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POSIBILITIES OF REALISATION OF THE MINOR CONTROL NETWORK WITH GNSS TEHNOLOGY IN THE OCCUPYED AREAS WITH FOREST VEGETATION IN MOUNTAIN AREAS

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Abstract: *Posibilities of realisation of the minor control network with GNSS tehnology in the occupyed areas with forest vegetation in mountain areas is characterized by a number of issues, due to the same technologies as the configuration of land and work. Lack of mutual visibility between control points or loss related signals geodetic points placed in areas with forest vegetation cover in mountain areas, make it impossible or significantly reduce the possibility of realisation the minor control point, using conventional technology for this purpose only. For minor control networks realisation of the mountain forest sector can use GNSS technology to register their observations using the geodetic receivers with single or dual frequency (L1, L1L2), and for processing, specialized computer systems, which allow you to obtain final coordinate in the national reference system and a report complex data processing. In relation to existing facilities can apply various methods of registering data, adapted working conditions of the particular mountain area. Working method for achieving network dedicated with GNSS technology is relatively static and can be done and fast static version, if vector length does not exceed 4-5 km. To obtain the final coordinates in the national reference system transformation parameters are required. Usually these are used to obtain common geodetic points (points known in both coordinate reference systems) found in the work area to obtain results with high precision. In the mountains geodesic points are located at a density appropriate, taking account of the geometric triangulation related networks, is relatively well preserved, presenting normal the technical conditions. Determination of transformation parameters is usually done using traditional static positioning method and positioning points of the minor control network is done by fast static method. Considering the practical needs that commercial forestry in the mountain area of forest management activities, is essential for complex Topo-Cadastral works, which is based on the existence of a complex minor cotrol network of the details. To streamline these activities in the sector terrestrial measurements, is it necessary to implement modern technologies for collecting and processing data and that proper management of various final products obtained.*

Key words**:** *forestry vegetation, mountain area, GNSS technology, calculation system, coordinate transformation, geodetic points, dense network, detail point*

INTRODUCTION

National Forest Fund is characterized by a high degree of heterogeneity in the point of view orographic and respectively distribution on the forms of relief occupied by forest vegetation. So in the motain area is located 58.5% of the t.otal area, 38.7% in the hills area and \+ spectively 8.9% in the plain and meadow (CRAINIC G.C. 2009, FLORESCU I., NICOLESCU V.N., 1994).

Various ongoing activities of a practical nature, related to the forestry sector requires clear evidence of the area occupied by forest vegetation, the areas for forestry and related activities of the forest management, not least areas situation which according to the Forest Code an respectively with other reglementation in vigour may enter or exit by the case from the forest fund (CRAINIC G.C., et. al. 2010).

Realisation of some operations related terestrial sector measurement in areas occupied by forestry vegetation from the mountain areas, involving a series of special working conditions, related to the specific land and respectively used logistic.

The presence of geodetic points in mountainous areas, on the positive forms of relief, in the strategic position is one of the advantages of the state geodetic triangulation in our country.

Although in recent decades a number of geodetic points were destroyed due to various reasons, relatively inaccessible mountainous or difficult to access, they were relatively well preserved, being not subject to various pressures of human activity. But note that these signs point with land pyramids, pyramids with bridges, trees signals is nonexistent in most cases encountered these signal buildings were destroyed (CRAINIC G.C., 2010) - Fig. 1.

Figure 1: Pyramids with bridges related to the geodetic point Vârful Bogdan destroyed

MATERIAL AND METHODS

This case study was realised in the Forest District Praid, Harghita County, in areas occupied by forest vegetation belonging Ocna de Jos Administration, respectively management unit (U.P.) X Creanga Mică (Fig. 2) being located in mountainous areas, mixtures of resin and resin mixed with beech - (KACSO Z., 2010).

The primary objective of the study case is the realisation of the minor control network of details related to area occupied by forest vegetation, managed by O.S. Praid, Harghita County.

Figure 2: Study case localisation

As study methods were used itinerary observation, observation in the stationary experiment and simulation.

Realisation of the minor control network has been designed to make GNSS technology, throught fast static method, the working sessions of 30 minutes, and period of registration is 15 ". To obtain transformation parameters static traditional method was used, the working sessions of 5 hours, with 15" period of registration.

Registrations were used to achieve a number of four GPS receivers of geodetic class with a single frequency (L1), the type Trimble R3.

For the realisation of the study case has been used a total number of four points that are in the inventory of geodetic OCPI Harghita - Tab. 1 as points of trigonometrical control network in the work area, determining the transformation parameters.

Table 1

Inventory geodetic coordinates of the points used for obtaining transformation parameters, in the national reference system

No. point	X(m)	Y(m)	Z(m)	Toponymy
1067	559192.725	504730.072	1028.173	Piatra siclod
1089	559678.148	513119.711	878.225	Varful Ionel
1102	571170.906	524296.345	1496.361	Varful Borzont
1106	569217.467	520347.531	1297.350	Varful Bogdan

Geodetic points have been identified in the land using a GPS navigation Pocket Loox N520 Fujitsu Siemens model, equipped with software MapSys PDA 2.0.

Geodetic points have been used are located with in stands of beech (Piatra Şiclod, Vîrful Ionel), spruce (Vîrful Bogdan) and mixed spruce beech (Vîrful Borzont) which represents the upper storey closed uniform and continuous.

a)Signaling on the tree control b)Installed GPS receiver

Figure 3: Geodetic point Piatra Siclod

Figure 4: Geodetic point Vârful Ionel

Figure 5: Geodetic point Vârful Bogdan

Sketch of proposed experimental device for registering data in order to obtain the transformation parameters is presented in Fig. 6.

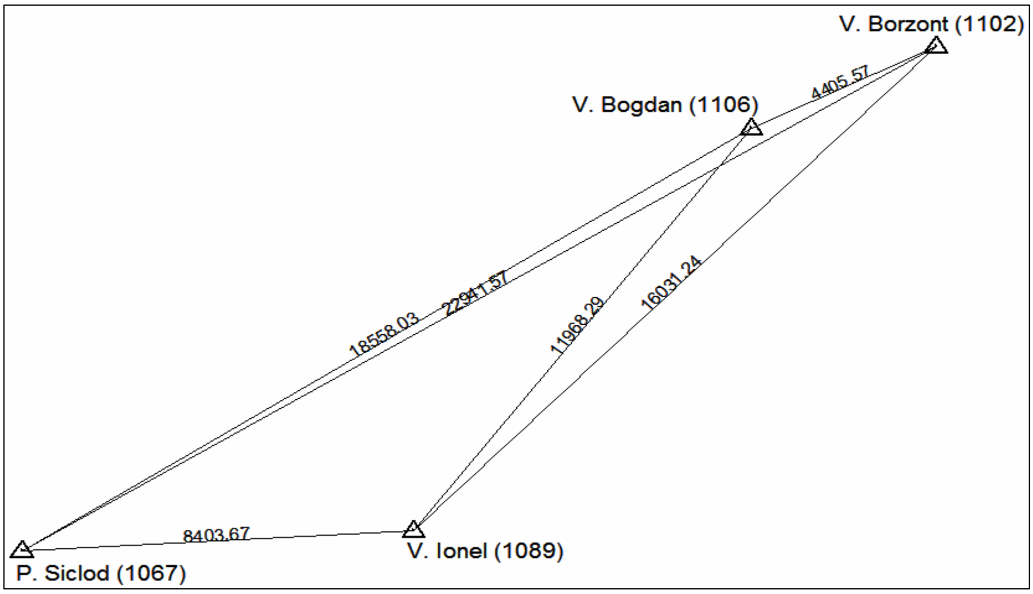

Figure 6: The experimental device designed to obtain the transformation parameters

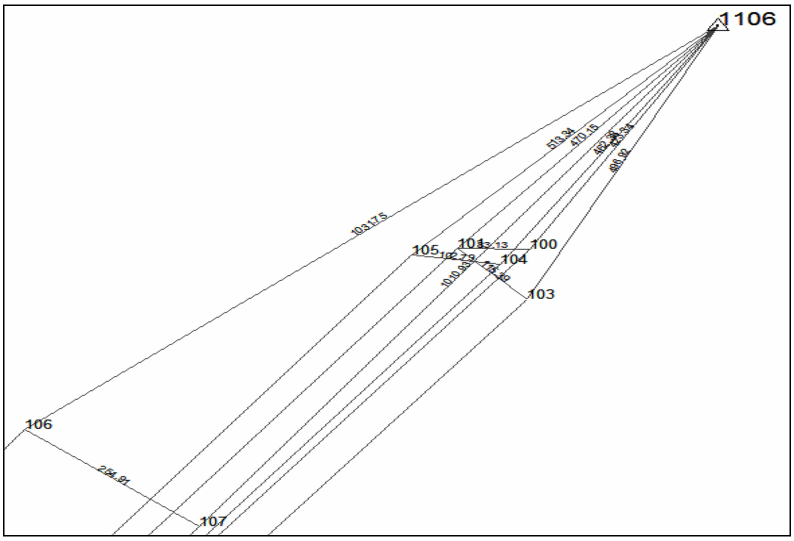

Figure 7: The experimental device designed to achieve minor control network

RESULTS AND DISCUSSIONS

Registering data processing GNSS technology was realized in three variants of calculation, version one made with Trimble Total Control software, version 2 made with the TTC calculation - basic and coordinates respectively TopoSys processing and final coordinates for version 3 was used to obtaining final coordinates TransDatRO 4.01 application.

ANCPI TransDatRO4.01 application is recommended for transformation the national system of reference coordinates in ETRS 89 reference system using the GRS 80 ellipsoid.

In order to use the registering were used TransDatRO4.01 common permanent GNSS station registrated Odorheiu Secuiesc (ODOR), Harghita County, as the closest permanent GNSS station area.

To obtain items Trimble Total Control program transformation have been used four common geodetic points, the inventory OCPI Harghita , elements resulting from the processing are presented in tabular and graphic continuu.

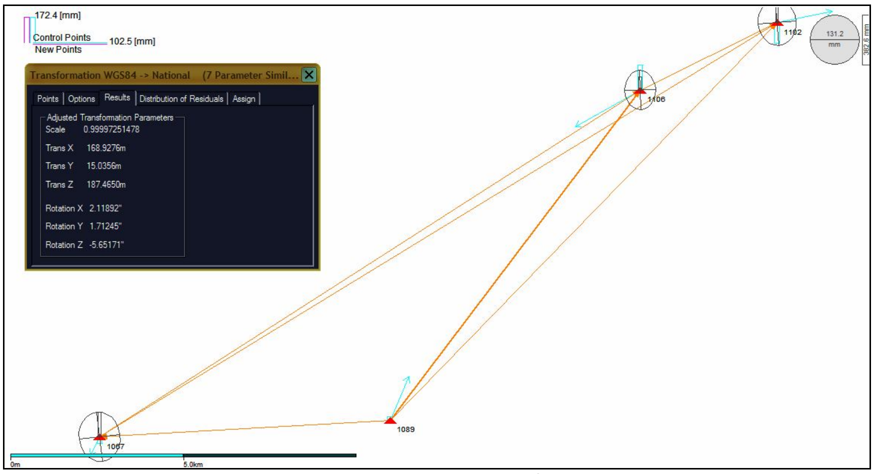

Figure 8: Rigorous compensation and spatial transformation parameters obtained

Spatial coordinates compensated to achieve transformation on common points were characterized by a planimetric standard deviation of 131.2 mm, the standard deviation on height being 382.6 mm

Standard deviation to achieve the transformation plan have value 102.5 mm, while the height standard deviation related allowances have a value of 172.4 mm.

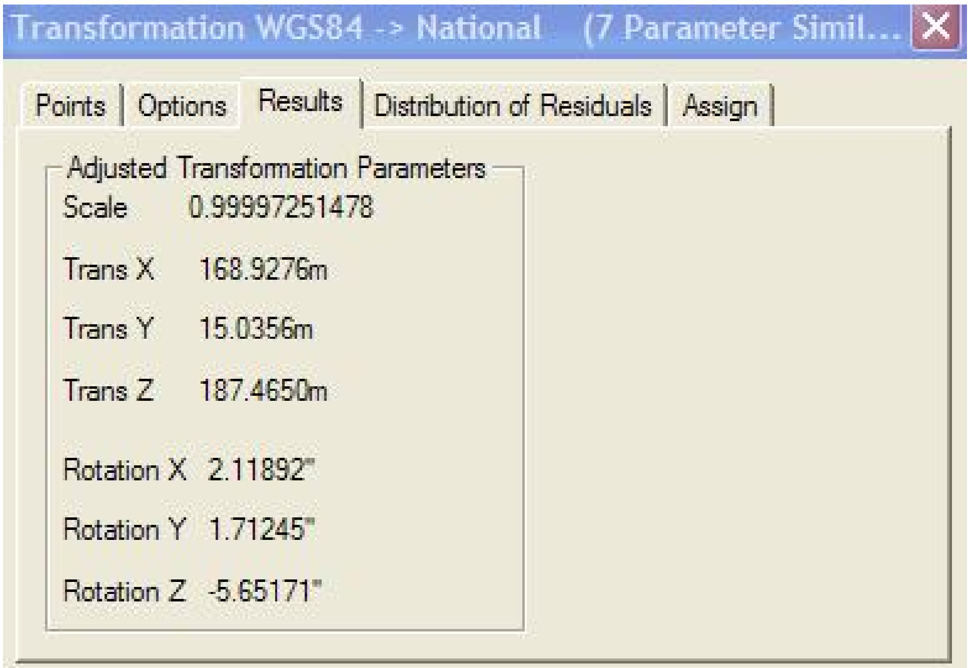

Figure 9: Processing parameters on the four common points determined by TTC program

Transformation parameters obtained were implemented in the database computer system can be used for various applications in the area, as appropriate.

Table 2

Inventory coordinates from the minor control points in the national system reference and standard deviations associated-1 variant

No. point	X (m)	σx(cm)	Y(m)	σy(cm)	σxy(cm)	Z(m)	σz(cm)
100	568853.266	11.1	520131.399	11.6	16.1	1206.214	23.1
101	568854.616	11.4	520048.279	11.8	16.4	1202.522	23.5
103	568771.445	21.8	520128.183	21.4	30.6	1192.579	37.2
104	568828.378	16.2	520097.483	10.5	19.3	1200.581	21.8
105	568843.374	16.2	519995.792	10.5	19.3	1197.699	21.8
106	568558.822	22.5	519553.185	11.1	25.1	1122.567	31.0
107	568399.989	12.1	519752.570	10.3	15.9	1103.892	31.7
1067	559192.533	22.2	504729.873	11.0	24.7	1029.652	30.9
1089	559677.972	7.8	513119.622	6.2	9.9	879.510	14.5
1102	571170.819	8.6	524296.132	7.7	11.5	1497.302	15.2
1106	569217.467	0.0	520347.531	0.0	0.0	1298.171	0.0

Elements spatial transformation and respectively processing parameters on the four common points , with TopoSys 5.0 computing system are presented in Tab. 3 and 4.

Table 3

Spatial processing elements in common points with the program obtained TopoSys 5.0

No. point	dX(m)	dY(m)	dZ(m)
1067	0.001	-0.041	0.035
1089	-0.013	0.034	-0.015
1102	-0.052	-0.109	0.105
1106	0.064	0.116	-0.125
Mean error coordinates			
m0(m)	mX (m)	mY(m)	mZ(m)
0.108	0.048	0.097	0.097
No.	**Parameter**		**Value**
1	X0 (m)		43.963
2	Y0 (m)		138.812
3	Z0 (m)		-57.367
4	rX (m)		0.000005919
5	rY (m)		-0.000027908
6	rZ (m)		-0.000006718
7	k		0.999973539

Table 4

Inventory coordinate from lifting points in national system reference determined with the TopoSys program

No. point	X(m)	Y(m)	Z(m)
100	568853.392	520131.514	1205.259
101	568854.756	520048.394	1201.567
103	568771.518	520128.303	1191.618
104	568828.451	520097.614	1199.613
105	568843.447	519995.926	1196.728
106	568558.900	519553.307	1121.591
107	568400.068	519752.690	1102.915
1067	559192.726	504730.031	1028.207
1089	559678.135	513119.746	878.210
1102	571170.854	524296.236	1496.466
1106	569217.531	520347.647	1297.224

Inventory coordinates in the official reference system, obtained in the version 2 of the calculation are presented in Tab. 5.

Table 5

Inventory coordinate points for variant 3 of calculation, obtained by application TransDatRo 4.01

No. point	X(m)	Y(m)	Z(m)
100	568853.621	520130.894	1205.228
101	568854.985	520047.773	1201.538
103	568771.748	520127.679	1191.586
104	568828.682	520096.991	1199.579
105	568843.68	519995.3	1196.693
106	568559.127	519552.671	1121.567
107	568400.287	519752.058	1102.897
1067	559192.758	504729.191	1028.765
1089	559678.03	513119.094	878.589
1102	571171.121	524295.73	1496.41
1106	569217.775	520347.03	1297.18
ODO	533878.14	522992.566	497.711

By analyzing the elements of Fig. 10 shows that, offset ellipsoidal coordinates were determined with a standard planimetric error of 316.4 mm and standard deviation height with a of 562 mm.

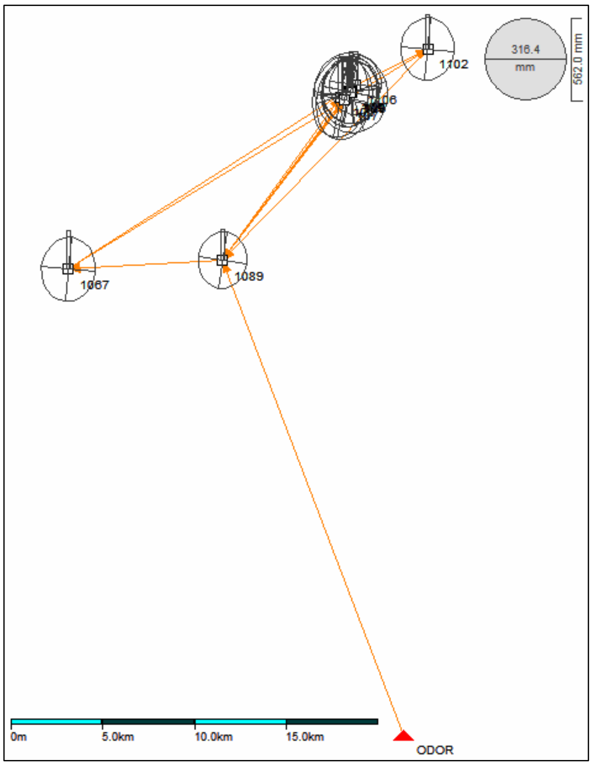

Figure 10: Sketch vectors obtained by using common registers Odorheiu Secuiesc permanent GNSS station

In the Tab. 7 and 8 are presented the differences between coordinates of points positioned processed GNSS technology and differentiated variants, with different computer systems.

Table 7

Differences of coordinated national system of reference for specific points in the three variants of calculation

Point no.	**Variant 2-Variant 1**			**Variant 2-Variant 3**			**Variant 1-Variant 3**		
	Dx(m)	**Dz(m)**	**Dy(m)**	**Dx(m)**	**Dz(m)**	**Dy(m)**	**Dx(m)**	**Dz(m)**	**Dy(m)**
100	0.126	0.115	-0.137	-0.229	0.620	0.031	-0.355	0.505	0.167
101	0.140	0.115	-0.136	-0.229	0.621	0.029	-0.369	0.506	0.165
103	0.073	0.120	-0.143	-0.230	0.624	0.033	-0.303	0.503	0.177
104	0.073	0.131	-0.150	-0.232	0.623	0.033	-0.305	0.492	0.183
105	0.073	0.134	-0.151	-0.233	0.627	0.034	-0.306	0.493	0.186
106	0.078	0.122	-0.156	-0.227	0.636	0.024	-0.305	0.514	0.180
107	0.078	0.120	-0.161	-0.219	0.632	0.018	-0.298	0.512	0.179
1067	0.193	0.158	-0.840	-0.030	0.839	-0.560	-0.223	0.681	0.280
1089	0.163	0.123	-0.668	0.105	0.652	-0.379	-0.058	0.528	0.289
1102	0.035	0.104	-0.056	-0.267	0.506	0.057	-0.302	0.402	0.112
1106	0.064	0.116	-0.126	-0.244	0.617	0.044	-0.308	0.501	0.170

Table 8

They also calculated the differences in geodetic coordinates for the four points used for processing in the three variants of calculation, reported the coordinates of points acquired from Miercurea Ciuc O.C.P.I.

Point no.	Variant 1			Variant 2			Variant 3		
	Dx(m)	Dz(m)	Dy(m)	Dx(m)	Dz(m)	Dy(m)	Dx(m)	Dz(m)	Dy(m)
1067	0.192	0.199	-0.874	-0.001	0.041	-0.034	0.031	-0.880	0.594
1089	0.176	0.089	-0.653	0.013	-0.035	0.015	-0.118	-0.617	0.364
1102	0.087	0.213	-0.160	0.052	0.109	-0.105	0.215	-0.615	0.048
1106	0.000	0.000	0.000	-0.064	-0.116	0.126	0.308	-0.501	-0.170

CONCLUSIONS

Spatial positioning of the points minor control network from the forestry sector related to the mountain areas, difficult access may be relatively optimal conditions using GNSS technology.

For these works need adequate logistics, taking into account the technical requirements imposed by the working methods adopted and the conditions on the ground, in particular orographic and forest vegetation.

The coordinates of the points from the minor control network obtained in the three variants of calculation falls within the tolerance imposed by the technical rules in force for the mountainous area.

Coordinate differences obtained in the three variants of calculation algorithms are due to different relative positioning of items and obviously the particular work conditions.

To achieve a homogeneous database at national level, it is recommended to use the TransDatRo 4.01, recommended application by A.N.C.P.I.

To streamline the process of spatial positioning of the various details of GNSS technology in the forestry sector, should consider the relationship between financial effort due to the logistical base to ensure the accuracy necessary for the proper realisation of the work and results.

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