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THE REALIZATION OF AN ELEVATION NETWORK IN ORDER TO REVISE THE SITUATION PLAN OF UASVM CLUJ-NAPOCA

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Abstract

In the beginning, from TăieturaTurcului, we made a backwards multiple intersection. We have chosen this method because the points we had as visas areunstationable and the station point is stationable. After finishing the measurements on the field, the backwards multiple intersection and the polygonal route, the next step was processing the data from the measurement. For processing the data, we applied the matrix method for the backwards multiple intersection and for determining the provisional coordinates of the beginning point we used the baricentric procedure of the backwards intersection method.

Key words:*geodesy, network, plan.*

INTRODUCTION

The aim of this paper was to create a supported polygonal route by a targeted departure visa/sign from Taietura Turcului up to the GPS point inside the University of Agricultural Sciences and Veterinary Medicine Cluj - Napoca in order to review the USAMV Cluj-Napoca situation plan.
We achieved a backwards multiple intersection from Taietura Turcului taking as sings/visas the following points of Cluj-Napoca support network : 47 (hill Hoia) , 215 (Steluta) , 46 (St. Michael Cathedral) and 844 (relay TV) . We have chosen this method because the points in question are nonmobile and the station point is mobile.
First, we calculated provisional coordinates of the point 01 by the backwords intersection method (Moldoveanu, 2004), the barycentric coordinates procedure (Ortelecan and Pop, 2005; Ortelecan, 2006).

MATERIALS AND METHODS

In order to calculate the weights of each point, the coordinates of point 01 respectively we used the following formulae:

$$X_{01} = \frac{X_{47} \times P_{47} + X_{215} \times P_{215} + X_{844} \times P_{844}}{P_{47} + P_{215} + P_{844}}$$

$$Y_{01} = \frac{Y_{47} \times P_{47} + Y_{215} \times P_{215} + Y_{844} \times P_{844}}{P_{47} + P_{215} + P_{844}}$$

$$P_{215} = \frac{1}{ctg215 - ctg1}$$

$$P_{844} = \frac{1}{ctg844 - ctg2}$$

$$P_{47} = \frac{1}{ctg47 - ctg3}$$

RESULTS AND DISCUSSIONS

On the basis of the known coordinates we calculated the guidelines of the points. The results obtained by means of the baricentric coordinates method are presented in Table 1.

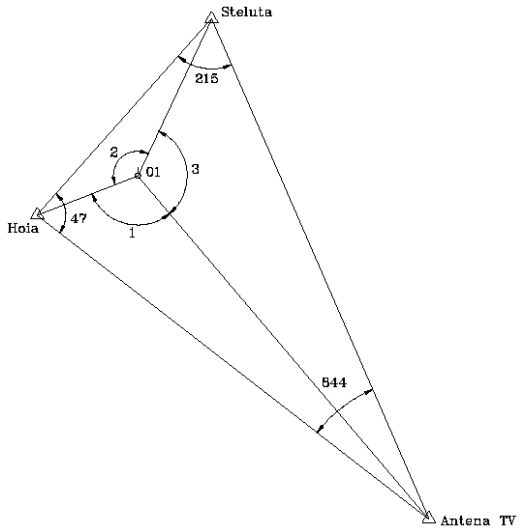

Figure 1. The angles used in intersection

Angles	1	120.8640
	2	151.7423
	3	127.3937
	47	95.9168
	215	72.2156
	844	31.8676
Shares	P47	1.911278101
	P215	1.240039584
	P844	0.346707109
Coordinates	X	587266.1267
	Y	390436.1529

Table 1.The provisional coordinates of point 01

After the calculation of point 01 provisional coordinates, we switched to calculating the final coordinates calculation through the matrix method.

Calculation of the guidelines:

$$\theta_{A\text{-}B} = \arctan\frac{y_B - y_A}{x_B - x_A}$$

Table 2. Guidelines calculated

Orientation		DY	DX	DY/DX	θ
01	Hoia	-2037.7759	-800.7457	2.5448	276.1640
	Steluta	1492.1311	3183.0933	0.4688	27.9063
	Sf Mihail	1976.2051	-687.9397	-2.8726	121.3262
	Antena TV	5896.7781	-6970.4767	-0.8460	155.2999

Distances calculation :

$$D_{A\text{-}B} = \sqrt{(y_B - y_A)^2 + (x_B - x_A)^2}$$

$$a_i = \rho^{cc} \times \frac{\sin\theta_i}{D_i}$$

Table 3. Distances between given points

Distance		D
01	Hoia	2189.457567
	Steluta	3515.471214
	Sf Mihail	2092.52183
	Antena TV	9130.144453

Table 4. Coefficients a1

a1	-270.6223108
a2	76.86352116
a3	287.3242858
a4	45.03396208
[ ]	138.5994582

Calculating the directioncoefficients:

$$b_i = \rho^{cc} \times \frac{\cos\theta_i}{D_i}$$

Table 5. Coefficients b1

b1	-106.341336
b2	163.969293
b3	-100.0208049
b4	-53.23376482
[ ]	-95.62661279

Table 6. Free terms

Point		θ	Ri	Zi	Zm	θ M	l
St 01	HOIA	276.1640	276.1665	-0.0025	-0.0004	276.1661	-0.002075
	STELUTA	27.9063	27.9088	-0.0025		27.9084	-0.002075
	SF MIHAIL	121.3262	121.3203	0.0059		121.3199	0.006325
	TV	155.2999	155.3025	-0.0026		155.3021	-0.002175
[ ]							0.000

where:

Ri-(directions measured on the ground)

$$Zi = \theta i - Ri$$

where : n – visa number

[Zi] – Zi sum

$$\theta \mathrm{M} = \mathrm{Zm} + \mathrm{R}$$

$$l = -(\theta M - \theta)$$

The equation system:

$$\begin{cases} -a_1 \times \Delta x_0 - b_1 \times \Delta y_0 - \Delta z_0 + l_1 = v_1 \\ -a_2 \times \Delta x_0 - b_2 \times \Delta y_0 - \Delta z_0 + l_2 = v_2 \\ -a_3 \times \Delta x_0 - b_3 \times \Delta y_0 - \Delta z_0 + l_3 = v_3 \\ -a_4 \times \Delta x_0 - b_4 \times \Delta y_0 - \Delta z_0 + l_4 = v_4 \end{cases}$$

Applying the 1-3 Schreiber rule , the system is:

$$\begin{cases} -a_1 \times \Delta x_0 - b_1 \times \Delta y_0 + l_1 = v_1 \\ -a_2 \times \Delta x_0 - b_2 \times \Delta y_0 + l_2 = v_2 \\ -a_3 \times \Delta x_0 - b_3 \times \Delta y_0 + l_3 = v_3 \\ -a_4 \times \Delta x_0 - b_4 \times \Delta y_0 + l_4 = v_4 \\ [a] \times \frac{i}{\sqrt{n}} \times \Delta x_0 - [b] \times \frac{i}{\sqrt{n}} \times \Delta y_0 = v' \end{cases}$$

For the matrix solving we used direction coefficients matrix (A) , the matrix free terms (L) and correction matrix (X).

The correction matrix is obtained with the formula:

$$X = \left(A^* \times A\right)^{-1} \times A^* \times l$$

$$A = \begin{pmatrix} a1 & b1 \\ a2 & b2 \\ a3 & b3 \\ a4 & b4 \\ [a] & [b] \end{pmatrix} \quad l = \begin{pmatrix} l1 \\ l2 \\ l3 \\ l4 \\ l5 \end{pmatrix}_{15 \to 0} \quad X = \begin{pmatrix} \Delta X \\ \Delta Y \end{pmatrix}$$

$$A = \begin{pmatrix} -270.622311 & -106.34134 \\ 76.86352116 & 163.969293 \\ 287.3242858 & -100.0208 \\ 45.03396208 & -53.233765 \\ 138.5994582 & -95.626613 \end{pmatrix}$$

$$A^* = \begin{pmatrix} -270.6223 & 76.8635 & 287.3243 & 45.0340 & 138.5995 \\ -106.3413 & 1639693 & -100.0208 & -53.2338 & -95.6266 \end{pmatrix}$$

$$P = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & -1 \end{pmatrix}$$

$$I = \begin{pmatrix} -0.002075 \\ -0.002075 \\ 0.006325 \\ -0.002175 \\ 0.000000 \end{pmatrix}$$

$$X = \begin{pmatrix} 0.0114319 \\ -0.0100045 \end{pmatrix}$$

The calculation of the final coordinates:

Table 7. The final coordinates of point 01

Pct	$X=X'+\Delta X_0$	$Y=Y'+\Delta Y_0$
01	587266.138	390436.143

On the basis of point 01 final coordinates, we achieved a supported polygonal route by two spots inside USAMV Cluj-Napoca (Figure 2).

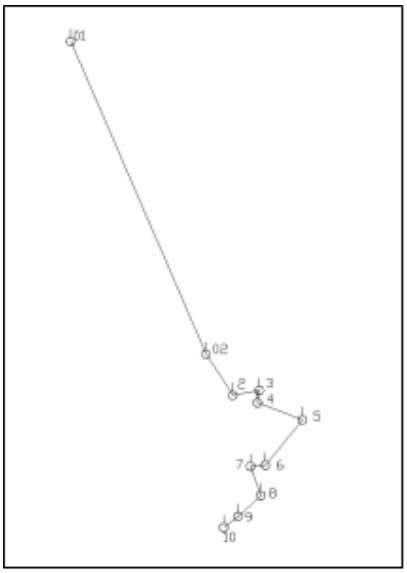

Figure 2. Polygonal route

For the preparation of the route we conceived the table that comprises the guidelines calculation, horizontal distance, provisional rectangular coordinates, coordinates correction and final rectangular coordinates (Table 9).

Table 8. Coordinates

Coordinates		
Pct	X	Y
01	587266.138	390436.143
10-GPS	585592.769	390963.405

We also calculated the overall length of the route, the total coordinates error(X , Y),and the coordinate unit error (Table 10).

Table 9. Polygonal route coordinates

Point		Orientation	Hz	Provisional coordinates		Corrections		Final coordinates		Point
St	V			X'	Y'	X	Y	X	Y	
01	02	173.9918	1173.4030	586189.302	390902.296	0.0778207	-0.0255467	**586189.380**	**390902.271**	**02**
02	2	163.0973	169.1940	586047.747	390994.971	0.0890417	-0.0292303	**586047.836**	**390994.942**	**2**
2	3	88.4501	92.8740	586064.504	391086.321	0.0952012	-0.0312524	**586064.599**	**391086.290**	**3**
3	4	209.9547	43.0850	586021.945	391079.611	0.0980586	-0.0321904	**586022.043**	**391079.579**	**4**
4	5	123.1465	165.2450	585963.179	391234.054	0.1090177	-0.0357880	**585963.288**	**391234.018**	**5**
5	6	243.5281	201.2510	585807.166	391106.925	0.1223648	-0.0401695	**585807.289**	**391106.884**	**6**
6	7	294.4491	51.5520	585802.677	391055.568	0.1257837	-0.0412919	**585802.803**	**391055.527**	**7**
7	8	178.2184	106.3520	585702.489	391091.250	0.1328371	-0.0436073	**585702.622**	**391091.207**	**8**
8	9	252.5309	106.0210	585630.560	391013.362	0.1398684	-0.0459156	**585630.700**	**391013.316**	**9**
9	10	258.6250	62.6900	585592.625	390963.452	0.1440261	-0.0472804	**585592.769**	**390963.405**	**10**

Table 10. Coordinates errors

Total length of the polygonal route	2171.6670
Total error on X	-0.144
Total error on Y	0.047
Unit error on X	-0.0000663205
Unit error on Y	0.0000217715

CONCLUSIONS

Because of the fact that the non-openings ranged within tolerance limits, we considered the points to be fixed , thus checking the entire network of the university (points marked in red on Figure 3).

Review plan USAMV situation inside Cluj-Napoca was the figuration of the plan of the new building on campus , " Life Sciences Research Center " completed in 2009 and the bridge over the PârâulȚiganilor facilitating access to the building. Since the situation of the university plan was last updated in 2006, these buildings did not exist at that time, it was necessary to update the plan (Figure 3).
All details of the building or bridge , were taken from station 192, 315 respectively in the immediate proximity of the two structures (Figure 3).

Figure 3. UASVM Cluj-Napoca situation plan

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