Testing scientific Geodetic range for Certification of Devices and Technologies

Ihor TREVOHO, Stepan SAVCHUK, Ihor TSYUPAK, Ihor KOSHELEV, Ukraine

Key words: reference basis, reference range, metrological certification

SUMMARY

The results of creation and use metrology of objects of scientific geodetic range are analyzed: reference linear basis and reference geodetic range for certification and control of linear geodetic devices.

SUMMARY

Приведені результати використання наукового геодезичного полігону для метрологічної атестації і сертифікації приладів з вимірювання відстаней.
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Metrology the maintenance of geodetic measurements guarantees their unity and promotes increase of quality and efficiency of jobs. In a modern geodesy and at cadastral survey the linear measurements prevail which carry out with the help electronic tachymeter, light range-finder, laser roulettes, GPS of receivers. The necessity periodic metrology of certification or adjustment of linear devices is connected to change in due course of some technical parameters of devices, that is for maintenance of unity of measurements is necessary original metrology monitoring of measuring engineering. Metrology of the certification of devices should be carried out on reference bases. For certification and adjustment of receivers of signals GPS the companions are more preferable for having a reference geodetic network.

The frequency metrology of certifications and adjustment of reference objects depends on stability of their design, sizes, location, such as the centers and other reasons. But it is especially important, that the reference lines remained constant long time. For this reason metrology objects should pass the periodic control by alternative methods.

In Institute of Geodesy of National University “Lviv polytechnic” more than 30 years are conducted researches on metrology. Were constructed and some reference linear geodetic bases of a special design fixed high-stable by the tubular centers were effectively used and the recommendations on testing on them of geodetic measuring engineering are developed.

During last 12 years the new multifunctional scientific geodetic range (SGR) was created. Reference SGR is intended for research of modern geodetic engineering and technologies, for metrology of certification and testing of linear devices [1, 2] (chief of the project the professor I.Trevoho).

The features of designing and creation SGR are stated in the publications [1 - 4]. In them use of range for the decision of a complex of scientific and technical geodetic tasks among which is supposed it is possible to allocate: research satellite leveling, research of modern technologies and methods, perfection of a design of reference linear bases and development of technology of the control of their lengths on the basis of satellite measurements, development of a technique of the control of reference range, technique for realization of certification and metrology testing of the GPS-equipment. Structure SGR includes two local metrology of object, namely: reference linear geodetic basis and reference fundamental geodetic network for metrology of certification GPS-receivers.

The reference linear basis functions since 2003. He is fixed 20 by the special tubular centers with a compulsory centering. Length of basis 2260 m - sufficient for realization metrology of certification and calibration practically of all modern linear devices. In an initial part of basis the phase site with short intervals centre to centre for realization of special researches is incorporated.

The stability of reference basis is supervised as with the help of satellite measurements, and precise by geodetic devices. In table 1 the devices are given with which the control of lines of reference basis was carried out during 2003 – 2009 years.

<table>
<thead>
<tr>
<th>Table 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TS 5C - Instrument Calibration</strong></td>
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<tr>
<td>Ihor Trevoho. Stepan Savchuk, Ihor Tsyupak, Ihor Koshelev</td>
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</table>

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The detailed analysis of experimental measurements by different devices and methods has shown, that the divergences between values of lines of reference basis received by a method based on application of satellite technologies and with the help precise electronic tachymeters, do not exceed 1 mm. It testifies not only to enough high accuracy of an operative method GPS, but also about stability of a of the tubular centers of reference basis. Let’s note, that the maximal residual of lines for 6 years of operation of basis has achieved 1,5 mm. On reference basis the experimental researches both metrological certification, and adjustment of devices are spent.

Eight points enter into a reference geodetic network. Five of them are fixed by fundamental monoliths with the centers of a special design with a compulsory centering. The monoliths are incorporated up to radical breeds on depth up to 4,5 m. Besides the initial and final items of reference linear basis, and also permanent station GPS - SULP, included in network EUREF are switched on in a reference network. Distance from station SULP up to reference range of 40 km, and maximal distance between items of a reference geodetic network - 20,5 km.

For metrology the certification of satellite receivers while no a uniform technique and normative documents. Therefore, now, the reference geodetic network is optimum metrology by object allowing to estimate actual accuracy of the GPS-equipment. For achievement of the status of a reference geodetic network, maintenance of its accuracy the annual GPS-campaigns, duration 3-5 day, with use two-frequency of receivers of firm Trimble, supplied precision aerials are spent. The processing of daily files of supervision is carried out mainly by program TGO, but the programs GAMIT, GrafNav/GravNet and for the control of the separate decisions - Bernese v. 5.0 were in used. The analysis of results of processing of long-term supervision GPS in a reference network SGR allows to assert, that the accuracy of definition of spatial coordinates is less 1 cm, and the situation of fundamental items of a network is stable enough. It is demonstrated result by the given tab. 2, where the fragment of differences of vectors of a reference network is given.

<table>
<thead>
<tr>
<th>Line</th>
<th>Difference, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOSH-ANDR</td>
<td>3,5</td>
</tr>
<tr>
<td>GOSH-TZSU</td>
<td>-2,6</td>
</tr>
<tr>
<td>GOSH- VASL</td>
<td>0,2</td>
</tr>
<tr>
<td>ANDR-TZSU</td>
<td>-5,7</td>
</tr>
</tbody>
</table>

Table 2

TS 5C - Instrument Calibration
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From the analysis long-term GPS of definitions the average value of coordinates of items of reference range on epoch 2005.477 in system of coordinates ITRF2000 (table 3) are appreciated. Also from the analysis of coordinates of these items determined with 2005 on 2008 years, the estimation of speed of change of their coordinates is received [4].

<table>
<thead>
<tr>
<th>Point</th>
<th>$m_X$, m</th>
<th>$m_Y$, m</th>
<th>$m_Z$, m</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOSH</td>
<td>0.0020</td>
<td>0.0025</td>
<td>0.0017</td>
</tr>
<tr>
<td>ANDR</td>
<td>0.0068</td>
<td>0.0017</td>
<td>0.0104</td>
</tr>
<tr>
<td>TZSU</td>
<td>0.0030</td>
<td>0.0006</td>
<td>0.0034</td>
</tr>
<tr>
<td>VASL</td>
<td>0.0029</td>
<td>0.0034</td>
<td>0.0063</td>
</tr>
</tbody>
</table>

Table 3

CONCLUSIONS
1. The long-term monitoring with use of the most up-to-date equipment has shown high spatial - temporary stability metrology of objects at a level of several millimeters for reference GPS-range and < 1 mm for reference linear basis.
2. The experimental method of operative check of linear intervals of reference basis is developed on the basis of GPS-measurements, which provide accuracy up to 1 mm.
3. The stability of the tubular centers of basis is confirmed which during long time, practically, have not changed the spatial rule (situation).

REFERENCES

BIOGRAPHICAL NOTES
Ihor Trevoho is Professor of Geodesy at the National University Lviv Polytechnic at Lviv, where she has been on the faculty since 1961. Its scientific interests are connected with geodetic metrology. It is the President of the Ukrainian society of a geodesy and cartography since 2001.

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