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Topographical Mapping of Lychee Orchards Using Beidou-2 China's Global Navigation Satellite System

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Abstract: Global Navigation Satellite System (GNSS) refers to a constellation of satellite's which provide signals from space and then transmit positioning and timing data to its receivers. Then receivers use that data to determine location. Nowadays, GNSS is used to determine precise locations all over the globe, in any weather conditions and at any time of the day. GNSS geodetic surveying equipment has become smaller and easier to use being faster to use than other surveying methods. GNSS is specially used for large topographic surveys where a centimeter level accuracy is enough. Therefore the study was conducted on lychee orchard, farm of CEWRI field station at the National Agriculture Research Centre (NARC) Islamabad. The total area comes to about 2.15' acre after taking all elevation points from receiver. The map was created.

Keywords: GNSS, NARC, and Pakistan.

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INTRODUCTION

The BeiDou Navigation Satellite System (BDS) has been independently constructed and operated by China with an eye on the needs of the country's national security and economic and social development. As a temporal-spatial infrastructure of national significance, the BDS provides all-time, all-weather and high-accuracy positioning, navigation and timing services to global users.

In today's world, there are two Global Navigation Satellite Systems (GNSS) which are fully operational working around all over the world to provide all guidance about weather 24 hours around anywhere on the earth, It is the collection of systems and they use satellites to know the exact location of a point where receiver is being fixed (Earth-centered) coordinate system and in order it has becoming a positioning system of a choice for the agricultural technologies. Bellow this we are shortly described about current six main purposes of GNSS uses in Agriculture:

- Yield monitoring
- Compaction profile sensing
- Tree planting fumigant applications
- GPS based mapping and surveying

- Precise weed management system
- Robotic applications

Problem Statement

Land Surveying is a technique and science of accurately measuring the distances and angles between different points, on the surface of Earth. GNSS has been used by land surveyors since the late 1980s, primarily for geodetic control networks and for photo control. Nowadays, GNSS is used to determine precise locations all over the globe, in any weather conditions and at any time of the day. GNSS geodetic surveying equipment has become smaller and easier to use being faster to use than other surveying methods. GNSS is specially used for large topographic surveys where a centimeter level accuracy is enough.

METHODOLOGY

Study Area

The study was conducted on lychee orchard, farm of CEWRI field station at the National Agriculture Research Centre (NARC) Islamabad, having a geographical location of 3727702.903 North latitude and 327398 East longitudes, and the elevation point of our benchmark is 467.026. The total area comes to about 2.15' acre.



Figure 1

Description of Equipment

- **T300 plus receiver** (electronic devices that receive and digitally process the signals, from the one our surrounding satellites around the globe with the help of antenna and turns into measurements that we can understand ,On dual antenna systems they are usually called as ‘primary and secondary receivers’ to provide the position of the user which is settled on benchmark known as base/primary receiver and another which is used for collecting elevation points is known as Rover/secondary receiver.)
- **Lithium-ion batteries** (Rechargeable batteries used to operate receiver)
- **Whip antenna** (basic function is to receive the signals from the satellite and pass to the receiver, or we can say it facilitate the receiver to catch the signals from the satellite, and it work in internal radio base mood)
- **30cm Extension bar/rod** (extend the height of tripod)
- **GNSS connector** (used to connect antenna with the receiver, varies in different sizes based on the type of receiver.)
- **R500 android data collector** (simply a android device which use radio waves between satellite and a receiver inside your phone, to provide location and time information which we use in our work, the GPS receiver of that device use the data from these signals and triangulate where the work is being done and what time it is.)
- **Controller bracket** (used to mount android device easily on the staff rod)
- **2m range pole/Staff rod** (in which Rover/secondary receiver is fitted on the top and the data is collected in m/ft)
- **Box** (use to collect the parts of equipment, easy to carry out all the parts of equipment)
- **Tripod** (it is a three-legged frame or stand, used a platform for supporting the weight and maintaining the stability of the object/ tribrach).
- **Tribrach** (it is a surveying instrument, mounted on a tripod which will help to collect a bench mark or known as a base point and at the top of the

base/primary receiver is mounted on a certain point and the other receiver collects the data from the field, and this base receiver will help us to understand that what is difference between this point compared with the all other points noted on data collector with the help of Rover).

- **Android Software** (Survey master software used to connect base and rover and making of all the project work will run in this).
- **H.I Tape** (used to measure the height of the instrument)
- **Lemo Cable** (used to transfer the data from device to PC)
- **Google Earth Software** (Google Earth is a computer program, formerly known as Keyhole Earth Viewer, that renders a 3D representation of Earth based primarily on satellite imagery. The program maps the Earth by superimposing satellite images, aerial photography, and GIS data onto a 3D globe, allowing users to see cities and landscapes from various angles).

ADJUSTMENT OF EQUIPMENT

Setting up tripod

- Open the tripod cover and take out the instrument from the cover.
- Open the tripod legs enough to stable the instrument.
- Locate the tripod directly over the station point. To check the tripod’s position, look through the center hole in the tripod head.
- Tightly press the tripod ferrules into the ground.
- Level the top surface of the tripod head.
- Securely fasten the thumb screws on the tripod legs.
- Place the tribrach on the tripod head.
- Insert the tripod mounting screw into the center hole of the base plate of the instrument.
- Tighten the tripod mounting screw.

Centering/Benchmarking point

- Align its central axis precisely over the station point. To center the instrument, you can either use the optical plummet

- Set up the optical plummet on the tripod, (The optical axis of the plummet must be aligned with the vertical axis of the instrument.)
- While looking through the optical plummet, align the reticle with the station point. To do this, turn the leveling screws until the center mark of the reticle is directly over the image of the station point.
- While supporting the tripod head with one hand, loosen the tripod leg clamps and adjust the lengths of the legs until the air bubble is in the center of the circular level.
- Tighten the tripod leg clamps.
- Use the plate level to level the instrument
- Look through the optical plummet to check that the image of the station point is still in the center of the reticle mark.
- If the station point is slightly off center, loosen the tripod mounting screw and then center the instrument on the tripod. Use only direct movement to center the instrument. Do not rotate it. When the instrument is centered, tighten the mounting screw

Leveling

- Make the vertical axis of the instrument exactly vertical. To level the instrument, use the plate level.
- Loosen the upper plate clamp.
- Rotate the alidade until the plate level is parallel with any two of the leveling screws (B and C).
- Use leveling screws B and C to move the bubble into the center of the level.
- Rotate the alidade approximately 90°
- Use leveling screw A to move the bubble into the center of the level.
- Repeat Step 1 through Step 5 to center the bubble in both positions.
- Rotate the alidade 180°. 8. If the bubble in the plate level remains centered, the instrument is level. If the bubble moves off center, adjust the plate level.

HOW TO OPERATE THE EQUIPMENT

Base set up

- In first fix 30 cm extension bar into the tripod and tight the bar using rotating it and make sure that it will be fix correctly
- After that takeout the rover from the equipment box and add attach 2 batteries in the primary/base receiver (make sure that both batteries are fully charged)
- Then fix that receiver on the top of that bar and rotate him properly
- Now fix the whip antenna in that receiver and tight him
- Now start the receiver by pressing the power button

Rover set up

- Take 2m range poll/rod
- Fix bracket at waist level on 2m range poll/rod
- Fix R500 DATA collector on bracket

- Put batteries in the T300 plus rover
- Fix T300 plus rover on the top of poll
- Set Height of both receiver and rover to 1.8 m using inch tape
- Fix antenna on rover
- Press the power button and make sure that rover is on

Set up Internal Radio Mode via Survey Master Software

- Go to survey master software by opening it into R500 data collector
- Open your existing project if you have remaining project if not then create now project
- Give a name to your project as u want
- If you have remaining project, then select EXISTING PROJECT if not then select DATUM
- Now select the datum of your country, and our country DATUM is WGS84.
- After that check your user defined datum, find your local ellipsoid and projection and enter proper parameters
- Select user defined option and go to ellipsoid and select WGS 84
- Then go to the second option which is PROJECTION
- Click the projection option and set your zone with the help of Google map by clicking the map option settled aside with that, and press ok
- After that press another OK, you will come back to main menu now your project is ready to use.
- In main menu scroll the screen left and you will see a option name titled as CONNECTION
- Open that option and select the option which is named as TARGET OPTION
- By clicking this you will see the device name with their code number
- The code number which comes on your screen in Bluetooth option, match that number with the code number of your RECIEVER, which is already written on that
- By clicking it a option comes on your screen, he will ask you for your permission to pair your device with the receiver, just allow it to pair
- After that you will see that your device is connected, and bellow that you see that 2 options are available one is cancel and the second one is setting option
- Click on that setting option and the device will ask you for CURRENT MODE of your device, and your current mode is BASE so just click on it
- Then select the internal radio base mood and bellow that APPLY that option
- After applying that start your base station
- See the current status of your receiver at below the right side of your device it the BASE is written on it then your base is successfully connected with your device
- After that close the Base receiver

- Then open the Rover and similarly go to data collector device and go to connection option
- Once again target your device and connect the device with similar code which is written on the rover, and pair with it
- Then go to setting option Select the Rover option and select INTERNAL DATA LINK TYPE, transparent frequency, and the same frequency with the base

How to Collect the Readings

Now we know that our base point is managed and the current status of our in our data collector device is fixed it means our instrument is ready to use, Now take your rover and go to the field place the rover on that point where you need to take the elevation points these points are continuously saved in your UTM software, Whenever you want to end the survey or delayed it you can easily let it there, and after some time if you need to continue your existing work you can easily starts from where you leave.

How to Transfer Readings, and Creation of Map

After completing your research/ taking all points which we need simply go to the homepage of the UTM app and open an option named as export, connect device with another android device with Bluetooth or transfer that data via data cable given in the instrument

- Select 3s time for taking any point if u want another option u can manage it.
- Then CONFIRM it and select the SAVE option
- In final APPLY the internal radio rover mode
- Start your survey work when getting fixed solution
- Check bellows the right on your device your current status is showing as FIXED means now your instrument is ready to use.

box, (you also can save it into the android data personal storage), we export these data in KML format to easily open that data in Google earth software.

Open Google earth software and open files from your pc take these data from where you save it and it shows you all the points which you take in your work, and it gives you a 3D representation of Earth based primarily on satellite imagery.

The program maps the Earth by superimposing satellite images, aerial photography, and GIS data onto a 3D globe, allowing users to see cities and landscapes from various angles.

RESULTS AND DISCUSSIONS



Figure 2

All elevation points taken from the field. (Some discussion about datum) latitude or longitude heights are in terms of a “Global co-ordinate datum” which in most modern cases is synonymous with the WGS84 datum. A Global co-ordinate datum approximates the entire globe. Local latitude or longitude heights are in terms of a “Local co-ordinate datum” which is a datum that is a regional best fit,

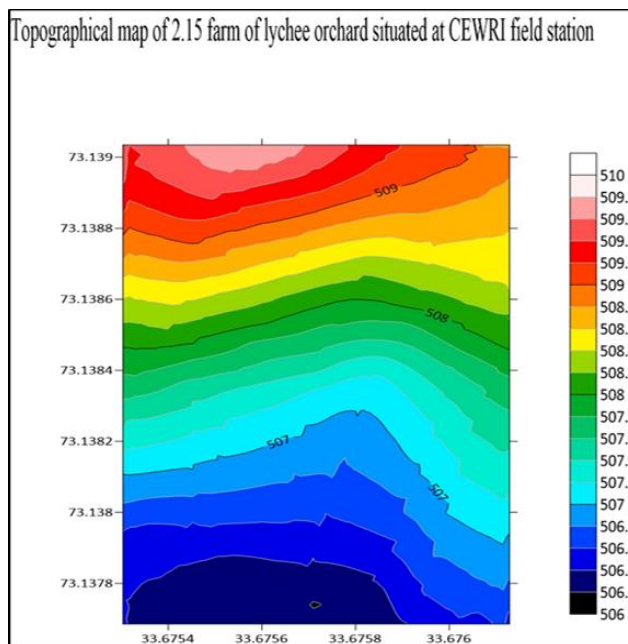


Figure 3

rather than a global best fit. An example for local co-ordinate datum is Australian Geodetic Datum.

CONCLUSION AND SUGGESTION

The main purpose of this project work is to conduct a topographic survey of 2.15-acre farm of CEWRI field station by using GNSS. The topographic map is very important while planning for agricultural infrastructures and for soil and water conservation studies. For this purpose, the main equipment's used were (Beidu-2 Sino GNSS). As a part of this project the principles and working of GNSS were studied. Using GNSS all required points were surveyed and the coordinates of all boundary corner points were taken, these points were post processed in PC EXCEL Software. The processed reports were exported to the required file format. The data of the base line report helped in knowing the longitude, latitude, elevation, easting, and northing and other details of the point.

So it is a knowledge which have been keep in mind that GNSS is a equipment that can be used for surveying in a short span of time in a more accurate manner, but there are advantages and disadvantages; In case of time, it requires very less time for taking measurements of a points, Hence we can't use it in the forests, places having good canopy and high rise buildings because of satellite interference, GNSS can cover wider areas but shows limitations in places with dense canopy and weather dependent.

They're easy to use, don't drift and can achieve high levels of accuracy. However, they're not perfect. For starters, to reach their full potential they need a clear and uninterrupted view of the sky. That's great if you're working in the middle of a field, but if you're trying to survey city streets, or working under bridges and in tunnels, at best you get reduced accuracy, and at worst you get no measurements at all, we can't use it in the forests, places having good canopy and high-rise buildings because of satellite interference. GNSS can cover wider areas but shows limitations in places with dense canopy and (it is weather dependent).

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