ASPECTS OF THE USE OF TECHNOLOGY COMBINED THICKENING NETWORK OF SUPPORT IN THE FORESTRY SECTOR, IN HARDWOODS FOREST STANDS

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Abstract: *Achieving development support network in the forestry sector presents a number of features due to working conditions. Modern technologies in the sector requires a number of ground measurements of working conditions, which in the forest sector often can not be achieved only partially. Obtaining accuracy of various works carried out in the forest sector may be influenced by the technologies of specialized programs that work and post-processing calculation. One possibility to achieve works of stuff network support in the forestry sector is represented by the use of combined technologies, depending on their technical requirements and that the working conditions on the ground. GNSS and conventional technologies now provide the logistics sector land measurements. Programs for work can provide a number of advantages even in the particular situation of working, that when visibility is reduced or the signals received by GPS receivers can be affected by a number of perturbation factors. Hyper-specialized software working methods used in technological processes benefits from a number of possibilities to optimize the results, obtaining results that are characterized by accuracy within the tolerances proposed technical standards. A method which can be successfully used for thickening and support network to achieve network that lifting the details of the forestry sector is the intersection of linear limit, a generic method called free station. By applying this method will determine the spatial coordinates of a new point that will be stationed with total station and which will cover at least two points whose coordinates were determined with GNSS technology. The flexibility of this method is that the points determined by GNSS technology can be placed conveniently in terms of technical conditions claimed by this technology. In the case study were analyzed a series of points whose spatial coordinates were determined with more modern technology work to assess the efficiency of the method with the Free Station. The results obtained in this case study recommends working method analysis to determine points of stuff network support and network that lifting the details of the forestry sector.*

Key words**:** *forestry sector, geodezical network support, technology combined, GNSS technology, conventional technology, free station*

INTRODUCTION

Making measurements of various terrestrial applications in the forestry sector is conditioned by a number of issues related restrictive areas under forest vegetation. Also, a series of geodetic and topographic points were determined at various works in the forest or near the forest edges either been destroyed or are not visible throughout the year (especially in vegetation season).

GNSS technology in forestry is restricted in most situations due to the technical requirements they advertise it, following a series of cases occur. Particular situation of working with the most common GNSS technology in the forestry sector are the determining points in the mesh placed regeneration, the determination of points near the forest edge and that points to determine the occurrence of forest compact. Accuracies of determining points of GNSS technology in the forestry sector varies with the objective reality on the ground, which should ensure minimum technical conditions. Although known claims against working conditions complained of GNSS technology, are cases in which points can be determined with adequate accuracy with this technology, to conduct operations in the forestry sector.

Technology conventional TS (total station) is used in situations that use spatial positioning satellite technology can not be achieved.

They are also a number of situations common to achieve various topographic-geodetic operations in the forestry sector when combined with technologies, using principles that GNSS positioning and lifting total station.

These combined technologies are used to determine the work items related network dense, network points for raise of the details and in some cases raising related detailed forest fund.

Achieving these complex applications in the forestry areas involve an adequate logistics, to address issues related to land in appropriate technical measurements (to the nearest appropriate and relatively short time) and reduced financial effort.

MATERIAL AND METHODS

The case study was realized in the management unit (UP) I Sîniob, Forest District Săcuieni, Bihor County Forest Administration on forestry areas Iepuriste, Valea Mică, Cabană, Drum Cadea, La Pin – Figure 1.

Figure 2 is presented in the form raster topographic map trapez L-34-33-Aa, which was used in the realisation of the case study.

Logistics used is represented by geodesic grade GPS receivers with a frequency (L1) with software such as Trimble R3 related to registration and transfer observations and software for processing GPS observations - Trimble Total Control (TTC) 2.7.

Conventional technology used is represented by total station (TS) Trimble 3605 with accessories – Figure 3. Data transfer system of calculation was done with the program Datatransfer 147, and processing was performed with the program Terramodel 10.43. For reporting specific points were being used Mapsys 8.0.

For efficient location of the case study were used orthophotomap scale 1: 5000 and that topographic map at 1:25 000 scale, form and rasterisation georeferenced.

Figure 1: Locating the case study on orthophotomap

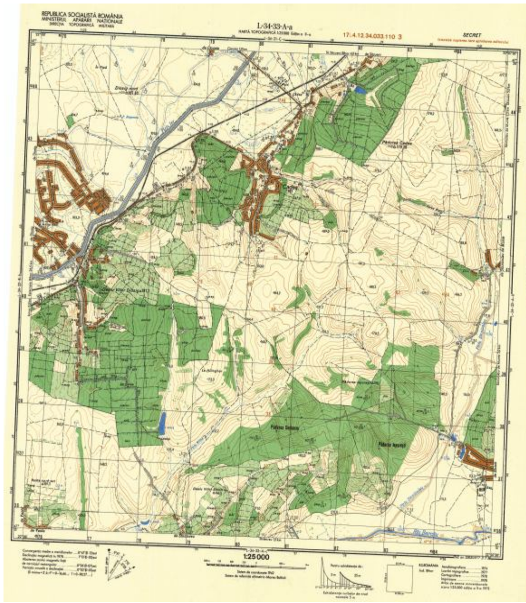

Figure 2: Topographic map - trapez L-34-33-Aa

Figure 3: Trimble total station 3605

Achieving network of dense in the area was done using four points of support network of Bihor county (in the metropolitan network calculated between 2000 to 2002 with GNSS technology), which are presented in Table 1.

Table 1

Inventory coordinate of the geodesical support network of Bihor county used for the case study

No.	Point	X(m)	Y(m)	Z(m)	Observations
1	7 - Salard	641143.150	275370.096	109.517	OCPI Bihor
2	11 - Sarsig	641359.879	287730.401	138.411	OCPI Bihor
3	41- Diosig	648959.326	274488.095	111.925	OCPI Bihor
4	16401- Cubulcut	648424.902	285780.343	218.360	OCPI Bihor
5	101 - Sonda	645476.991	281928.501	116.098	Doctoral Studies
6	125 - Plantatie	645281.164	279475.739	179.677	Doctoral Studies
7	190 - Deal	644810.435	280867.626	166.289	Doctoral Studies
8	800 - Drum forestier	645205.719	279561.727	182.624	Doctoral Studies

Realisation of the positioning technology using combined in this case study is based on use the Free Station (free state). Therefore, determining point coordinates new (state) is obtained by measuring distances and / or angles of at least two and at most eight points, something which can be achieved using field work program of the total station or post-processing program Terramodel 10.43 .

This method of setting is used when the station coordinates of station point are unknown. This function enables the free station using several combinations of angles and distances. Principle of calculation consists in the combination of intersection and triangulation. If you are taking action, in addition to the mean coordinates will be obtained and the standard deviation value (Sdev).

Determination of coordinates is done by clearing rigorous as "the method of least squares. Setting free station can be done with a large number of different combinations of points, angles and distances, or to limit using only two points of known coordinates.

To establish the free station using known points between 3 and 10 are possible following combinations:

Angles and distances;

Only angles. In this case, required a minimum of four points.

In determining the station (new section) using two known points is used calculation method that combines the angles and distances – Figure 4 and 5.

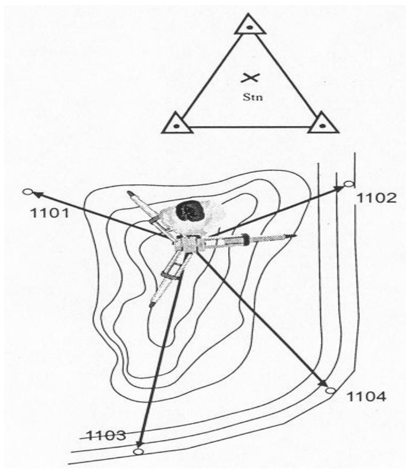

Figure 4: Setting free station

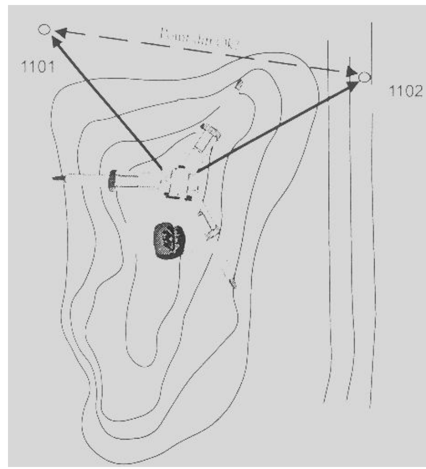

Figure 5: Setting free station with two known points

(Stația totală TRIMBLE 5503 DR - Manual de utilizare)

Hence, it performs a linear retro-intersection limit, known coordinate points are determined by the method static GNSS technology (traditional and rapid static), and distance from point to point new angle is determined and that will measure the total station – Figures 6 and 7.

Figure 6: Locations points of the experimental related for studying case for spatial positioning technology combined

Spatial positioning method for points 100 and 314 respectively is detailed in Figures 6 and 7, find material on orthophotomap points of known coordinates and that new points.

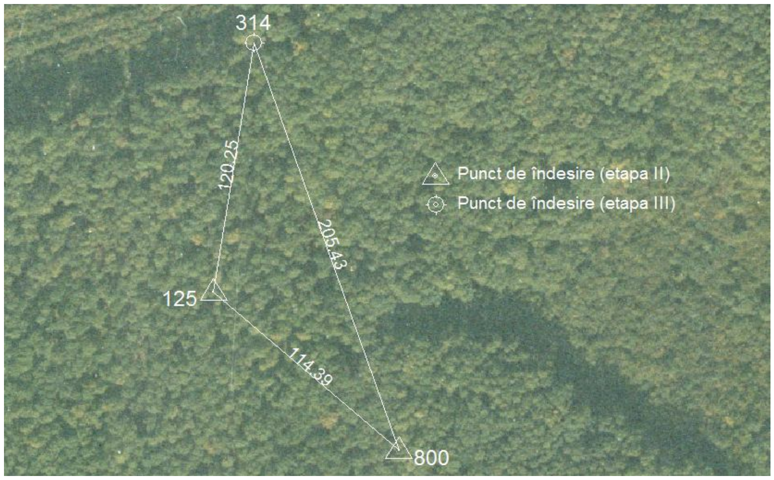

Figure 7: Locations of the experimental device for case studies to study the spatial positioning technology combined 314 point

Data recorded by total station is in the form of ASCII type files that can be found in books on digital terrain being coded properly – Figure 8.

St	Ha				
100	1.520				
Pno	Hz	V	Sd	Hs	Code
190	16.5630	95.6766	759.722	1.800	1
101	167.0700	99.8526	594.245	1.800	1
9999 0 0 0 0 C					

Figure 8: Data field

where: St. - point station, Ha - height device, Pno - new point, Hz - horizontal direction, vertical direction V, SD - inclined distance, Hs - prism height, Code - the code point.

To be obvious the technical features of the technology combined geodetic and topographic positioning points in the forestry sector have shown a small number of examples of methodological considerations, issues studied are complex, we claim to having exhausted them in this work.

Following cases were analyzed spatial positioning technology combined 100 points and 314 respectively, points which were determined to control GNSS technology (static and fast static method).

RESULTS AND DISCUSSIONS

After processing the data recorded with conventional technology and that Terramodel 10.43 GNSS program were obtained results are presented in a comprehensive report processing – Figure 9.

```
Standard Deviations
Point ID          Northing(m)  Easting(m)     Elevation(m)
100                 0.013        0.012           0.023
Error Ellipses @ 95% Confidence
Point ID            Major          Minor           Azimuth
100                 0.035          0.025          N60.0885W
COMPUTED COORDINATE RESULTS
Point                X(m)            Y(m)         Z(m)     Code
---------------------------------------- ----------------
 100            644977.203     281607.026    114.982    4
 101            645476.991     281928.501    116.098    2
 190            644810.435     280867.626    166.289    3
```

Figure 9a: Extract from report data processing program for Terramodel 10.43 new item 100

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Standard Deviations
Point ID          Northing(m)   Easting(m)    Elevation(m)
314                 0.008         0.014          0.005
Error Ellipses @ 95% Confidence
Point ID            Major          Minor              Azimuth
314                 0.036          0.017            N22.7057E
COMPUTED COORDINATE RESULTS
Point                X(m)             Y(m)             Z(m)    Code
------------------------------------------------------------
125               645281.164     279475.739       179.677   2
314               645399.906     279494.693       182.318   4
800               645205.719     279561.727       182.624   3
```

Figure 9b: Extract from report data processing program for Terramodel 10.43 new item 314

According Technical Rules for entering general cadastre (Article 3.3.4.) Average standard deviation for determining the geodetic network points of dense does not exceed ± 5 cm in planimetry position.

$$s_{x,y} = \sqrt{s_x^2 + s_y^2} \quad (1)$$

where:

s_x - standard deviation on X;

s_y - standard deviation on Y;

$s_{x,y}$ - standard deviation planimetry;

$$s_{x,y}100[m] = \sqrt{(0{,}013)^2 + (0{,}012)^2} = 0.013 \quad (2)$$

The analysis of search results presented in the report processing (Figure 9) and by applying the formula in relation (1) Note that point 100, 314 was determined by the technology combined with a positioning accuracy of planimetry and that high altimetric $s_{xy} < \pm 5$ cm, $s_z < \pm 5$ cm, can be included within the default network dense and geodesical support network in the studied area.

CONCLUSIONS

Positioning technology combined points in the forest sector offers the completion of complex problems which are significantly influenced by conditions of work.

Combined technology is characterized by high flexibility, and may have been set as required, with a certain lightness geodesical support points.

Using technologically differentiated (GNSS or conventional) provides technical options to achieve alternative and complementary positioning characteristic points used in various practical applications.

For terrestrial applications in the field measurements made in land covered by forest vegetation with modern technologies, is essential to proper documentation, using for this purpose existing cartographic materials relating to these locations.

Logistics is available provided crucial for implementing the spatial positioning with modern technology using combined methods of work. Therefore, use of appropriate tools for data collection and processing specialized programs that lead them to obtain accurate results with a minimum financial effort.

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