Using Satellite Methods, GNSS ROMPOS In Developing The Control And Survey Network Of LIPOVA Forestry Buildings, U.P.V. BELOTINT, ARAD County

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Abstract: - The paper presents the determination of new points for the control and survey network based on the points from the existing National Geodesic Network, using satellite measurements and determinations, GNSS. The geodesic network us located on the administrative territory of Belotint, Arad county. The control and survey network of GNSS satellite measurements and determinations was used for measurements in the field of forest cadastre, applying the new ROMPOS technology, partially available at the moment of measurements, only on the GPS segment, but not on the GLONASS segment. Finally, some conclusions are drawn regarding the usage of this new technology in the forest cadastre.

Key-words: - Control network, survey network, GNSS satellite determination, ROMPOS, forest cadastre, geodesic network

1. The Topo-Geodesic Works That Are Verified And Their Location

The objective of this paper is to determine new points for the high-density and survey network, based on the points of the existing National Geodesic Network, through satellite measurements and determinations. In the same time, a survey network was determined, developed in the high-density geodesic grid previously determined. The geodesic network is located in the administrative territory of Belotint, Arad county.

2. The Existing Geodesic Network

The existing geodesic points from the work area used for the determinations by GNNS measurements belong to the State Geodesic Networks and comprise 5 triangulation points, as follows:

No.	Point label
1	IAGONITA (III)
2	NEGRILOT (III)
3	DAMBUL DOMANULUI(IV)
4	FRASINEL(IV)
5	BARZAVA CIMITIR (CEMETERY) (V)

3. The Technical Project For Works Implementation

The technical project, drafted on the 1:10000 scale map was finalized after the field recognition of the points of the existing state geodesic network. The 5 points of the geodesic network were spatially determined using satellite methods. 4 points were projected for the high-density grid, labeled as follows: B1, REF1, REF2, REF3, and for the survey network this was not necessary, because the RTK method was used for measurements.

When choosing the location of the points, the following aspects were taken into account:

- the new points should be located near traverses that are easily accessible all year;

- the points should be located near the objectives which are going to be topographically surveyed;
- the physical obstacles, power lines or transformer stations should be avoided near the receptors (elevation angle > 15^G)
- the conservation of points should be assured for a long time.

4. The Materialization Of The High-Density Geodesic Grid Points

The materialization of new contour and high-density points determined using GPS measurements was performed with FENO like boundary marks, according to regulations, accepted by the beneficiary.

5. The Equipment Used For Measurements

The measurements were performed using 4 LEICA SR20 L1 receptors, for the trans-computation polygon and 3 geodesic class L1 L2 GPS GLONAS, RTK LEICA 1230 receptors.

6. Performing Gps Measurements

The GPS measurements were carried on between 30.08.2008 – 20.10.2008 using the static method with GPS signal processing intervals of 5 seconds and the RTK cinematic methods in sessions of 3-20 periods of 5 seconds. The bases determined by the points where the GPS receptors were stationed have lengths between 20 m and 11 km.

The PDOP values fall withing the optimal limits 2 – 4. During measurements, in certain bases the PDOP was larger because of intersection with the measurement period of other receptors, but for short time (< 5 min), or because of the bad configuration of satellites, and therefore these bases were removed from processing. The number of observed satellites varied between 4 and 11.

7. The Computation And Compensation Of Gps Measurements

GPS measurement data processing, the computation and compensation of the high-density geodesic grid were performed using LEICA Geo Office 6.0 L1 L2 GPS GLONASS software.

Processing Summary

10.09_belotint2_postprocesare

Project Information

Project name:	10.09_belotint2_postprocesare
Date created:	11/07/2008 17:49:56
Time zone:	2h 00'
Coordinate system name:	belotint
Application software:	LEICA Geo Office 6.0
Start date and time:	10/09/2008 11:44:15
End date and time:	10/09/2008 16:59:46
Manually occupied points:	1
Processing kernel:	PSI-Pro 2.0
Processed:	11/07/2008 19:56:50

Processing Parameters

Parameters	Selected
Cut-off angle:	15°
Ephemeris type:	Broadcast
Solution type:	Automatic
GNSS type:	GPS
Frequency:	Automatic
Fix ambiguities up to:	80 km

Min. duration for float solution (static):	5' 00"
Sampling rate:	Use all
Tropospheric model:	Hopfield
Ionospheric model:	Automatic
Use stochastic modelling:	Yes
Min. distance:	8 km
Ionospheric activity:	Automatic

Baseline Overview

FAGE - ref2	Reference: FAGE	Rover: ref2
Receiver type / S/N:	SR530 / 506850302	GX1230GG / 469264
Antenna type / S/N:	LEIAT504 LEIS / -	AX1202 GG Tripod / -
Antenna height:	0.0000 m	1.3460 m
Coordinates:		
Easting:	280960.6990 m	266875.1717 m
Northing:	487749.9581 m	512204.4025 m
Ortho. Hgt:	172.5644 m	271.5630 m
Solution type:	Phase: all fix	
GNSS type:	GPS	
Frequency:	IonoFree (L3)	
Ambiguity:	Yes	
Time span:	10/09/2008 11:44:15 - 10/09/2008 16:59:46	
Duration:	5h 15' 31"	

Quality:	Sd. E: 0.0018 m	Sd. N: 0.0037 m	Sd. Hgt: 0.0012 m
	Posn. Qlty: 0.0042 m	Sd. Slope: 0.0022 m	
Baseline vector:	dX: -10244.2505 m	dY: -20311.8625 m	dZ: 16699.5279 m
	Slope: 28220.3943 m	dHgt: 98.4799 m	
DOPs (min-max):	GDOP: 1.7 - 24.0		
	PDOP: 1.5 - 21.7	HDOP: 0.9 - 19.5	VDOP: 1.2 - 9.5

The precision imposed on processing this data is 5cm +/- 2ppm. The points from the high-density and survey network were determined based on at least three vectors. After processing the data using the LEICA Geo Office 6.0 software, the following standard deviation values of bases determination were obtained:

- dx=4,3 mm, dy=2,7 mm, for the high-density network, and dx=1mm dy=1 mm for the survey network.

The trans-computation of coordinates from the WGS '84 datum into the Stereographic'70 datum was performed using the LEICA Geo Office 6.0 (Datum/Map) software.

The computation of transformation coefficients was performed based on the common points chosen from the state geodesic network. This option was chosen because a good general precision of coordinates is obtained after trans-computation. This transformation yields a file with geocentric coordinates X,Y,Z on the Krasovski ellipsoid.

The parameters of the transformation are:

Transformation details

Height mode:	Orthometric

3D-Helmert transformation

Number of common points:	5
Sigma a priori:	1.0000
Sigma a posteriori:	0.0432
Transformation model:	Bursa-Wolf

No.	Parameter	Value	rms
1	Shift dX	-7.8016 m	31.3064 m
2	Shift dY	-29.6288 m	34.9499 m
3	Shift dZ	156.0217 m	31.4082 m
4	Rotation about X	1.84569 "	1.04721 "
5	Rotation about Y	-2.15343 "	1.14378 "
6	Rotation about Z	-5.91821 "	0.96991 "
7	Scale	-5.2441 ppm	3.9472 ppm

After the spatial transformation the reverse process of trans-computation begins. Thus, from geocentric coordinates ==> geographic coordinates ==> stereographic'70 coordinates, both for the points from the state geodesic network and the points from the high-density and survey network.

Coordinates Overview

Project : final1

User Name	Trimble Employee	**Date & Time**	16:43:59 8/3/2009
Coordinate System	Stereo70	**Zone**	stereo70
Project Datum	S-42 (Hungary)	**Geoid Model**	
Coordinate Units	Meter		
Distance Units	Meter		
Height Units	Meter		
Angle Units	Degrees		

Number of Points 6

Point Information

Point Name	Point Code	Point Info.	Fix	Adjusted	Local	Control
B01	B01		No	Yes	No	No
BARZ	BARZ		No	Yes	No	No
DOMAN	DOMAN		No	Yes	No	No
FRAS	FRAS		No	Yes	No	No
IAGO	IAGO		Yes	Yes	No	Yes
NEG	NEG		No	Yes	No	No

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WGS84 - Cartesian Geocentric Coordinates

Point Name	X	Y	Z
B01	4112344.7869m	1657408.4673m	4570155.5114m
BARZ	4107512.9054m	1658444.5527m	4573911.4886m
DOMAN	4113918.9177m	1658961.4429m	4568117.1837m
FRAS	4115677.9465m	1656726.5052m	4567308.2208m
IAGO	4113653.8616m	1649848.2703m	4571599.2673m
NEG	4112324.0882m	1657407.1617m	4570175.7195m

WGS84 - Geographical Coordinates

Point Name	Latitude	Longitude	Height
B01	N 46° 03' 36.24506"	E 21° 57' 03.72635"	378.4047m
BARZ	N 46° 06' 36.11436"	E 21° 59' 12.57881"	244.9441m
DOMAN	N 46° 02' 02.84974"	E 21° 57' 43.34227"	327.3163m
FRAS	N 46° 01' 26.09755"	E 21° 55' 36.39189"	298.0277m
IAGO	N 46° 04' 46.13348"	E 21° 51' 14.62253"	304.2483m
NEG	N 46° 03' 37.15827"	E 21° 57' 04.02997"	379.2957m

National Grid Coordinates

Point Name	Northing	Easting	Height	Elevation
B01	511224.5325m	264282.5889m	337.8180m	337.8180m
BARZ	516669.2247m	267260.6734m	204.4426m	204.4426m
DOMAN	508310.1648m	265023.5407m	286.7293m	286.7293m
FRAS	507280.9051m	262251.5006m	257.3817m	257.3817m
IAGO	513672.9120m	256868.9890m	263.5300m	263.5300m
NEG	511252.4609m	264290.1906m	338.7093m	338.7093m

National/Local Grid Control Coordinates

Point Name	Northing	Easting	Elevation
IAGO	513672.9120m	256868.9890m	263.5300m

8. The Precision Of Determinations After Measurements Computation And Compensation

Based on the comparison of stereographic 1970 coordinates of triangulation points and the coordinates of the same points obtained as result of GPS determinations, it is shown that the differences between the coordinates of the points determined by the method of triangulation and of the points determined by the GPS method are smaller both on X and Y.The differences obtained between the coordinates of the state geodesic network and the coordinates determined by GPS measurements in case of spatial transformation are as follows:

No	Point label	dX [m]	dY [m]
1	IAGONITA (III)	-0.001	-0.001
2	NEGRILOT (III)	0.010	-0.020
3	DAMBUL DOMANULUI(IV)	-0.033	0.033
4	FRASINEL(IV)	-0.017	-0.020
5	BARZAVA CIMITIR (CEMETERY)(V)	-0.070	0.042

9. Conclusions

From technical geodesic-topographic point of view, the precisions imposed by the A.N.C.P.I. approved valid technical norms have been ensured. The points from the high-density and survey network determined using satellite methods can be used within this work, as well as during other topographic measurements performed in the area.

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