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The role of reference geodetic landfills in the standardization of the satellite system and the problems of their metrological support

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ABSTRACT: This article examines the world experience in detecting measurement errors in the satellite system, i.e., errors in coordinate and distance measurements, and the resulting reference geodetic polygons. The research methods developed for the satellite system emphasize the need for the user to establish a reference geodetic network to assess its accuracy in measuring coordinates and distances under production conditions, to determine the type of error and to reduce the impact of error.

KEYWORDS: Triangulation, GPS receivers, GNSS, light number, polygon, standard, laboratory, coordinate and distance measurement, survey of geodetic instruments, metrology.

I. INTRODUCTION

Modern geodesy uses distance, angle and topographic surveys, GPS receivers, electronic tachometers, light meters, laser roulettes and traditional instruments. Currently, geodesy is a developed science in the field of measurement, successfully applying the methods of measurement theory, as well as a direction that is coordinated with the methods and means of metrological support based on the relevant standards of physical units and methods of measurement. Geodesy and metrology are closely related scientific disciplines in terms of measurements: metrology generally deals with measurements, geodesy performs measurements on the surface. In addition to the traditional topics of geodetic metrology, it is necessary to consider the metrological problems of distance measurement and angle measurements, leveling, gravimetric and geodetic networks, as well as modern space geodetic technologies that are widely used today. Metrological support of geodetic measurements guarantees their unity and helps to increase the quality and efficiency of work [1].

One of the most important tasks of metrology is to develop methods and means of measurement. The peculiarity of geodetic metrology is that the whole set of works on the development of new geodetic measuring instruments and the study of existing ones is carried out in the laboratory. The emphasized peculiarity of geodetic metrology leads us to a dialogue about the existence of geodetic metrology in two areas, one of which is the "closed" (laboratory) area, and the other - the "open" area, which I call the "polygon". By "landfill" we mean the general environment and the bulk of geodetic measurements in the surface layer of the atmosphere. Hence, the conditions closest to geodetic measurements are variability and unpredictable results [2].

Problem situation analysis: In geography and geodesy, specific methods of coordinate determination are used; in fact, geodesy and cartography are a special type of metrology that needs its own system of standards and benchmarks. In geodesy, such standards have long been understood as practical and methods that allow triangulation networks to determine the exact geographical coordinates of objects using classical angular instruments. Triangulation networks are not global but national in nature and are the infrastructure of each state, i.e. they require a limited scope of services in geodetic activities. Since 1984, this concept has changed in the world, the hidden triangulation network has been replaced by global satellites in geodesy. In this method, the spatial position of points on the earth's surface can be determined at any time and under any conditions using satellites and their terrestrial receivers, as well as antennas.

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Currently, the following satellite navigation systems are used to determine the spatial coordinates of points: Russia's GLONASS satellite global navigation system and the US NAVSTAR GPS satellite navigation system (Navigation System with Time And Ranging Global Positioning System - detection navigation system, global point detection system). Satellite measurements are based on several astronomical geodetic points, a global coordinate system has been created and is based on four space geodetic methods. In this regard, metrologists in user countries other than the United States, Russia, China, and partly the European Union should be aware that they do not rely on national standards in determining distances and coordinates. For many countries, measuring instruments and measurement processing programs are "imported" and no one can guarantee compliance with international standards. Geodesists and metrologists are now tasked with measuring the lengths of one meter to several kilometers with millimeter accuracy in the field of distance measurement of laser electronic distance meters and global navigation satellite systems.

To perform geodetic measurements with a satellite system, satellite signal receivers and their software must be metrologically certified. Manufacturers may supply geodetic instruments to the consumer without a special license, but geodetic organizations engaged in geodetic, topographic, cadastral and other works are prohibited from carrying out the above work with uncertified equipment.

The study of the issue of certification of satellite system receivers should be carried out only by equipment manufacturers, as they must provide the relevant certification documents to the buyer (geodetic organization). However, any geodetic equipment needs regular inspection, not a one-time. Satellite receivers are no exception. At present, all countries have adopted a set of normative and technical documents for the inspection and certification of satellite receivers.

Thus, Russian sources emphasize the importance of studying the metrology of satellite equipment, and also emphasize the need to conduct research in three areas:

1. Research of satellite system receivers.
2. Software research (computer software that processes and equalizes satellite measurements).
3. Research of inspection methods.

Scientists dealing with the metrology of satellite systems have concluded that a special reference geodetic landfill is needed to conduct inspections [3].

II. TASK ASSIGNMENT

Numerous studies conducted at metrology landfills have determined the successful timing of data collection, evaluated the capabilities of receiving receivers, and the accuracy and ease of use of scientific and practical applications. This article examines the developed schemes of Ufimsky and Verkhnevolzhsk landfills created in Russia. To certify the geodetic network of the satellite system, a special Choke Ring antenna, software and geodetic receivers performing maximum accurate measurements must be used. The satellite system is performed using special software such as Bernese (version 5.0 and above), GAMIT / GLOBK (version 10.0 and above), GIPSY-OASIS II for processing and alignment of measurement work. When attesting SYTEGT points, i.e., in determining vectors and coordinates, the mean quadratic error of the receiver being tested should be within the working range.

The difference between the measured and reference base values, the following formula does not exceed the allowable basic absolute error calculated using the receiver is considered usable.

$$\Delta_{don} = 2 \times (a + b \times 10^{-6} D)$$

Where a and b are numerical values in mm. in, according to the documents provided;*D* – base length v mm.

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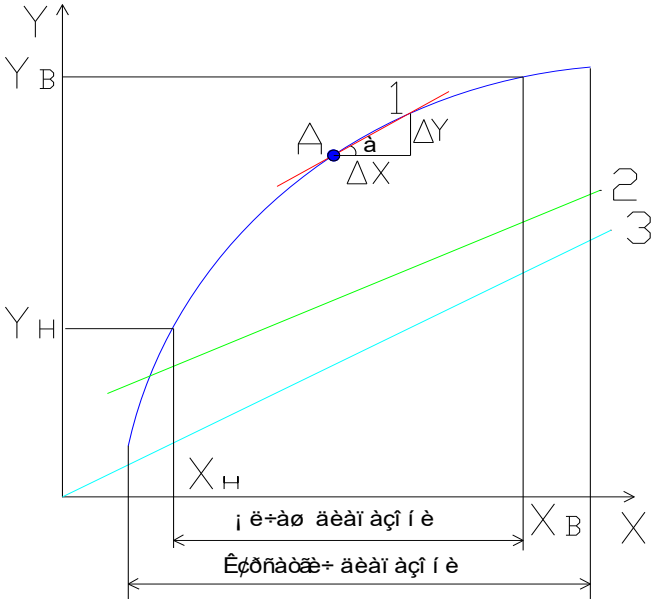
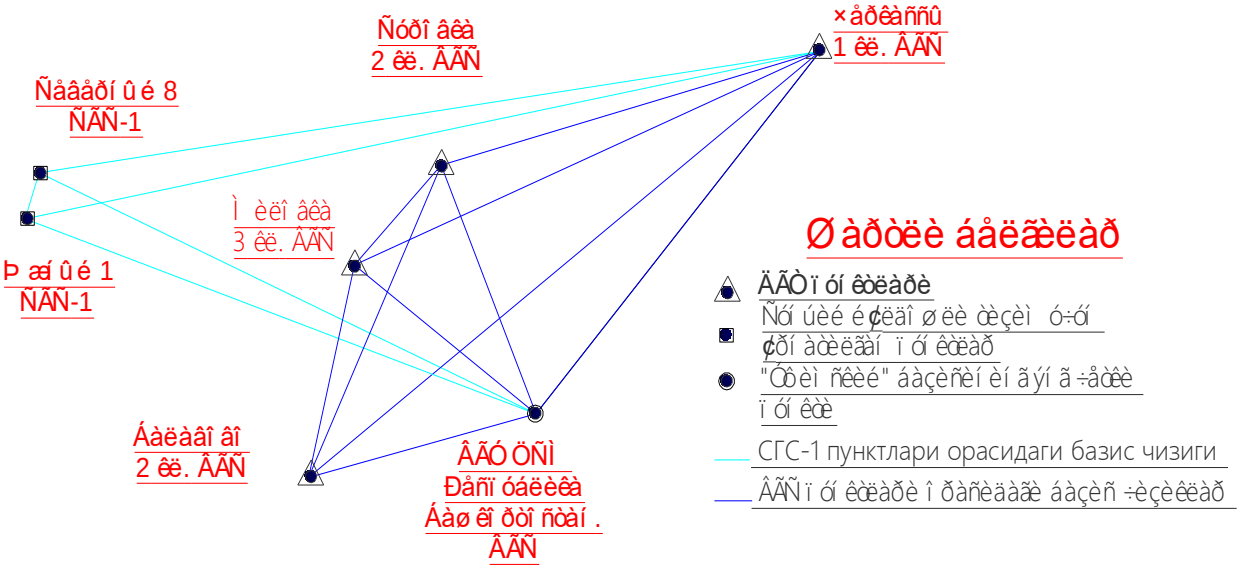
STATIC CHARACTERISTICS OF THE MEASURING INSTRUMENT



The characteristic of a measuring instrument is expressed as the smallest time interval between individual pulses or the shortest distance between objects recorded separately by the device.



The scheme of the settlement of the points of the Russian state "Ufa" polygon [4]

However, the developers of the Verkhnevolzhsk polygon of the Russian state state will carry out geological survey points of the geological survey of the GNSS receivers at this point. Such a branch is an ideal set of "standard" bases.

High-definition LEDs allow you to measure a few kilometers away with a one-tenth of a millimeter error. Such a catastrophe is less than the length of the thunderstorms detected by artificial satellite equipment. For this reason, GNSS receivers need to be accepted in the volume of the volume, which is measured by the "standard base" of the metrological landfill.

In this way, the verification of the lengths of the GNSS receivers at the Verkhnevolzhsk test site was carried out on a measurable basis by means of instruments (measured by LEDs) that measured the length of the bases.

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III. CONCLUSION

From the experience of metrologists and surveyors, it can be concluded that the current state of the metrological supply of traditional measurements in geodesy meets the current needs of operations.

However, in the field of high-resolution GNSS-measurements, there are certain problems with the equipment inspection and measurement method [6].

In order to certify and validate the GNSS receivers, which are used for short and long base distance measurements in Uzbekistan, taking into account the observations and surveys carried out abroad,

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