning will be for the 2D profile will start. So, gently slowly I will take the unit and I will move it along the same path that we choose. So, now you can see on the display once again the hollow chamber has been encountered and till here the chamber was there and it has been now over. So, you can as I have seen that while taking the profile also you can see that there is a hyperbola that is coming.

So, we can mark the position over here for the interpretation part that we have encountered a utility pipe over here. So, we can mark the location here by putting some color on the ground or we can mark it manually. And now I am moving further away. So, the total profile was around 9 meters and similarly the second hyperbola has also arrived here. So, that means in both the profiles we are getting the correct data.

So, 9 meters has been completed. So, I will stop the scan. So, we have taken the second profile. So, to access the second profile we will once again go to the playback mode and you can see a second profile has been generated over here. The second file has been generated. And so, there is a check box that we have to select and we have to click on this part.

So, you can see to go to the full screen once again you have to click on the playback file. So, you can see the chamber was there over in this portion and so if that profile total was 9 meters that we took while going from the initial position to the final position. And the chamber that we encountered was from 5 meters at the horizontal distance from the initial point from the first profile. And so, by back calculating it was around 3 meters. So, our chamber was from 5 meters to 8 meters in the initial profile and by looking at that the profile should start at 1 meter from here the chamber should start from 1 meter and it should get over at the 4 meter.

So, as we can easily see that it is starting from 1 meter and it is getting over at 4 meters and other than that we can clearly see the hyperbola structure over and over. So, a similar kind of profile has been generated. So, that means the noise value or the signal that we have encountered is from the utility and not from other kinds of noise. So, now I will show you how we can see how we can acquire the 3D. So, I did the 2D acquisition of the data.

Now we will acquire the 3D data using the 3D mode which I have mentioned earlier. So, to go to the 3D mode I will just stop playback and system options, then system shutdown and I will close this application and go to the start screen. So, this will close our 2D data profiles and now we are back to the start screen. So, once again I will press A1 and I can change the mode using this tab. So, initially it was 2D, now it is 3D as you can see and now I will create a new project and I will create a new data path and give it a name lab practice 3D.

So, now you can see the file has been generated and the name of this is lab practice 3D greed 1. So, we can take several grids. So, I will design a 3D grid for our 3D data acquisition. So, the signal process is the same as 2D that I have discussed earlier. We have to just define the 3D grid.

So, you can see there is one mode that has been added over here. So, I will go to the 3D mode and in 3D mode we can configure the grid. So, you can see that we have to configure the grid. So, the grid mode shows that there is X start, X end, Y start, Y end and the spacing between the X line and the spacing between the Y line. So, what we can imagine is like so for 3D mode. What we can imagine is a grid like a coordinate system, a 2D 2-dimensional coordinate system in which we have X coordinate and Y coordinate.

So, suppose we want to create a grid of 2 by 2 meters. So, for that and the interval for each meter should be one the offset between the grid should be 1 meter. So, the grid size will be we will give the X is equals to 2 and Y is equals to 2 and the offset will be of 1 meter. So, it will create a 2 by 2 grid with a mark between 1 1 meter. So, that is the spacing that is how it is getting configured.

So, I want to create a 2 by 2 grid. So, X start will be 0, X end will be 2, Y start will be 0 and Y end will be 2. So, now you can see the system has generated a 2 by 2 grid having a spacing of 1 meter the X spacing and Y spacing is 1 meter. So, as you can see this is the 0 0 coordinate that means X is 0 Y is 0 over here. So, we have configured the 2-3D grid of 2 by 2 meter having a spacing of 1 meter on the system and similarly, kind of grid we have also marked on the ground as you can see this is also a 2 by 2-meter grid having a spacing of 1 meter in X and Y direction. So, now we will keep this unit on the initial position and it is very important to know that the initial point always should be correlated to this point.

This is the initial starting point of the profile. This mark has been given. So, this is the center point of our transmitter and the receiver. So, our profile should always start from this point and not from the beginning of the cart, but it should be from the center point of the cart. The mark has already been given on the cart.

So, I will adjust so that our central part is matching with the marking and we will start the scan. So, as soon as I start the scan it will show that we are going to cover this part of the profile. So, as soon as I click on the run tab, so it will you can see the profile is getting generated and as soon as 1 meter will be completed this 1 meter has been completed and we can correlate it with the ground also and as soon as the 2 meter will get completed it will automatically get over. So, now you can see this profile has been taken.

We have taken one grid. So, now I will go to the second position. So, now I have moved the unit to our second profile and I will press the run tab and it will start taking the second profile from the x direction. So, now it has been completed. Now initially I will once again take the profile to the final x position and I will press the run tab. So, it will take until we have completed the x direction profiles.

Now I will get back to the 0 0 location of the profile. So, now we will take a profile in the y direction. So, now the y direction profile is being shown. So, as soon as I did so I brought the unit to the 0 0 initial location. Now we will take the profiles along the y direction.

So, as you can see in the screen the y direction has been now shown. So, now we will press the run tab and this profile is getting captured. So, one profile has been taken. We will get back to the second y position and press the run tab. So, this will start taking the second profile and now we will take the third profile third and final profile which will complete our 3 D total grid.

So, I will press the run tab and. So, now we have seen that we have taken the. So, now till now we have taken. So, we can see over here that in the grid 4 total 6 in the grid 4 grid number 4 total file number are 6. That means, we have taken 6 files.

So, I will go to the playback mode and we have. So, we have taken the data into grid number 4. So, we will select it and as we can see there are a total of 6 profiles that are getting loaded and you can playback files. So, individual files you can go you can select. So, this is file number 1 and next file this is file number 2 next file number 3 next file number 4. Similarly, we can see that we have taken 6 total files of 2 meters each.

So, now I will go to the playback mode. Now if we want to see the overall animated profile. So, we can go to the z slice and we can. It will get loaded and you can see that overall profiles that have been taken have been . Now you can see from 0 to 2 meter it is getting varied and from 0 0 meter to 2 meter it is getting an animated ah on the screen. So, you can visualize the data and you can also ah see that you can also take the ah x slice or y as we have taken the z slice we can also ah take the x and y slices ah we can animate the x and y slices. So, if you want to go to the y slice you can see. So, you can animate all the layers

using this similarly you can go to the x slice.

So, you can see all the profiles are getting animated and you can visualize the same ah individually and using the ah grid mode. So, ah we have seen how we can acquire 2D and 3D data ah through ah using the GPR technique and you can easily detect or image the near subsurface ah region up to a depth of 4 meter and if we will reduce the frequency. So, there are other unit's ah that are of 100 megahertz and 200 megahertz from which you can attain a depth of around 20 to 30 meters ah and similarly you can go to the deeper level of the ah data. So, ah now ah further we can also process the ah data using the Radan 7.

So, if time will be there. So, we will also show if there will be time. So, we will show you how we can process the 2D and 3D data on the Radan 7 software to reduce the noise and to enhance the data. So, I will stop here and we will get back to the next lab. Thank you.