GPS Surveying

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Lecture - 18
Procedure of GPS Surveying- III (Processing & Report Preparation)

Welcome friends, today is the eighteenth lecture for the course on GPS surveying. Today I am going to discuss on the concluding part of procedure for GPS surveying. Now as you know to ensure the standard output from GPS surveying we need to carry out GPS surveying with proper planning and efficient execution of different sets of operations. Now, in order to do that, we need to follow some standard procedure consisting of planning, preparation, field observation, GPS data processing followed by report generation.

Now, of these 5 steps already I have discussed the details behind the procedure step of planning, preparation and field observation. So today I am going to discuss on how to carry out the GPS data processing and to generate the report of the GPS surveying. Now during field observation or field operation stage we have concluded that we can carry forward our GPS surveying once we are satisfied with the quality of the GPS observables as the quality of the GPS observables satisfy the requirements of the projects, we do store the field observation data in some storage devices, may be also in the office computer.

Now once it is available in the office computer means it is available in the form of files; now the next step of GPS surveying that is data processing has to be started.

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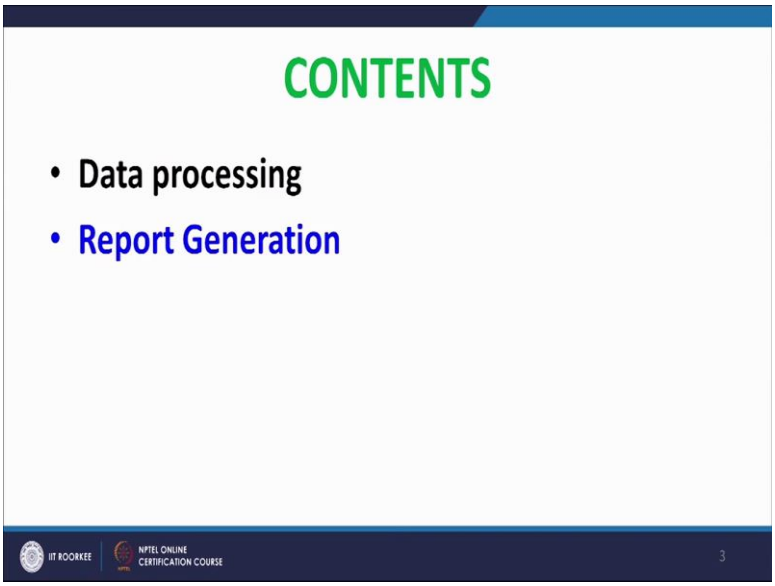

Now in order to carry out data processing we need to follow (Refer time: 03:00) following steps. First, we need to download the data or import the data to the processing software, then we should go for many pre-processing operations to improve the quality of the GPS surveying still better and then we should go for processing of the data followed by final quality analysis of the output from GPS processing data.

Now, to import or download the data from the storage devices the GPS processing software most of the GPS processing software has the module to download the data from the GPS receiver or to import data from files. So it can be done quite easily, only thing we have to take into consideration that whatever data we are trying to import or download that the format of the data should be compatible to the processing software otherwise the data that is available, GPS data that is available may also be converted to Linux format and Linux format may be imported to the concerned processing software and most of the processing software has the capability to import Linux data and to convert into the format which is compatible to that particular software.

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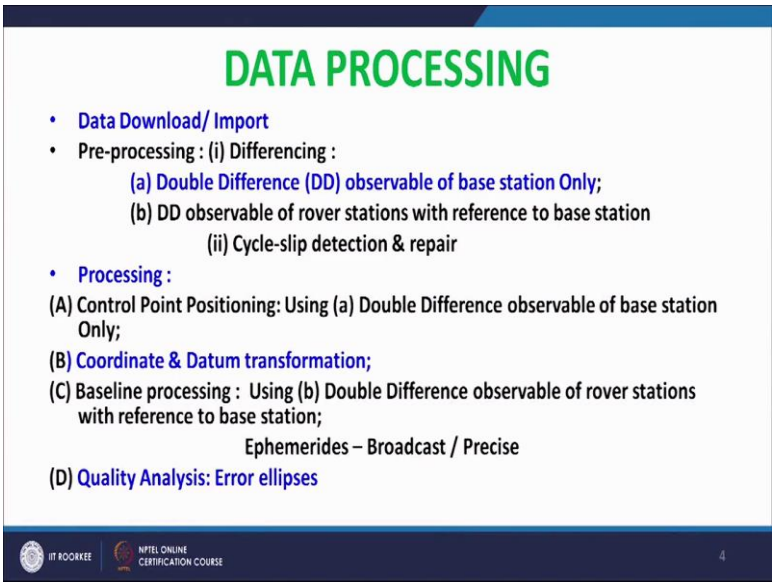

After that we should go for pre-processing operation, already we have discussed in few classes that there are different pre-processing operations that we can do. That the primary objective of the pre-processing operations is to minimize the amount of errors that is available inside the GPS observables and most of the errors can be minimized through differencing operations and we know that there are 3 types of operations; differencing can be done that single differencing, double differencing and triple differencing.

However, it is the double differencing which we generally make use for further processing. Now for processing purpose we should go for differencing in two particular ways, one is that we should take the data of the base receiver only and to carry out the differencing from that data. That means data from single receiver will be further undergone double differencing. So, that particular type of double differencing we need to do for base data and for other data also we should go for double differencing but in all those data; that means, all lower data has to carry out has to undergo double differencing operations with reference to base data.

So, this is what particular thing we have to keep it in mind that while we will be carrying out the differencing operation in first case we will carry out the double differencing for the base data only, in the second case we will carry out the double differencing operation for lower data with reference to base data only. Now also we should carry out circle slip detection and repair as we have discussed in the pre-processing operations that it is the

triple difference data where we can detect the presence of circle slip and the location of circle slip. So, we should go for the differencing of the data and to identify the circle slip, location and corresponding data has to be taken out from our observation data. One more thing which we need to do that is called (Refer Time: 07:46) and that is to be done for processing of phased observable data only because ambiguity is related to the phased observable data.

Now, for these double differencing or circle slip detection or for ambiguity resolution there are well developed modules available in processing software so we can directly go to that module and we can click the or we can invoke those part of the software to carry out these operations. So, once the pre-processing step is over we expect that our data is now of better quality than it is available in the time of import. So, also at this stage we can go for some quality testing as we have seen in case of raw data quality testing. So, those same operations or same criteria can be tested of (Refer Time: 09.08) the pre-processing operation and to see whether the quality has been improved or not.

It is expected that the quality is improved, if it is not then we have go we have to look inside the observables, we have to list the data, we have to find out the possible locations or possible observables which are creating problems to the pre-processing operation or which is not providing the better quality of pre-processing and those has to be removed and that is the very rigorous process and tedious process also. So, we have to improve the quality we need to do that thing (Refer time: 10:00). After we have done the pre-processing operation next we should go for actual processing.

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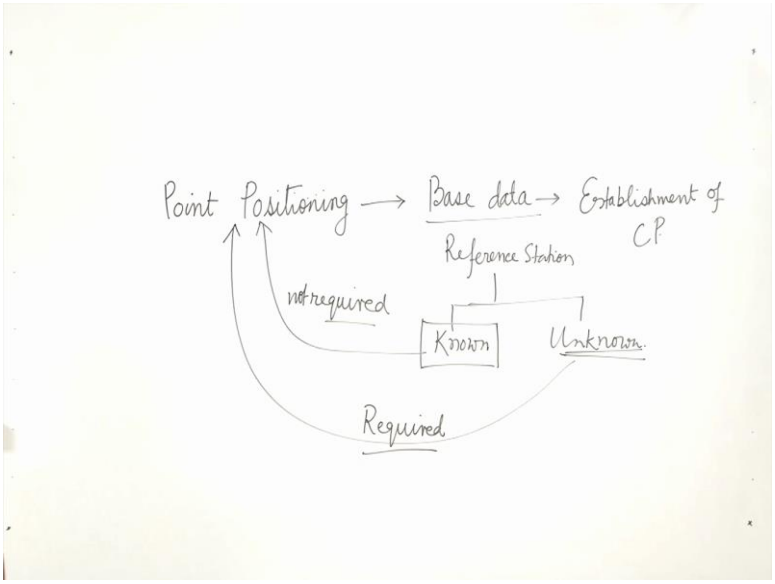

Now processing of GPS data which again will be of 2 fundamental categories at this stage that is called first one will be called point positioning. Now for the base data we do go for point positioning and that will be lead to the establishment of control point. Now there may be two cases, one is that the base data is placed on a reference station. Now the reference station may be known or it may be unknown. So, if it known then we need not go for any point positioning, not required; but if the reference station location is unknown then we should go for point positioning. So, point positioning will be required to establish control point if the location of reference station is not known.

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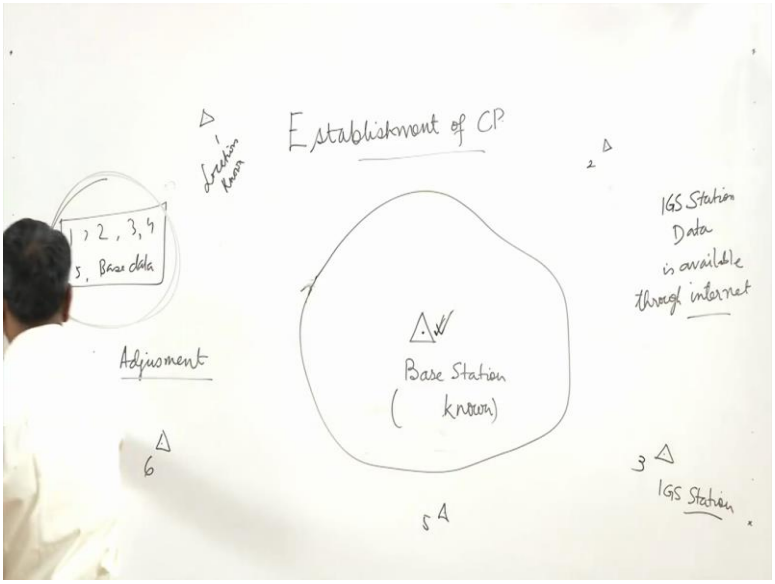

Now in order to carry out point positioning for establishment of control point, suppose this is the base station, in this case we need to download the data from many other stations that is available all over the world, these are IGS stations. So, many IGS stations around our base stations as it is available around the world it can be will be downloaded from the internet. The data IGS station data is available in the internet.

So, once these data are downloaded then we should process these, all these 1, 2 suppose 5 stations around our base station data has been downloaded. So, so what we have to do, we have to 1, 2, 3, 4, 5 and base data; all these data has to be processed together with the post-processing software and since these stations are IGS stations their locations are known, locations known so with respect to these known locations the location of this can be find out and once it has been find out that is called establishment of the control point.

So, now for all area for the area to be surveyed this is now once it is established now it is known. So, it became known. So, this is what is called point positioning and in doing this actually we make use of double differencing data not only at the base station data also the double difference single station data of all. So, that will provide us better solution. Now the coordinate that we will get all in this method will be either X Y Z or lambda of 5 lambda h, but both are in W G S 84 coordinate system.

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So, as the coordinates of these base station is available in the W G S coordinate systems, but we may be interested to carry out our field mapping or field work or we are interested to have our (Refer Time: 16:32) in some particular system, system of our interest some local system like for our India we like to go for Everest 1956. So, if you remember in my previous class in one of my previous classes I discussed you the positioning and its transformation. So, in through that the planimetric position X Y or phi lambda we can convert it to our local system and our h can be converted to orthometric height by using a parameter called geodetic undulation.

So, this is what we have discussed in my previous class please refer to that class. So, by referring to that class we can, you will able to understand that now the W G S 84 coordinate system that coordinates of the base stations is converted to our desired system. So, if we convert the base station coordinate in the beginning itself then during further processing we will provide the location of this station as the input in the desired system, then the coordinates of all other points we will get in the desired system. So, this is the idea. So, I am suggesting that the coordinate and datum transformation better be done when the base station has been processed and its coordinate has been found.

After that we should go for processing of base data as reference. We should take base data as reference and rover data. So, we have to take together all these data in a file and we should go for this, processing of this called the baseline processing. This baseline

processing there is another module available inside the GPS software which is called baseline processing. So, now we can make use of that module to process the rover data using base data as reference data, there we will select the base data as the control point and we will provide this input location some X some Y, whatever it is X Y. Suppose this is the coordinate we got in the local coordinate system and we will provide this as a input as a result of which all the point that has been collected, all the lines different information we have collected through rover station or through rover receiver that we will get in the desired system.

In this case, we have generally we have taken the broadcast ephemerides. Now if we want to end up with still better solution we have to process the data using precise ephemerides. Precise ephemerides are the ephemerides which is available again in the internet. So, we have to download the precise ephemerides for these stations for which the base data and rover data has been taken and that precise data will be available only after 3 days, 5 days, 7 days, 9 days and 15 days in the internet. So, if we carry out the processing after 15 days then we will end up with a very good ephemerides data for precise ephemerides data and using that data precise ephemerides data if we process the base data and reference data then we will end up with more accurate position.

So once we have done this processing work we need to see what is the quality of our processing and that is as we had discussed in the last in the class number 15, quality analysis by root mean square error for the point position and root mean square error by for point positioning and for base line parts per million we can see what is the value for the different points and what is the standard criteria this has satisfied. Whether the standard criteria that is satisfying our points and lines are within the objective of the project work or not. If it is, fine you should go for preparation of your map using these data or if it is not then we have to go back to the data and again we have to see the processing strategy, we have to look into different other aspects and we should do the thing there are. So, many intricacies are there which you need to do and we can input that result. And in worst cases you may be need to go back to the field and retake the data.

So, in that way I can explain what is the data processing how to do it and what are the points to be considered for GPS data processing. So, once the GPS data processing is over then we have our parameters that are required out of GPS surveying is available

with us and which may further be taken for our mapping purpose to the mapping community. But before we end over the results means output from GPS data processing we need to prepare a well-informed report to be accompanied with the outputs of GPS data processing. So, that is very important steps because this is what we will help in preparing the proper map as well as to identify if there is any mistakes or if in future there is a need to go for further GPS surveying then that can be carried out.

Now, salient points which should be incorporated in the generation of the report, I like these that in the report first we have to write down what is the objective of the surveying work and what is the standardized standard specification requirement, what is the requirement of standard specification for that particular project. Because that will guide the quality of the work, then we need to tell about the geography as well as geomorphology of the area. All the base maps or images that is available for the area has to be included with the report along with the markings which we did during the reconnaissance or actual field surveyor.

We should also give the location of the control points and if any monuments has been constructed there all specifications as well as other detailing of the control points, then we should tell about the different methods that has been actually implemented; what are the different types of receivers that we have used, what are the different types of field data or field actual information we have recorded in a paper or in a record book that has to be accompanied. Then we should also inform about the different processing schemes or processing strategy that has been implemented, we should also inform about the quality of the raw data which we did during our data collection or field operations those has to be mentioned. Then we should also inform the final coordinates, final locations of the control points along with the level of uncertainty. Also we need to tell about the project statistics; because one will be processing the data we will be generating the lot of statistical data about the GPS data.

So, all those statistical information has to be included along with the report then original log of the report or the and finally if the instrument malfunctions then the durations we have to mention in the report. So, and finally, any other important point which has not been covered under these (Refer time: 27:00) particular point has to be included along with the local tie stations.

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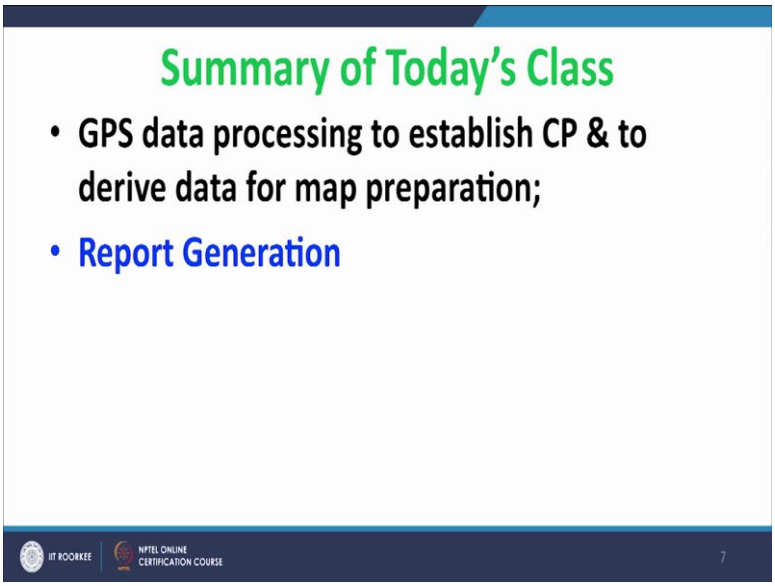

So, these I would like to conclude about the GPS surveying procedure and before concluding this class I would like to summarize about the about today's class that after we had stored the GPS data having met the field quality of the data, the data has to be imported to the post processing software for further processing. The processing consisting of in office processing of GPS data consist of pre-processing followed by processing and under processing we need to first establish the control point then that control point need to be transformed to datum transformation or as coordinate transformation as per the system which we will be following for our mapping.

Then once the control point has been established we should go for baseline processing using the base data as the reference data and rover data as the base data as reference along with rover data. So, once the baseline processing is over then we should go for its quality assessment and the quality of GPS processing is being just by a system known as error ellipse which we have discussed in a last class. After the output made the standard quality or as per the need to the project requirement we should go for a detailed report generation.

Thank you. See you in the next class. In the next class I am going to demonstrate the field observation. I will take the field observation which will be demonstrated in the class.

Thank you.