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CREATION OF A NETWORK OF PERMANENTLY OPERATING SATELLITE REFERENCE STATIONS. STATE AND OPPORTUNITIES OF THE STATE GEODESIC NETWORK REPUBLIC OF UZBEKISTAN

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ABSTRACT
Creation of network permanent satellite the referents of stations I have arisen in a consequence of identification of essential shortcomings of traditional methods of measurements. In this article process and the purposes of creation of satellite stations are considered. The main advantages and shortcomings of use of network permanent satellite the referents of stations are revealed. The analysis of the current state and capabilities of the state geodetic network of the Republic of Uzbekistan is carried out.

KEYWORDS: Reference stations, GNSS, GPS / GLONAS / GALILEO, CORS, Vector.

INTRODUCTION

Reference stations are stations that have geodetic coordinates determined and connected to the state geodetic base network, which perform GPS measurements continuously. They are an integral part of the state's geodetic framework.

Permanent reference stations include a satellite geodetic receiver and antenna, which are installed in reliable locations and operate from a regular power supply. The receiver constantly receives satellite signals and transmits these signals to other devices that operate in real time.

Includes permanent reference station, complex satellite receivers, antenna, general control (computing) center, special software programs, communication systems, means of communication and economic infrastructure. The number of reference stations is selected based on their coverage area, availability of communication lines, terrain, and consumers. The number of stations recommended in the Republic of Uzbekistan to ensure the regular guaranteed operation of the network is four.

The creation of a new satellite geodetic network will provide defense and the country's economy with fast and accurate coordinates of the location of any objects on the ground at an efficient and low cost. Similar stations have been built in the Republic of Uzbekistan, connected to the state geodetic base network and their permanent operation is provided.

PRACTICAL USE OF PERMANENT ACTIVITY REFERENT STATIONS

In the XXI century, the use of satellite geodetic systems has become an objective reality. First of all, the specialists of geodetic organizations studied and applied modern instruments and satellite measurement methods, software that provides the coordinates of the points as the final information. Coordinate measurement in the satellite method is widely used in various processes of geodetic production:

- construction of geodetic foundations;
- in engineering research;
- topographic surveys of different purposes and scales;
- in cartographic production;
- providing information to geographic information systems;
- creation of the state geodetic base;

• in monitoring the movement of the earth's crust;
• geodetic works during construction;
• monitoring of deformations that may occur during the operation of structures;
• in cadastral works in different directions, etc.

It is also used in navigation, navigation, airports, aircraft, vehicles, control of technological mechanisms in the construction process, automotive equipment in the process of prospecting for minerals, agricultural machinery in field work, complex work in the construction of high-rise buildings.

Measurements in all high-precision satellite systems, regardless of the method of execution, are made in relation to the base stations. Vector measurements are performed at separate pairs of points. When doing large-scale work, you have to stand at these points for a long time, even in the dark. When creating geodetic bases on objects over large areas, the range of points is at great distances from each other, you have to walk several kilometers and stay at the points for a long time in static mode, which also leads to long measurements.

The main condition for a long stay to determine the coordinates at the geodetic base points is the constant reception of radio signals and the provision of a reliable autonomous power supply. During the measurements, it is necessary to make a "landing" of at least one specialist to work at the geodetic point or to guard the instruments. It is advisable to build and include at least three or four permanent reference stations in the geodetic foundation system to carry out the work quickly, efficiently and with quality. Of course, this depends on many aspects, firstly on the financial capabilities, secondly on the construction period, technical and geometric factors. Most importantly, the implementation of the project of permanent reference stations, first of all, increases the economic efficiency and is convenient and useful compared to the traditional method.

PERMANENT REFERENCE STATION
EQUIPMENT COMPOSITION

At present, reference stations have been built in four regions of the Republic of Uzbekistan and are equipped with basic and additional service equipment. This ensures that they have a permanent job.

To build and equip a single reference station, approximately the following will be required:

• construction of a reinforced concrete structure for the installation of receivers;
• receiver with modem in the satellite geodetic system (GNSS-GNSS Global Navigation Satellite System);
• cabinet for equipment and communication;
• permanent power unit;
• high-resolution antenna of the receiver;
• lightning protection;
• conditioners;
• barrier wall;
• Internet network;
• GSM connection with IP address.

You will need Topcon Tools to process and equalize data, TopNET + to manage the database station, and TopNET RTK software to operate in RTK (Real Taime Kinematic - Kinematic real time) mode.

For field work, you will need at least one receiver modem running on a satellite geodetic system (GNSS).

PERMANENT ACTIVITY REFERENCE STATION
ADVANTAGES AND DISADVANTAGES

Although the construction, equipping and commissioning of permanent reference stations costs a certain amount, its continuous long-term and uninterrupted use provides advantages and economic benefits over the use of temporary base stations:

• reduces additional work on the development of geodetic foundations and the installation of points;
• the cost of construction of temporary bases and the lack of transportation to and from them;
• There is no need to search for points and install receivers in the construction of geodetic base networks, and the possibility of working in RTK (rel time) mode using one set of receivers;
• Absence of errors in the permanent replacement of geodetic receivers at temporary geodetic bases;
• reliability of use of data of permanently operating reference stations;

• Ensuring the required accuracy of geodetic works using modern geodetic instruments of advanced manufacturers, satellite measurement methods;
• Establishment of accounting and control of automobiles and technological transport at construction sites, etc.

While it has some advantages, it also has some disadvantages:
• relatively high one-time costs in the construction and equipment of reference stations;
• Allocation of financial resources from time to time to ensure the continuous operation of the station;
• maintenance of a specialist with a fixed salary for technical inspection of tools and equipment.

CURRENT STATUS AND OPPORTUNITIES OF THE SATELLITE STATE GEODESY NETWORK OF THE REPUBLIC OF UZBEKISTAN

Taking into account the above advantages in a timely manner, on behalf of the State Committee of the Republic of Uzbekistan "Davergeodezkadastr" created a state satellite geodetic network (DSYGT-GSGS) by its enterprises. It consists of the following [1]:

• The network of reference geodetic points (RGP) consists of four points, MAGK (Tashkent), FARG (Fergana), JARQ (Jarqorghan) and URGA (Urgench), built in 2005-2006 using two-frequency GPS receivers and precision antennas;
• Class 0 satellite geodetic system (SGS-0 [2], Sputnik geodetic set - satellite geodetic network) consists of 15 points, built in 2005-2006 using two-frequency GPS receivers and precision antennas;
• Class 1 satellite geodetic system was built in 2010-2014 and consists of 145 points;
• The differential satellite geodetic system consists of 50 CORS Continuously Operating Reference Stations. SDGS (Sputnikovaya Differentsialnaya Geodezicheskaya Set) UzPOS (Uzbekistan Positioning System - UzPOS) was launched in 2018 and is equipped with modern infrastructure geodetic multi-frequency GPS / GLONAS / GALILEO receivers and precision antennas.
• The scheme of the state satellite geodetic network of the Republic of Uzbekistan (DSYGT - GSGS) is shown in Figure 1.

The state satellite geodetic network of the Republic of Uzbekistan

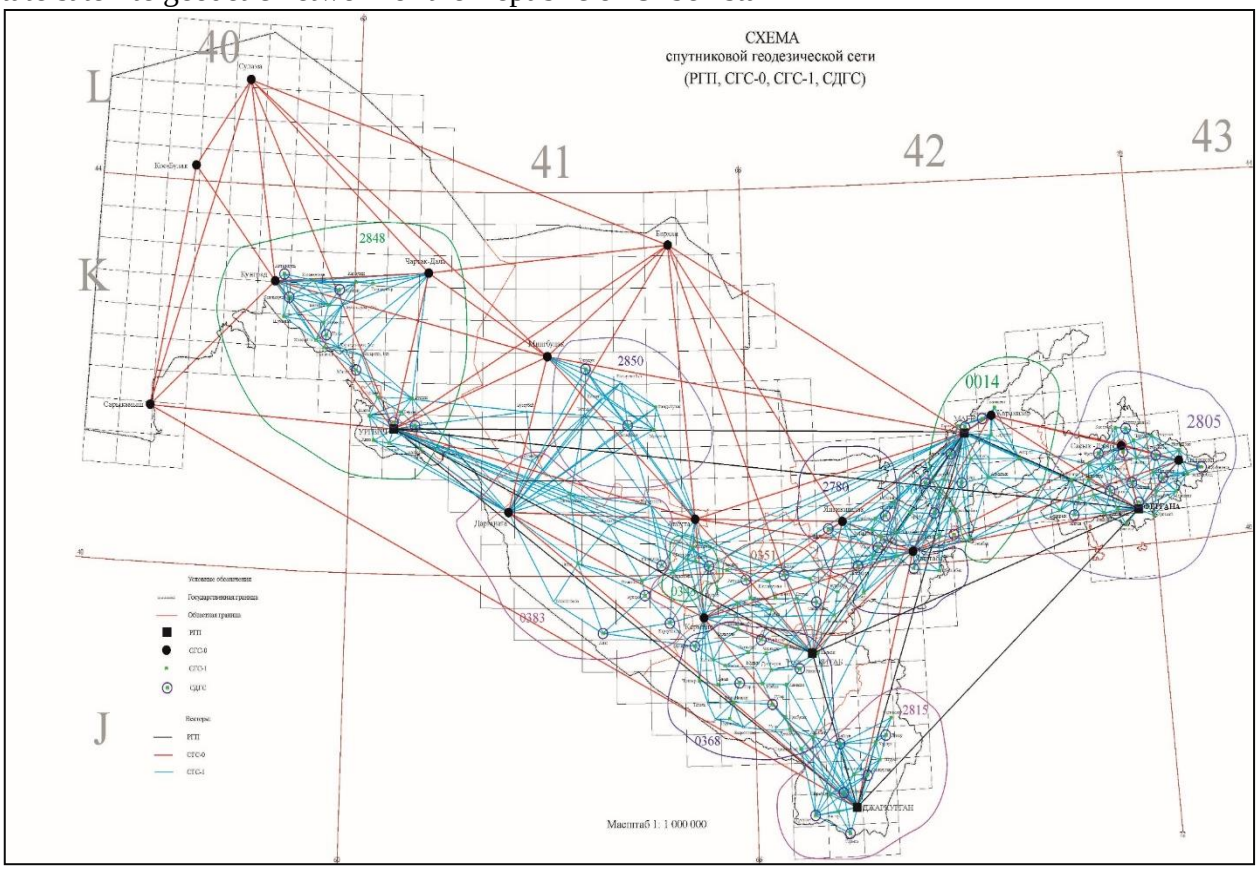

Figure 1

Satellite geodetic measurements under the program RGP (reference geodetic points) of the system of reference geodetic points of the Republic of Uzbekistan from 9.08.05.2005 to 9.11.05 (Figure 1) and from 15.08.06 to 28.09.06 (two) 2 performed using frequency satellite geodetic GPS (Global Position System) receivers and precision antennas. The measurement results files in RINEX format were made using Tough Business Center (vers. 4.1) software.

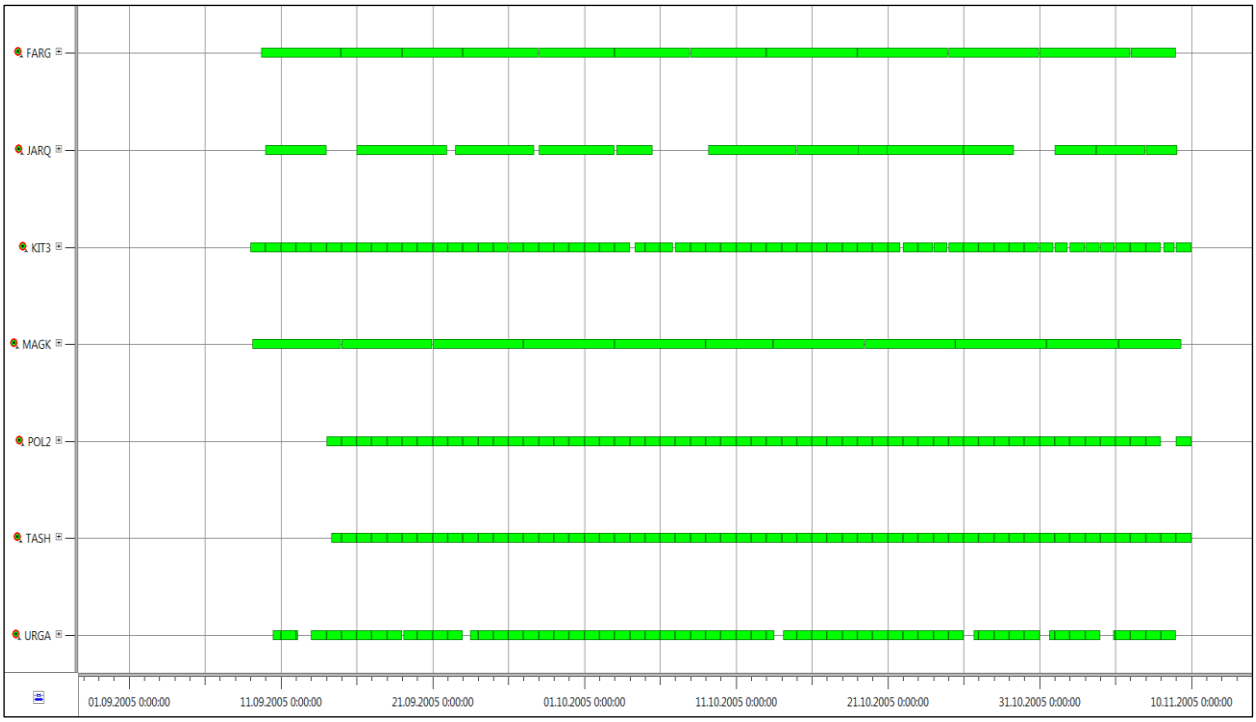

Figure 1. RGP 2005 y. Program-based measurement sessions.

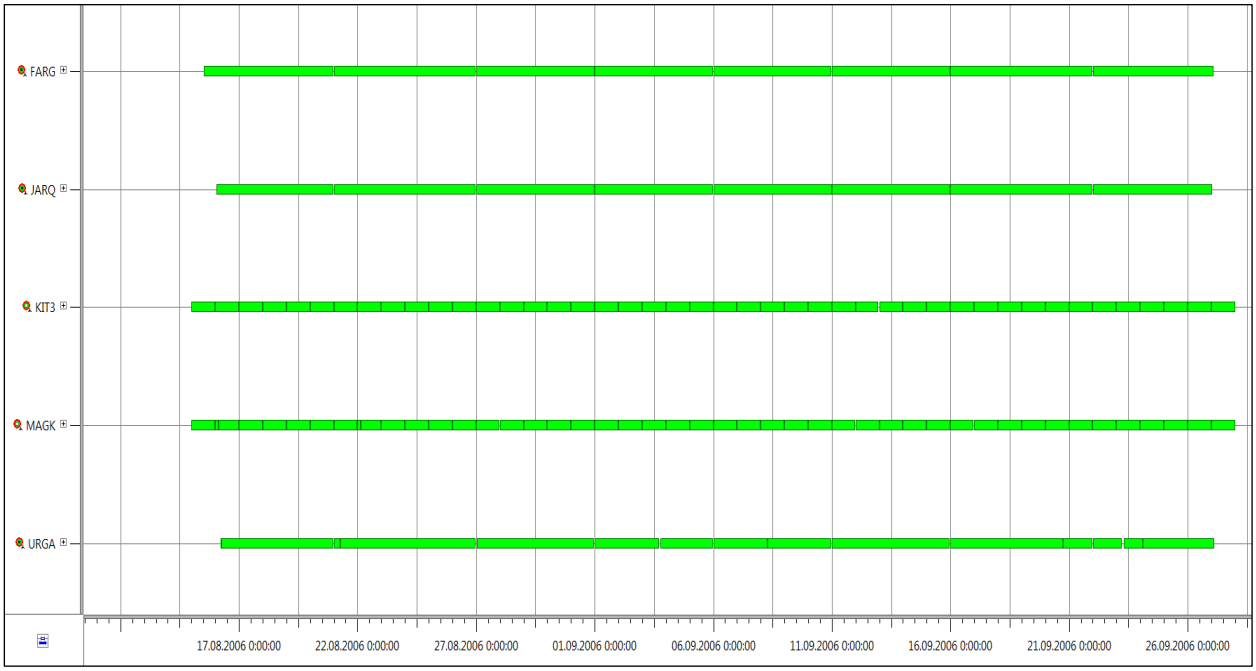

Figure 2. RGP 2006 y. Program-based measurement sessions.

A schematic of the work done by the RGP 2005 and 2006 programs is shown in Figure 2. The KIT3 (Book) point of the IGS (International GNSS Servise) network was used to link the RGP to the ITR (International Terrestrial Reference).

LOCATION OF RGP POINTS

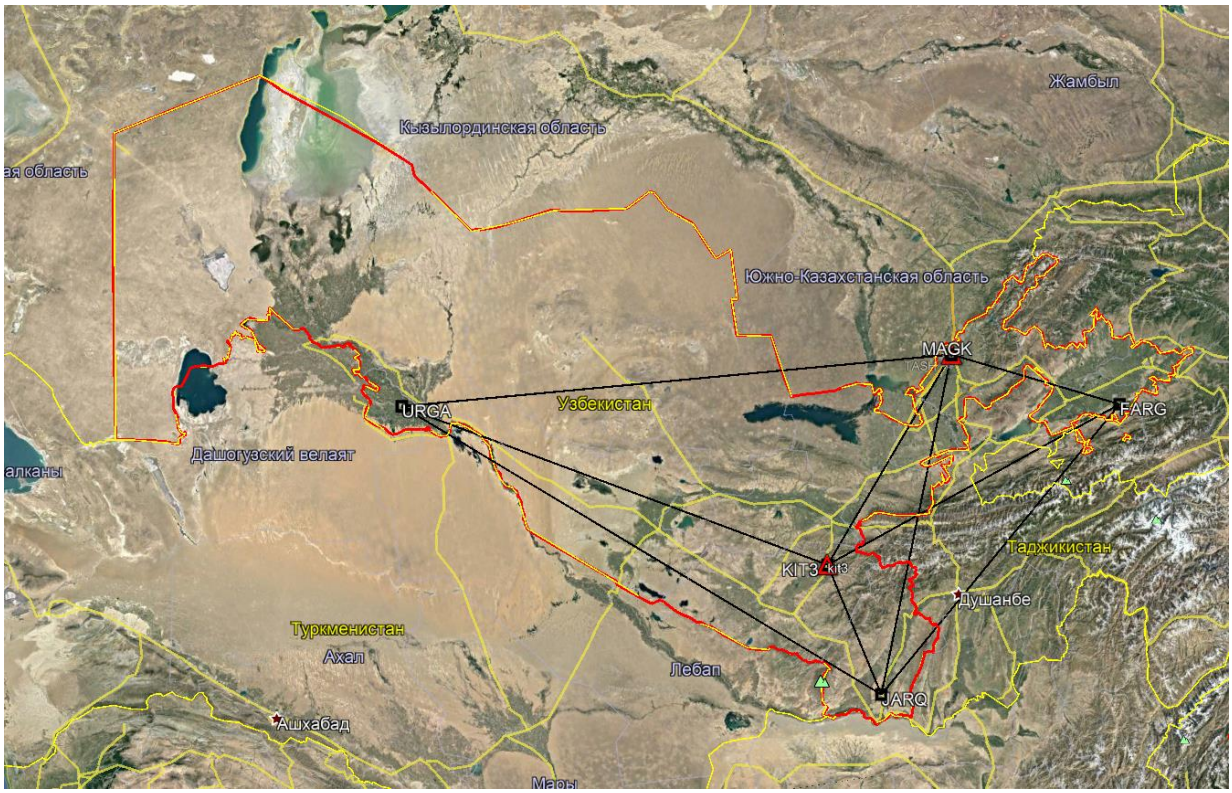

Figure 2

Preliminary processing of GPS measurement results showed that the data was of high accuracy and complied with regulatory requirements. The average square error of the position of the points was up to 1 cm in the plan, 3-4 cm in height.

Higher accuracy values for the 2005-2006 measurement results of reference network (RGP) points can be obtained after processing in the Bernese GNSS Software V5.2 software suite. Work on this has now been completed.

Permanent reference stations built in the Republic of Uzbekistan were used as a basis for the construction of future networks SGS-0, SGS-1, SDGS.

CONCLUSION

In conclusion, the creation of a new state satellite geodetic network (DSYGT - GSGS) provides fast, accurate and reliable coordinates of the location of any objects belonging to different sectors of defense and the economy. It is also widely used for scientific and scientific purposes, in the study of crustal movements. Therefore, it is expedient and cost-effective to ensure the continuous operation of RGP points of the reference network.

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