LEICA SR20 GPS RECEIVER USE AND DATA PROCESSING FOR TOPOGRAPHICAL SURVEYING IN ORDER TO REHABILITATE A COMMUNAL ROAD

Miluț Marius, Călina Jenica, Croitoru Alin, Buzatu Claudiu, Iosif Gheorghe
University of Craiova, Faculty of Agriculture
milutmarius@yahoo.com

Key words: GPS receiver, surveying, data processing

ABSTRACT
The paper presents general information about Leica SR20 receiver and how to use it for surveying the rehabilitation of a communal road segment. It is also presented the processing method of data collected using Leica Geo Office Tools Combined program. Based on coordinates of the points imported and processed in AutoCad will get the situation plans of and we can make cross profiles and longitudinal profile.

LEICA SR20 RECEIVER
Leica SR20 receiver is a topographic receiver, with the following characteristics: Receiver 12 channel parallel automatic selection. L1 Code / Phase, Internal antenna: Leica AT575 microstrip, built-in groundplane, External: Leica AT501 microstrip, Processor 240MHz RISC floating point processor, Display 240 × 240 pixel graphical LCD, 16 grayscale with backlight, Internal Radio: Bluetooth, Memory: ATA compact flash: Standard 32MB; Max 2GB, Data Transfer: RS232 Lemo, ATA compact flash, Internal Ports: RS232 Serial: 7 pin Lemo; Antenna Coaxial Lemo; Baseline rms (Post-processing):
L1 Code only: Typically 30cm (rms);
L1 Code and Phase typically 5 to 10mm + 2ppm (rms);
Data Recording Rate and Capacity: At 1Hz measurement; 1 hour runtime = 2MB, 16 hours continuous measurement per 32MB standard compact flash.

A standard package contain: two SR20 GPS Receiver, two External GPS Antenna AT501, four GEB90 batteries, two chargers for batteries, two feeders for chargers, a car adapter, two external antenna cable, a serial data transfer cable, two mounting supports GPS, 1 container, 2 sticks of 2.15 m, 2 tripod stick, CD documentation + Leica Geo Office Software, User Manual, 2 CF card 32 MB, a PCMCIA adapter - CF. Instead of sticks can choose tribrach + tripod + adapter
Keyboard and display SR20

Keyboard - is similar to mobile phone, being assigned to each key, a group of three letters, which can be accessed by successive presses when we first enter (eg Job, point, etc.).
- **ENTER** key is used to confirm or select menu options.
- **ESC** key is used to abandon the action (exit without saving), is also designed to delete characters in edit mode. During the measurement (Survey), pressing the ESC key, point name will not be saved, but it can be found in memory, with a formal name ~ TMP.
- **PAG** key is used to view device status at the time of measurement.
- **ON / OFF** key is used to turn on / off device, and a short press on it will turn the backlight.
- **NAVIGATION** keys - are the four arrow keys used for navigating menus and selecting options.
- **MENU** key is used for auxiliary menu appears when browsing through the device settings, and contrast adjustment in the main menu.

Display - In just moments start device, the display will look like with short active version of the menu:

![Main Menu](image)

### MEASUREMENT

For measurement we need two GPS receivers, configured identically. We use in our case, the configuration set TGCPOST and TEST job.

It indicated that in **SETUP \ HARDWARE MANAGEMENT \ HARDWARE \ UNIT NAME** to define names for different receivers, such Base for base receiver and rover for mobil receiver. It is also advisable to get the names and a label on the back of receivers.

Suppose we made a work to determine coordinates of four points. At a distance of 5 km it is a point with known coordinates in Stereo 70. The first step to do is install the base receiver on the known point. We will use the external antenna mounted on the stick. Antenna height is 2 m and defined job will be **TEST**.

Antenna height measurement will be from the lower collar of the antenna mounting nut. We measure with tape and calculate the height of the antenna effective height factor for used stick because the sticks are calibrated for the use of prisms. Example: If the stick have the value indicated by 2 meters and the effective antenna height is 1.93 meters, will have to apply a correction of 7 centimeters, lifting the stick from 2.07 meters to take the antenna height of 2 meters, scheduled for device . We mount the stick only vertically above point, helping us from focus bubble. We set stick with a tripod and check the cable between the receiver and external antenna.

**Points measurement** - For measurement select (1) **SURVEY** from the main menu. The following screen appears:
Here you can select the following:
- **Config set**: configuration set used in our case TGCPOST;
- **Antenna Type**: antenna type, in our case AT501 Pole;
- **Job**: work we are doing, in our case TEST;
- **Coord System**: coordinate system;
- **Codelist**: list of codes used, default CDLIST01, or a list of codes defined by us.

If we agree settings, select **APPLY**, then press **ENTER**, the screen will look like:

**Point Name**: is the name of the point you measure if we can edit this name

**Recommendation**: You must use the small name for known point (base), such as POINT0001, POINT0002, POINT0003 and long names for points to be determined, such as POINT0101, POINT0102, POINT0103, etc.. This will help us fast distinguish between them when processing.

**Antenna Height**: here we define the value of height antenna, which is characteristic value of each point measured. However a value of 2 meters is common and probably will not change it.

**Point Code**: We can select a code point, which describes it, if we upload a list of codes. Example: fence, road border, road ax, etc.

**Warning**: To measure, the device need to be initialized, this applies when the PDOP is calculated.

Initialization time can be up to 20 minutes. If the device is not initialized, pressing OCCUPY button, will display the error message "POSITION NOT AVAILABLE".

To begin measuring press the button OCCUPY, our screen will look like this:

Will display the following:
- **Point Name**: measured point name;
- **Antenna Height**
- **Point code**
- **GDOP**: GDOP value;
- **Time at pt**: time stationed on that point.

**Times of stationary points**: for BASE receptor, time of stationary of reference point will be equal or greater than the duration of the measurement with ROVER receiver for all points to be determined. To measure a point with Rover receiver the stationary duration will be at least 5 min / km distance from the base receiver, but not less than 15 minutes. Thus, for a baseline distance of 6 km, will be stationed at least 30 minutes. This term is necessary for the ambiguities to be resolved post-processing time. After the residence time was reached, we will press **ENTER**, having selected "STOP & STORE". At this time we have saved the point with his name. If you accidentally press **ESC**, item name will not be saved, but the corresponding point can be found in memory, with a registered name in the form xxxx ~ TMP.
DATA PROCESSING USING LEICA GEO OFFICE TOOLS COMBINED

To simplify things people from Leica have made a single program Leica Geo Office Tools Combined, with which you can retrieve, process and export data. We perform a processing for measurement in Kinematic Chain mode, measurement carried out in Leu village, for the rehabilitation project of communal road Leo - Buzduc.

The measurement started with the reference installation by arbitrar choosing of a point. To process data in this program must create a project. This is so (Fig. 2):

You click on option Projects, and then we will appeared a new window. The right click on the folder Projects and choose the option New, an option that allows us to create a new project. To this new project should give it a name, and to choose the desired coordinate system (for our country this is Stereo ’70 system). These operations will be performed according to figures 3 and 4.

Once we have established the project name and coordinate system wanted, you will need to import data downloaded from GPS in computer (Figure 5). We choose the all files we want and we will assign our project. The operation will be performed for each GPS used at measurement. In this case we used three GPS - a reference and two roveres (Fig. 6).
Then in the sub-menu GPS-Proc will appear measurements taken with every GPS, here we need to set Reference and two Roveres:
Figure 7. Reference and rovers setting

In sub-menu View/Edit can see the points imported in the program and the routes to go when measurements were made:

Figure 8. Imported points and routes from the ground
In Points, we can see points name and coordinates before to make corrections prior to process data. Here we set the reference point - Control Point so if coordinates taken from satellites are not accurate to correct it and data processing to be made according to this Control point.

Turning in GPS-Proc we can do data processing and then start exporting coordinates in ASCII format.

Before you export the points they need registered, this being done from Results, selecting only the static points and still not moving (points with name given by us, on the field).

We will make export in file type *.txt, this file is easy to use in later phases. We export only what we want, points measured (measured), the reference point (reference), GPS points recorded by automatically moving (navigated).

We can also choose what details we export about that point: apart from xyz, if we worked with codes can choose to export and the code of that point.

![Figure 9. Points export as *.txt file](image)

A file of this type where I want to export point name, XYZ will look like this:

**GPS ROVER – I**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>305755.6210</td>
<td>422725.4483</td>
<td>169.4391</td>
</tr>
<tr>
<td>C10</td>
<td>305745.0572</td>
<td>422696.7443</td>
<td>169.5880</td>
</tr>
<tr>
<td>C100</td>
<td>304713.6150</td>
<td>422160.7228</td>
<td>172.0072</td>
</tr>
<tr>
<td>C101</td>
<td>304717.5643</td>
<td>422154.4943</td>
<td>171.8075</td>
</tr>
<tr>
<td>C102</td>
<td>304683.2085</td>
<td>422146.3824</td>
<td>172.0859</td>
</tr>
</tbody>
</table>
This file text with content above will be imported into AutoCAD using a program called TopoLT.

After processing in AutoCAD will get situation plans and we can make cross sections and longitudinal profile. In our case we chose to list the area between 00 Km and 04 Km, work component of the 00 Km - 12 Km Leu - Buzduc. Scales used were 1:1000 for the situation plan, and 1:100; 1:100 for the profile.

CONCLUSIONS
1. GPS (Global Position System) is a positioning system on the Earth's surface or in its immediate vicinity, with a constellation of satellites and a special receiver.
2. GPS consists of three segments:
   - Space segment - consisting at present of about 30 satellites;
   - Control segment - consisting of ground stations for satellite control, positioned at the equator;
   - User segment - everyone receives and uses GPS signals.
3. For the communal road Leu – Buzduc 0.00 – 4.00 km rehabilitation, the topographical works were done using GPS receiver Leica SR20;
4. Measurement mode was Kinematic Chain, and for data processing was used Leica Geo Office Tools Combined program.
5. Based on coordinates obtained was drawn the situation plan, for the mentioned communal road segment and longitudinal profile at scales 1:100 and 1:1000.
6. Using GPS technology is reduced the time required for collecting and then processing the data required to draw up topographical study.

BIBLIOGRAPHY
1. Păunescu, C., Mocanu, V., Dimitriu, S., Sistemul global de poziționare G.P.S., Editura Universității din București;