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## POINTS COORDINATE TRANSFORMATION ACCORDING TO SATELLITE-DERIVED DATA USING SITE-CALIBRATION

In article deals with the transformation of coordinates of points, koordination using geodetic satellite receivers GPS. Postprocessing of the results of satellite measurements in the program Trimble Geomatics Office. Conducted investigations of the actual accuracy of the coordinates using the calibration of the work area and without it, the dependence between the accuracy paragraph and remove it from the base.

**Introduction.** When performing topographic-geodesic works for forest management and forest fund accounting data, geodetic satellites GPS receivers of the Trimble Navigation company (USA) are widely used [1]. Processing of results of measurements using these receivers is carried out in the program Trimble Geomatics Office (TGO) [2–4].

Performance of works of this kind demands determination of points coordinates in the state or local systems of coordinates. Therefore for calculation of coordinates by results of the satellite measurements, which are carried out by GPS receivers, the referencing to points of the state geodetic network (SGN) is necessary.

It is known that coordinates of the SGN points are received by block adjustment and have inevitable distortions on each local site of adjustment. In other words, in the coordinates of any SGN point there are the inevitable errors called data errors [5].

When performing satellite observation, it is possible to obtain the coordinates of a defined point with a significant accuracy, knowing coordinates of origin point, for example the SGN point. But in most cases the coordinates of this point are already wrong; therefore at a distance of several kilometers from it the defined point also will have error. Components of this error will include a geometrical arrangement of satellites on the celestial sphere relatively to each of receivers, and influence of the ionosphere on determination of pseudo-ranges from the receiver to the satellite.

Thus the error of the defined point will depend both on distance and data error.

Creation of new system of coordinates on a local site of works with use of the SGN points can be a solution of this problem. Such system of coordinates will be close to the original, repeating the same distortions as the starting points of SGN.

In the TGO program a new system of coordinates for a concrete site is called the calibration area. In this system of coordinates when using one origin point it is possible to calculate coordinates of the points measured from it with a high accuracy. It is necessary to notice that it is possible only within the calibration area.

**Main part.** For the purpose of a practical estimation of possibility of calibration area coordinates implementation, survey control points in Negorelsky experimental forestry station were deter-

mined with use of a set of the single-frequency satellite equipment Trimble R3 in system of coordinates WGS-84.

For transformation of coordinates according to the results of the satellite measurements which were carried out by means of GPS receivers, basic stations were established on the points of before created geodetic network with known coordinates [6].

When carrying out the researches it was necessary to determine coordinates of forestry station survey control points in the state and local systems of coordinates.

For this purpose in the course of post-processing of results of satellite measurements, parameter of works – a six-degree zone, characteristic for this site area was chosen in the settings of the TGO project.

For a practical estimation of possibility of calibration areas use the researches of the actual accuracy of determination of coordinates with use of the calibration area and without it were conducted.

Then comparison of coordinates of each SGN point, received in this and other systems, with the coordinates taken from the catalog was conducted.

The results of an estimation of accuracy of plane coordinates determination are presented in Table 1, where  $\Delta X_{CS-42}$ ,  $\Delta Y_{CS-42}$  are the deviations of coordinates of the SGN points calculated in CS-42, from values in the catalog;  $\Delta X_K$ ,  $\Delta Y_K$  are the deviations of coordinates of the SGN points, calculated by means of site-calibration, from values in the catalog.

Table 1

The results of estimation of coordinate transformation accuracy

Point No.	Deviation of point coordinates from values in the catalog, m			
	$\Delta X_{CS-42}$	$\Delta Y_{CS-42}$	$\Delta X_K$	$\Delta Y_K$
34	-0.57	-1.16	-0.01	-0.03
25	-0.53	-1.20	0.02	-0.05
33	-0.54	-1.19	0.02	-0.06
t6	-0.67	-1.25	-0.11	-0.15
31	-0.60	-1.01	-0.04	0.10
28	-0.55	-1.03	-0.02	0.08
29	-0.49	-0.99	0.03	0.11
35	-0.67	-1.30	-0.12	-0.15
t12	-0.43	-1.30	0.11	-0.12
t9	-0.51	-1.01	0.02	0.14

Similar transformations were conducted also for the local system of coordinates (LCS), where  $\Delta X_{LCS}$ ,  $\Delta Y_{LCS}$  are the deviations of coordinates of the SGN points, calculated by means of calibration areas in the local system of coordinates, from values in the catalog (Table 2).

Table 2

**The results of estimation of accuracy of coordinate transformation in the local system**

Point No.	Deviation of point coordinates from values in the catalog, m		Point No.	Deviation of point coordinates from values in the catalog, m	
	$\Delta X_{LCS}$	$\Delta Y_{LCS}$		$\Delta X_{LCS}$	$\Delta Y_{LCS}$
34	-0.02	-0.01	29	-0.03	0.08
33	0.02	-0.04	35	-0.02	0.05
t6	-0.09	-0.17	t12	0.07	0.00
31	-0.04	0.09	t9	-0.04	0.19
28	-0.07	0.08	32	-0.02	0.00

The obtained results show that upon calculation of coordinates of a defined point from a point with known coordinates (a basic point), the error of plane coordinates increases with deletion from origin (basic) point.

While calculation of coordinates of the chosen point in the calibration site, its deletion from origin (basic) point doesn't influence distribution of errors of plane coordinates determination. These errors are distributed in accordance with the peculiarities of the constructed model of new system of coordinates (the calibration site).

**Conclusion.** Application of calibration sites reduces value of errors of points coordinates, calculated from one basic point. Calibration sites can be replaced by the project, containing the SGN points, defining parameters of new (local) system of coordinates, and spatial GPS vectors from these points to a basic point.

**References**

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