SOME SPECIFIC CHARACTERISTICS OF THE GEOMATIC APPLICATIONS IN THE AGRO-FORESTRY SECTOR

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Abstract

Currently the geomatic applications represent efficient ways of spatial positioning and complex analysis of the objective reality in 2D and/or 2D+1D space according to the used logistics and objectives to be achieved. In the agro-forestry sector, due to the specific working conditions, the positioning of the details often must face a series of problems. The usage of some accurate satellite images (satellite maps) with corresponding resolution that can be accessed on-line in digital or analogue format are needed for the accurate identification, delimitation and positioning of various real estate found within or outside the incorporated area. The detail positioning can be accomplished by using vector-type data (collected with modern G.N.S.S., T.S., combined technologies) or raster-type data that were collected in corresponding working conditions (with specialised programmes) with the digital or analogue maps. The achieved coordinates after the detail positioning (by using the two methods) are used for the plan representation of the respective real estates, design of the thematic maps and/or of other final desired products. The case study was done in Groşi village, in the area of Vârfurile T.A.U., Arad County, during the period 2015-2016.

Key words: geomatics, spatial positioning, satellite maps, specialised programmes, advanced technologies, G.N.S.S. technology

INTRODUCTION

The current accomplishment of the applications on the spatial positioning of the various details of the agro-forestry sector involves a type of logistics suitable to the collection and processing of the field data and to obtain a final appropriate product in alphanumeric, analogue or digital format (Boş, 2011, Petrila, 2011).

The determination of the characteristic point coordinates corresponding to various land types subject to financing (subsidies) by A.P.I.A., is required to determine the surface with high accuracy and respectively to achieve the topo-cadastral documentation related to the registration of the property in the land register.

As for the calculation of areas and realization of the topo-cadastral documentation some vector-type data are required, obtained by spatial positioning with working technologies consecrated to these activities, the use of raster-type data will only have a role to identify the real estate with a high efficiency in the field. As a result, the use of orthophotoplan related to areas where the spatial positioning of the characteristic points of the identified real estate is achieved, it represents now an efficient way for the design of the works that are to be achieved (Iovan, Crainic, 2009).

The spatial positioning of the details in the agro-forestry sector can be achieved in optimum conditions with the G.N.S.S. technology the G.P.S. system with the conventional technology using the total station or with combined technologies using G.P.S. receivers and the total station in a combined working algorithm (Crainic, Damian, 2011).

MATERIAL AND METHOD

The case study was conducted in Groşi locality, Vârfurile Village, Arad County during the period 2015-2016, and had as a main objective the spatial positioning of some agricultural areas and partially covered by forest vegetation with the aim of obtaining A.P.I.A. subsidies.

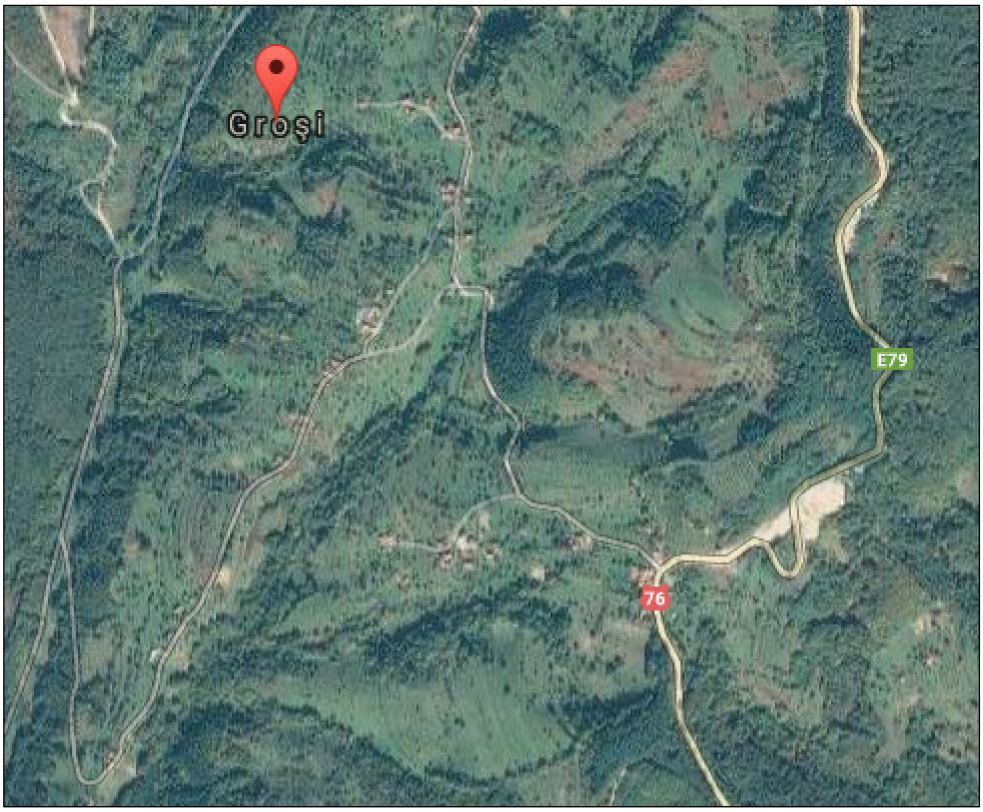

Photo.1 - Study location (http://satul.net/harta-grosi-ar/)

The used research methods are represented by the bibliographic documentation, observation, recording on magnetic media, experiment, simulation and comparison. Five G.P.S. receivers of Trimble R3 and R4 type were used for data collection.

The recording of observations has been made with Trimble Digital Field Book. The processing of records was achieved with Trimble Total

Control. Application TransDatRO 4.04 was used in order to obtain the final coordinates, in the national system of reference.

The reporting of coordinates and achievement of plans and maps was done with MapSys 10.0. The satellite map used to identify the details, respectively for the collection of raster-type data was implemented on the website: (http://satul.net/harta-grosi-ar/).

For the spatial positioning of the topographic details with the G.P.S. system by the static method, a thickening network was designed, by using the permanent G.N.S.S. station Gurahonţ – GURA, placed at a distance of about 20-25 km from the location of the case study (Crainic, Bodog, 2015).

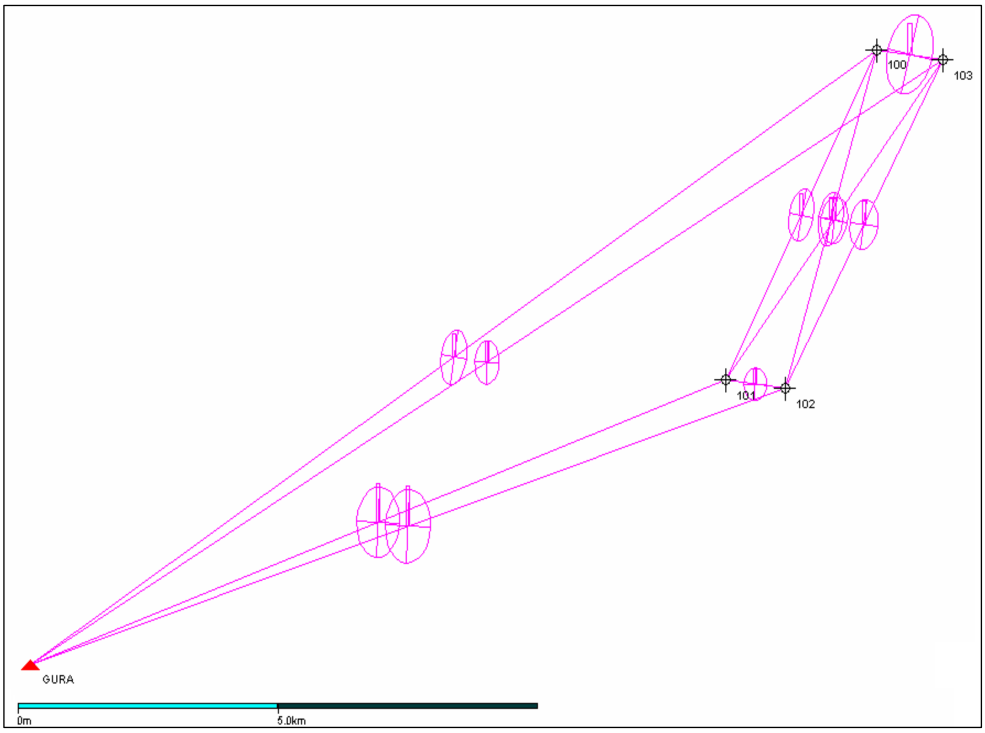

Fig. 2. General outline of the thickening network accomplished with the G.P.S. system by the traditional static method

After the accomplishment of the thickening network – fig. 2, for the positioning of the real estate (by real estate, according to Law no. 133/2012, it is understood the land with or without buildings on the territorial administrative unit T.A.U. – village belonging to one or more owners that is identified by a unique cadastral number) under study, point no. 100 fig. 3 was used, where a G.P.S. – TRIMBLE R3 was placed for a period equal to the time necessary to position all the other characteristic points, that were stationed with G.P.S. – TRIMBLE R3 receivers.

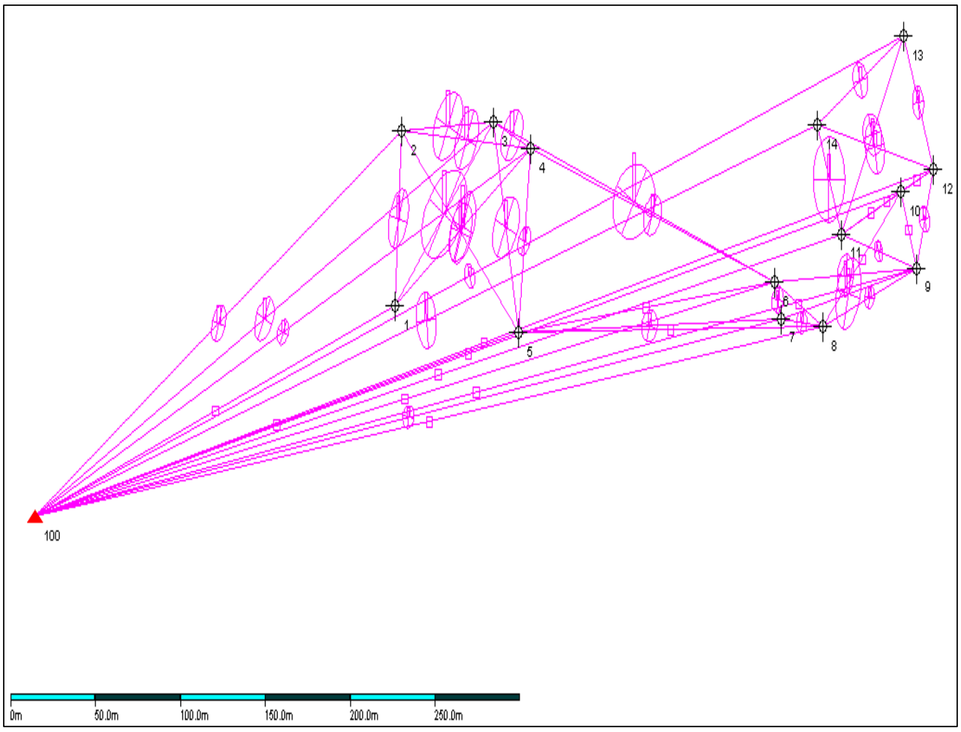

Fig. 3. General outline of the details positioning process with the G.P.S. system by the fast-static method, by using the well-known point 100

RESULTS AND DISCUSSION

The data for accomplishing the support network were recorded with the G.P.S. system by the traditional static method and were processed with the programme Trimble Total Control, thus obtaining the coordinates in global system, rigorously compensated, that are presented in the tables below:

Table 1

User Name	Trimble Employee	**Date & Time**	14:04:16 06/10/2016
Coordinate System	Romania	**Zone**	Stereo 70
Project Datum	S-42 (Hungary)	**Geoid Model**	EGG97
Coordinate Units	Meter		
Distance Units	Meter		
Height Units	Meter		
Angle Units	Degrees		

Table 2

Number of GPS Baselines	10
Number of Total Station Measurements	0
Number of Control Points in WGS84	1
Number of Adjusted Points	5
Confidence level	1 σ
Significance Level for Tau Test	1.00 %
Standard Error of Unit Weight	0.519
Number of Iterations	1
Refraction Coefficient	0.140

Table 3

Baselines Input in WGS84 (Components and Std.Dev.)

Observa-tion	**ΔXm**	**σmm**	**ΔYm**	**σmm**	**ΔZm**	**σmm**	**Solution**
100-101	4868.8281	8.8	-931.9891	6.0	-4202.739	10.1	Double Diff. / Fixed / L1
100-102	4492.7311	9.0	147.3274	6.1	-4290.563	10.3	Double Diff. / Fixed / L1
100-103	-469.0367	13.0	1181.6479	10.1	-183.9554	14.8	Double Diff. / Fixed / L1
101-103	-5337.8661	9.2	2113.6375	6.3	4018.7898	8.7	Double Diff. / Fixed / L1
102-101	376.0972	6.4	-1079.3154	5.0	87.8223	5.9	Double Diff. / Fixed / L1
102-103	-4961.7688	9.9	1034.3207	6.7	4106.6119	9.3	Double Diff. / Fixed / L1
GURA-100	-13493.614	9.4	11653.6780	6.3	7980.1865	10.6	Double Diff. / Fixed / L1
GURA-101	-8624.7793	15.9	10721.6842	10.3	3777.4204	13.1	Double Diff. / Fixed / L1
GURA-102	-9000.8771	16.7	11801.0003	10.8	3689.5969	13.7	Double Diff. / Fixed / L1
GURA-103	-13962.650	9.1	12835.3276	6.1	7796.2327	7.9	Double Diff. / Fixed / L1

Table 4

WGS84 Control Points Input (Cart. Coordinates and Std.Dev.)

Point	**X**(m)	**σ**(mm)	**Y**(m)	**σ**(mm)	**Z**(m)	**σ**(mm)
GURA	4085673.4549	0.0	1678807.3307	0.0	4585955.5123	0.0

Table 5

Adjusted Baselines in WGS84 (Components and Std.Dev.)

Observation	**ΔX** m	**σ** mm	**ΔY** m	**σ** mm	**ΔZ** m	**σ** mm
100-101	4868.8296	3.0	-931.9895	2.1	-4202.7450	3.3
100-102	4492.7323	3.1	147.3265	2.1	-4290.5676	3.3
100-103	-469.0375	3.4	1181.6487	2.3	-183.9519	3.6
101-103	-5337.8672	3.1	2113.6382	2.2	4018.7931	3.0
102-101	376.0973	2.6	-1079.3160	1.9	87.8226	2.5
102-103	-4961.7699	3.2	1034.3223	2.2	4106.6157	3.0
GURA-100	-13493.6118	3.4	11653.6771	2.3	7980.1787	3.6
GURA-101	-8624.7822	3.6	10721.6876	2.4	3777.4337	3.3
GURA-102	-9000.8795	3.7	11801.0036	2.5	3689.6110	3.4
GURA-103	-13962.6494	3.4	12835.3258	2.3	7796.2267	3.1

Table 6

Baseline Residuals (Residuals and Standardized Residuals)

Observation	Northing Res.	Stand. Res.	Easting Res.	Stand. Res.	Height Res.	Stand. Res.	Red.No.
100-101	-4.4mm	-1.118	-0.9mm	-0.479	-2.8mm	-0.747	1.67
100-102	-3.3mm	-0.809	-1.3mm	-0.633	-2.3mm	-0.600	1.69
100-103	2.7mm	0.406	1.0mm	0.234	2.2mm	0.360	2.34
101-103	2.8mm	0.827	1.1mm	0.510	1.9mm	0.490	1.69
102-101	0.3mm	0.162	-0.5mm	-0.311	0.1mm	0.054	1.17
102-103	2.9mm	0.763	1.8mm	0.779	2.4mm	0.573	1.81
GURA-100	-6.8mm	-1.698	-1.8mm	-0.904	-4.3mm	-1.124	1.56
GURA-101	10.2mm	1.703	4.3mm	1.063	8.7mm	1.107	2.34
GURA-102	10.4mm	1.655	3.9mm	0.934	9.6mm	1.160	2.38
GURA-103	-4.5mm	-1.629	-2.1mm	-1.190	-4.0mm	-1.173	1.35

Table 7

Adjusted Points in WGS84 (Cart. Coordinates and Std.Dev.)

Point	X(m)	σ(mm)	Y(m)	σ(mm)	Z(m)	σ(mm)
100	4072179.8431	3.4	1690461.0078	2.3	4593935.6910	3.6
101	4077048.6727	3.6	1689529.0183	2.4	4589732.9460	3.3
102	4076672.5754	3.7	1690608.3343	2.5	4589645.1233	3.4
103	4071710.8055	3.4	1691642.6565	2.3	4593751.7390	3.1
GURA	4085673.4549	0.0	1678807.3307	0.0	4585955.5123	0.0

Table 8

Adjusted Points in WGS84 (Geogr. Coordinates and Std.Dev.)

Point	Latitude (° ' ")	σ mm	Longitude	σ mm	Height m	Elevation m	σ mm
100	N 46° 22' 05.70870"	3.5	E 22° 32' 40.29971"	2.0	481.4569	438.6038	3.7
101	N 46° 18' 54.74604"	3.4	E 22° 30' 32.82376"	2.1	299.1618	256.3688	3.8
102	N 46° 18' 51.23836"	3.4	E 22° 31' 26.15396"	2.1	281.1681	238.3616	3.9
103	N 46° 22' 01.12854"	3.1	E 22° 33' 39.76702"	2.0	362.1401	319.2513	3.6
GURA	N 46° 15' 59.31620"	0.0	E 22° 20' 16.11551"	0.0	251.6871	208.9211	0.0

Table 9

Adjusted Points Error Ellipses

Point	Semi-major Axis (mm)	Semi-minor Axis (mm)	Angle (°)	95% confidence radius (mm)
100	3.5	2.0	8.3	7.3
101	3.4	2.1	5.4	7.0
102	3.4	2.1	5.4	7.1
103	3.1	1.9	4.5	6.6
GURA	0.0	0.0	90.0	0.0

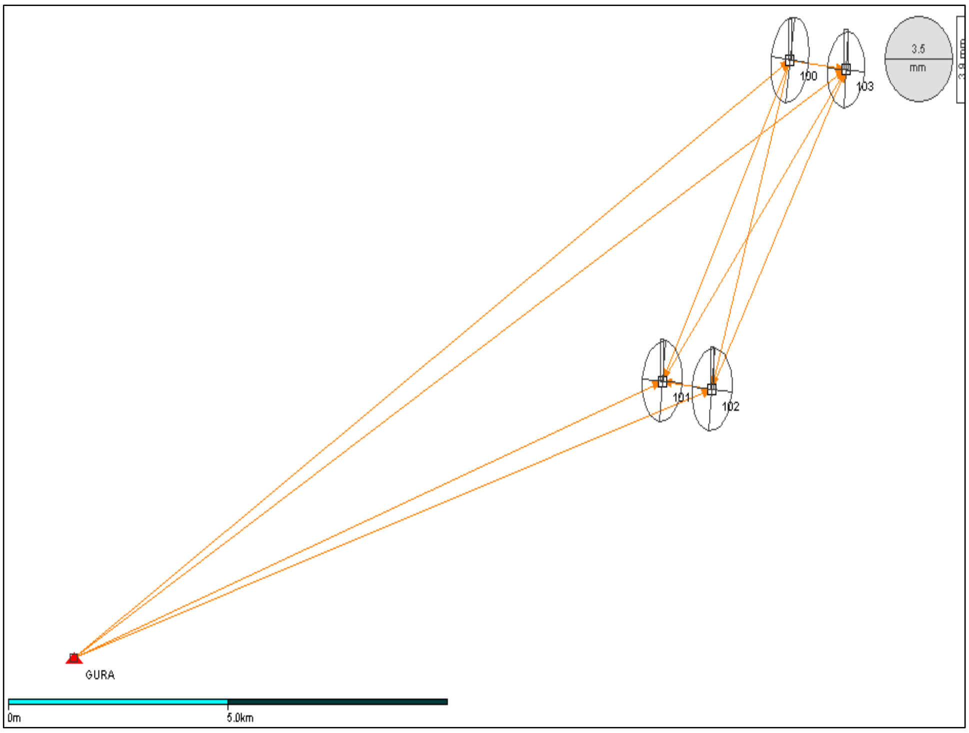

Fig. 4. Outline of the thickening network that is rigorously compensated in a global system if coordinates with Trimble Total Control programme

The rigorous compensation in a global system of the thickening network with G.P.S. system, by using T.T.C. programme is presented in fig. 4.

The final coordinates, in the Stereo System-1970 and the benchmark system Marea Neagra – 1975 were achieved by transforming the geographic coordinates with TransDatRO 4.04 application and are found in table 10.

Table 10

Final coordinates of the points in the thickening network

No. points	**X(m)**	**Y(m)**	**H(m)**
0	*1*	*2*	*3*
100	543875.436	311238.527	438.681
101	538066.836	308330.379	256.406
102	537922.934	309467.426	238.403
103	543694.927	312504.628	319.336
500 (GURA)	533080.983	294961.362	208.749

Similarly, the final coordinates (in the national reference system) of the contour points corresponding to the real estate positioned with the G.P.S. system by the fast-static method were determined.

Photo.2 -Thus observing the plan positioning of the real estate under study

Table 11

Final coordinates of the contour points corresponding to the real estate positioned with the G.P.S. system by the fast-static method

No. points.	X(m)	Y(m)	H(m)	Nr. pct.	X(m)	Y(m)	H(m)
0	*1*	*2*	*3*	*4*	*5*	*6*	*7*
1	543952.930	311450.040	412.859	28	544266.722	311647.615	446.907
2	544017.576	311454.211	386.037	29	544257.247	311631.278	444.506
3	544020.978	311508.138	392.033	30	544256.900	311636.932	446.334
4	544011.185	311530.141	394.556	31	543547.049	311369.521	410.619
5	543942.972	311522.815	416.833	32	543529.634	311376.342	411.283
6	543961.770	311673.517	431.474	33	543490.803	311395.949	412.197
7	543948.307	311677.368	437.064	34	543451.406	311420.157	412.995
8	543945.250	311702.071	440.875	35	543459.890	311435.403	415.439
9	543966.992	311756.942	447.171	36	543524.750	311391.334	412.804
10	543995.222	311748.060	439.102	37	543547.039	311369.485	410.599
11	543979.560	311712.834	435.503	38	543565.535	311366.764	410.224
12	544003.291	311766.738	440.454	39	543548.824	311382.943	409.323
13	544052.661	311749.308	425.256	40	543574.552	311379.562	407.511
14	544019.737	311698.083	415.023	41	543606.051	311364.406	408.032
15	544113.020	311711.278	448.678	43	543684.862	311359.885	389.223
17	544140.545	311645.266	449.854	44	543659.094	311345.359	388.487
19	544150.497	311656.690	453.417	45	543659.618	311359.675	389.442
20	544161.399	311671.786	457.911	200	543685.995	311360.593	389.660
21	544131.001	311712.955	455.856	201	543685.963	311376.242	390.376
22	544170.522	311640.835	454.131	202	543706.915	311376.426	379.634
23	544189.061	311629.701	453.239	203	543709.193	311360.138	376.934
25	544232.718	311614.458	442.101	300	544209.512	311673.543	461.547
26	544249.393	311624.913	444.008	301	544199.179	311647.377	455.713
27	544207.704	311621.743	449.538	302	544266.775	311647.522	165.983

For checking the accuracy of the details of the real estates in the field, an orthophotoplan was used that was implemented on-line in the spatial databases by the help of MapSys10.0 programme with the application ***map import***. As a consequence, the layer with the positioned characteristic points by the help of the final coordinates (in the national reference system) was overlapped over the orthophotoplan in digital system (raster), thus observing the plan positioning of the real estate under study (Photo.2).

CONCLUSIONS

The thickening of the support network can be accomplished with a high efficiency with the static method by using the records from the permanent G.N.S.S. station Gurahonţ (GURA), Arad county and implicitly the transformation parameters ANCPI.

The thickening points of the support network can be transposed in the field under the form of Feno-type landmarks or wood landmarks.

Having in view the aspects related to everlasting and security of the landmarks from the agricultural and/or forest lands in the area where the case study was accomplished, the wood landmarks that have the mathematical axis represented by a special metal bolt are recommended.

The positioning of details with G.N.S.S. technology, G.P.S. system, by the static method in the two variants, provides a high accuracy and precision.

The usage of the static positioning method represents a positioning alternative as long as the R.T.K. method cannot be implemented because of the technical and logistic conditions (lack of signal for data transfer from the permanent G.N.S.S. station).

The usage of the orthophotoplan and digital maps on-line by using specialized programmes for the achievement of the positioning project, respectively for checking the accuracy of results, represents now an opportunity related to the geomatic technologies, advantage that must be exploited correspondingly.

The further positioning of some details in the area where the thickening of the support network has been achieved, involves the usage of at least one thickening point that was previously processed, in order to use the transformation A.N.C.P.I. parameters for the working area, thus removing the need of a new acquisition of G.N.S.S. data.

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