LOCAL IMPROVEMENT OF THE TRANSFORMATION PARAMETERS OF COORDINATES

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1. INTRODUCTION

The definition of a geodetic reference frame by modern techniques (GPS) requires a determination of transformation parameters from the existent to a new reference systems. The real accuracy of establishment of new reference system is 1.5-2 m in a plan, that can not provide the necessary accuracy for decision of geodetic tasks. Usage of transformation parameters from the existent coordinate system to a new reference system will allow to use points' coordinates in the existent reference system and store the cartographic fund of country. The main task of the given work was to propose the method of determination transformation parameters between new and classic reference systems. The given method of determination transformation parameters is based on creation of the transformation field by the least-square collocation method.

2. CREATION OF TRANSFORMATION FIELD

The main problem for realization such transformation were the small quantity of general points, which coordinates are known in two systems, and their irregular distributing. The basic data for the decision of the given task were possible values of differences of geodetic coordinates between existing and new reference systems, which were received after the real results of researches. We had chosen the local district with sizes 1,5°×1°.
For 25 points in chosen local district by the method of generation of random numbers were calculated geodetic differences $\delta B, \delta L, \delta H$ **between new and classic reference systems (Figure 1).**

Received values of geodetic differences were used as basic data. For greater evident angular differences were converted to the plane square coordinates differences $(\delta B, \delta L, \delta H) \Rightarrow (\Delta x, \Delta y, \Delta H)$**. The differences between coordinates of points in an existent system and in a new reference system may achieve 1,5 m and in a height - 3 m.**

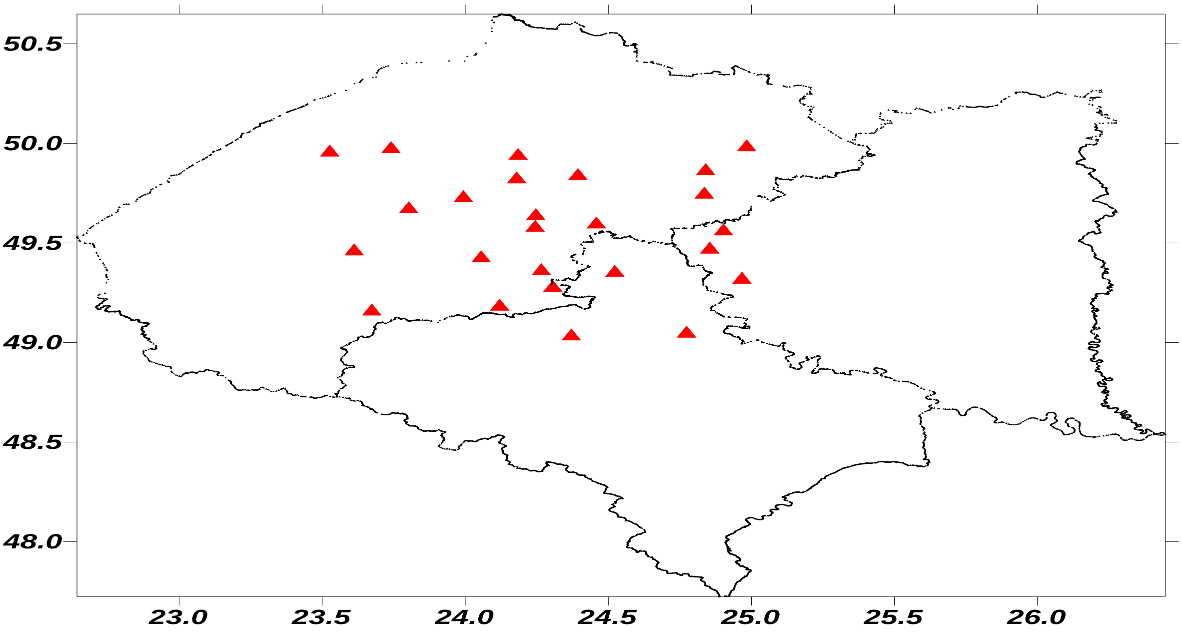

Fig. 1. Scheme of points, which coordinates are known in existing and new reference systems

For creation transformation field the geodetic differences were prognosed on the node of regular grid with a step 0.1'×0.1′ by the least-square collocation method (Figure 2).

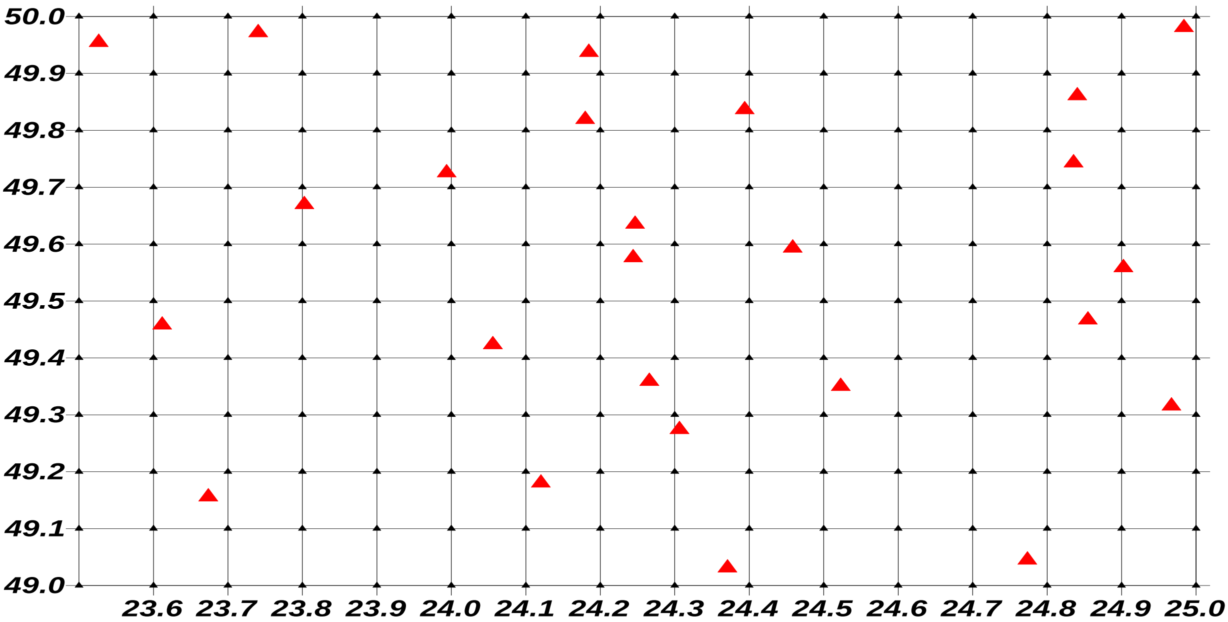

Fig. 2. Scheme of the created transformation field for the local district

For the prognosis of differences of geodetic coordinates by the least-square collocation method we had used such linear function:

$$c(r) = \frac{R_{\max} - R_{ij}}{R_{\max}}, \qquad (1)$$

where $R_{\max}$ **- maximal distance between basic points,**

R_{ij} **- distance between basic points(where** i, j **=1...25).**

General statistics of the prognosed geodetic differences of coordinates on the tops of regular net are shown in table 1. We had gotten 176 values of geodetic differences for our local district.

Table 1. Values of prognosed geodetic differences of coordinates between existing and new reference systems

parameters	Common amount of differences –176		
	minimal value	maximal value	average value
latitude, ^{o}	49,0	50,0	49.5
longitude, ^{o}	23,5	25,0	24,2
$\delta B,''$	-0,0063 ± 0,001	-0,0457 ± 0,001	-0,0260
$\delta L,''$	-0,0405 ± 0,002	-0,0579 ± 0,001	-0,0492
δH, м	0,8924 ± 0,002	-1,6024 ± 0,003	-0,3550

Using the same principles, we had prognosed the differences of geodetic coordinates for a point, in which it is necessary to model transformation parameters from the existent system to a new reference system. For this task as basic data we had used the tops of square, in which the prognosis point hits. The example of prognosis for point is shown at figure 3.

3. CALCULATION OF TRANSFORMATION PARAMETRES

Getting the differences of geodetic coordinates for the given point, we had calculated transformation parameters for local region from the existent system to a new reference system by the transformation formulas of coordinates' differences from the one system to another:

$$D_{X_i} = -\sin B \cos L \cdot M \cdot \delta B_i - \sin L \cos B \cdot N \cdot \delta L_i + \cos L \cos B \cdot \delta H_i ;$$

$$D_{Y_i} = -\sin B \sin L \cdot M \cdot \delta B_i + \cos L \cos B \cdot N \cdot \delta L_i + \cos B \sin L \cdot \delta H_i ; \quad (2)$$

$$D_{Z_i} = \cos B \cdot M \cdot \delta B_i + \sin B \cdot \delta H_i .$$

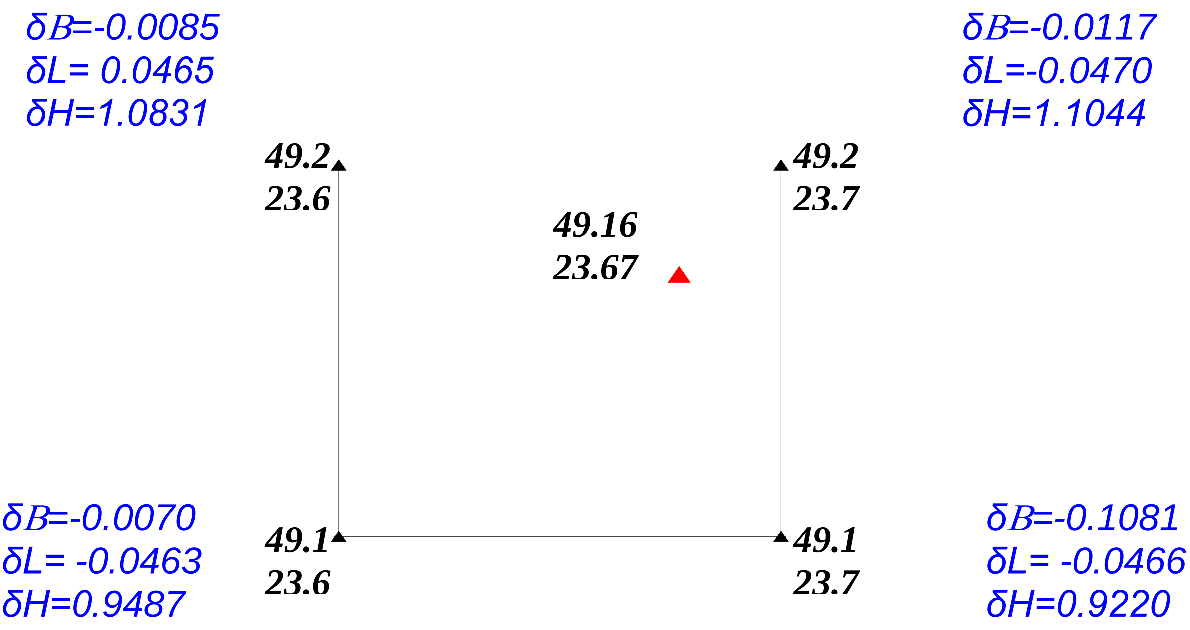

Fig. 3. Scheme of prognostication of differences between two reference systems for i point

Transformation from the existent system to new one we had done by means of the gotten parameters $D_{X\,i}, D_{Y\,i}, D_{Z\,i}$. The residual differences between coordinates in a new reference system and gotten by means of transformation parameters are shown at table 2 .

CONCLUSION

In general the value of error of coordinate transformation is near 3 m for Ukraine. The got parameters allow promoting transformation at local region between the systems with precision 2 cm.

Table 2. Differences between coordinates in a new reference system and got by means of parameters $D_{X\,i}, D_{Y\,i}, D_{Z\,i}$

№ point	Δx, m	Δy, m	ΔH, m
1	0.0771	0.0228	-0.1225
2	0.2434	-0.2297	-0.2053
3	-0.0622	0.1665	-0.0207
4	-0.2749	0.4698	-0.2129
5	0.0157	0.2016	0.3708
6	0.1017	0.0161	0.0347
7	-0.1953	-0.1579	-0.1032

8	*0.1349*	*0.0946*	*0.1626*
9	*0.0388*	*-0.1069*	*-0.4645*
10	*0.2518*	*-0.2385*	*-0.6485*
11	*-0.0875*	*0.1737*	*-0.2005*
12	*0.1004*	*0.3498*	*0.5379*
13	*0.2306*	*-0.0937*	*0.2569*
14	*0.0885*	*-0.1829*	*0.5795*
15	*-0.0437*	*0.1217*	*-0.1689*
16	*-0.1293*	*-0.1997*	*0.2461*
17	*-0.1083*	*0.2262*	*-0.0069*
18	*-0.0504*	*0.0804*	*0.5457*
19	*-0.1221*	*-0.0375*	*0.0843*
20	*-0.2850*	*0.4569*	*0.0060*
21	*0.0614*	*-0.5248*	*0.3620*
22	*0.1787*	*-0.5884*	*0.5950*
23	*-0.0411*	*0.1308*	*0.2845*
24	*0.1984*	*-0.0332*	*-0.3210*
25	*-0.2410*	*-0.3347*	*-0.3033*
Σ	0.0805	-0.2170	1.2878
average	0.0032	-0.0087	0.0515

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