Websites:
http://www.sciencepub.net/nature
http://www.sciencepub.net

Emails:
naturesciencej@gmail.com
editor@sciencepub.net

Nature and Science

MARSLAND PRESS
Multidisciplinary Academic Journal Publisher

Research Of Cultural Heritage Objects Using Satellite Observations

Yusupjonov Otabek[1], Uvrayimov Sunnatilla[2], Ablakulov Diyorbek[3]

National University of Uzbekistan named after Mirzo Ulugbek, 100174
Email: yusupjonov_otabek@mail.ru

Abstract: This article is devoted to the use of high-precision global satellite observations (GSN) and processing the results using software for the reconstruction of a satellite geodetic network in urban areas with cultural heritage sites. Using existing network points, developing a project for an urban satellite geodetic network, conducting reconnaissance, performing satellite observations using high-precision geodetic receivers at network points, as well as using the Trimble Business Center software to analyze the results, issues of development, creation Also provided is a thematic map of cultural heritage sites and preparation of the basis for the reconstruction of 3D models of objects.
[Yusupjonov O, Uvrayimov S, Ablakulov D. Research Of Cultural Heritage Objects Using Satellite Observations. *Nat Sci* 2024,22(9):29-33]. ISSN 1545-0740 (print); ISSN 2375-7167 (online). http://www.sciencepub.net/nature 05. doi:10.7537/marsnsj220924.05

Keywords: Satellite geodetic network, global satellite observations, reconnaissance, geodetic receiver, cultural heritage sites, 3D models, reconstruction.

1. Introduction

With the advent of global satellite technology in the United States in the early 1980s, the construction of geodetic networks of cities, especially at cultural heritage sites, requires serious consideration of traditional approaches to network reconstruction. With this technology, it was possible to create coordinates and heights of points on the earth's surface over large areas, and, if necessary, create three-dimensional models with high accuracy and low labor costs. [1].

The main objective of this work is the reconstruction of high-altitude local geodetic networks using satellite observations in the areas of existing cultural heritage sites of Tashkent and the analysis of the results obtained.

The purpose of reconstruction of existing local geodetic grids using satellite observations is to increase the accuracy of traditional geodetic grids, providing reliable values of parameters of mutual recalculation between geocentric, state and city coordinate systems. The main feature of this work is the preservation of materials of large-scale topographic maps (1:2000 - 1:500) of the local coordinate system, made in previous years, while ensuring the same high accuracy of the city geodetic network [4, 5].

A modern local geodetic network built using high-resolution satellite observations should ensure:

– updating large-scale topographic maps and plans of cultural heritage sites of all scales;

– delimitation, surveying and registration of urban lands;

– topographic and geodetic surveys for construction on and around cultural heritage sites;

– geodetic research of natural and man-made geodynamic phenomena on the territory of cultural heritage sites;

– ensuring the movement of underground and surface transport on cultural heritage sites.

2. Material and Methods

When forming a geodetic network using satellite observations of cultural heritage sites, it was found that the selected points meet the requirements given in [2, 3] for satellite observations. Much attention was paid to the absence of objects or surfaces around the network points that interfere with the transmission of radio signals from satellites or reflect them, causing many errors.

They negatively affect the accuracy of measurements and cause significant difficulties in the process of processing the measurement results. [2, 3, 5].

In satellite geodetic networks, it is desirable to perform measurements in one session using as many receivers as possible.

The receivers used should be of the same type, if possible. Before leaving for satellite field observations at points of the geodetic network of cultural heritage sites, for each point, using the program included in the set of satellite receivers based on [2, 3].

During field observations, it is necessary to try to maximize the number of simultaneously operating receivers, which increases the accuracy and reliability of observations by increasing the number of redundant measurements. Observations at 9 points of the network designed at cultural heritage sites were carried out statically in 2 sessions using a total of 6 dual-frequency GNSS receivers Chcnav i90 developed in the People's Republic of China. [17].

To connect the sessions, 3 common points were selected: Tashkent, Takhtakoprik and Taukat (Fig. 1) [7].

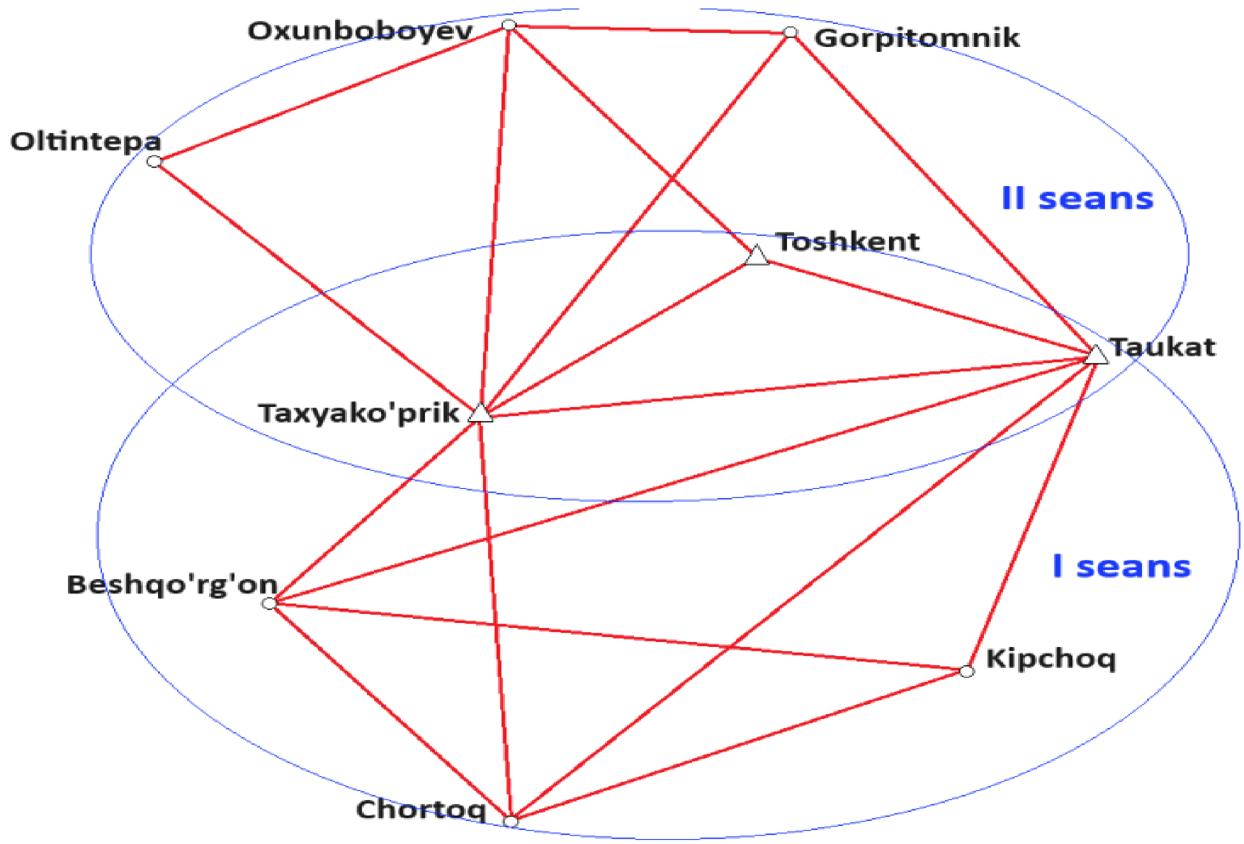


Figure 1. Observations in the geodetic network of the city of Tashkent session limit

Observations were carried out simultaneously at 6 points for a duration of four hours per session.

Convenient days for field surveys (11/05/2023 and 19/11/2024) were selected using the Planning section of the Trimble Business Center software to determine satellite visibility, minimum number, maximum proximity and location in measurements, and the DOP indicator.

Satellite measurements were performed statically in 2 sessions. The duration of the sessions depends on the length of the measured lines, the number of points simultaneously monitored, the type of receivers and the accuracy of the measurements. The sessions must receive signals from at least 4 satellites during 90% of the tracking time.

Requirements for conducting satellite measurements at points are as follows:

• installation of the satellite receiver at the point in the most convenient position;

• duration of measurement – not less than 4 hours in each of the two sessions;

• data recording interval – 5 seconds;

• number of simultaneously monitored satellites – not less than 10;

• minimum elevation angle of satellites – 15°;

• DOP indicator – not more than 4 [2, 5, 8].

GPS signals are affected by objects around the antenna: trees, buildings, vehicles, and people. Traffic and people walking near the antenna can even block the signal.

3.Results

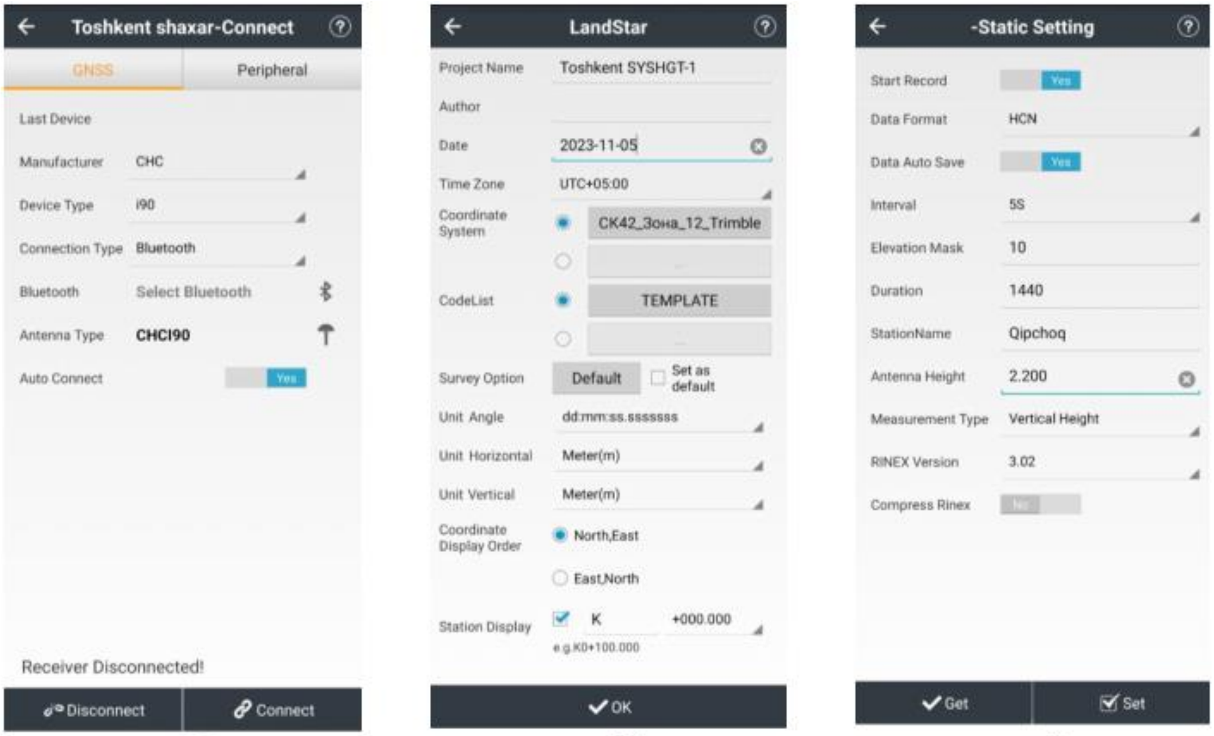
The work procedure at the stations begins with installing the antennas. First, a tripod is installed on the center of the point, then the tripod is fixed with an optical centering device and centered. Then the receiver is installed on the tripod. After this, the equipment should be placed in such a way that the cable length is sufficient not only to connect the units, but also to be able to freely approach the tripod and measure the antenna height. To ensure that the antenna height does not change or shift during the measurement, the tripod on which the antenna is installed must be firmly fixed to the ground. The antenna is centered with an optical centering accuracy of ±1 mm. The antenna is oriented to the north through the existing orientation axes. All tracked satellites must be tied to the space of the antenna center. Therefore, it is necessary to carefully measure the antenna height twice.

The antenna height measurement error affects the accuracy of determining the point coordinates. The antenna height was measured 2 times before and after the observation with a tape measure or a special tool. If the difference between the antenna height values measured at the beginning and end of the session does not exceed 2 mm, their average value is taken. If the difference is more than 2 mm, then it is not allowed to work with this session. The process of measuring the height of the antennas was carefully carried out with the participation of a specialist and recorded in the journal. A fragment of the installation of devices and observations at the points of the frame network is shown in Figure 2 below [5, 8].

Figure 2. Installation of receivers at points of the frame network

The receiver can initiate measurements using a preset auto-trigger or manually by the operator pressing a button. The first method is typically used for long extended sessions, while the second is typical for field work.

The sequence of standing measurements by the Chcnav i90 GNSS receiver at each station of the network was carried out as follows. After placing the device at a point in a convenient position, the satellite receiver antenna and the control unit are connected to each other via Bluetooth (Fig. 3, a). Then, using the control unit, i.e. the controller, a project is created through the "Project" menu (Fig. 3, b), entering the "Statics" section, entering the data in the following sequence, i.e. the time, coordinate recording interval, number of sessions, point name, satellite receiver antenna height, etc. were entered (Fig. 3, c).



a) b) s)

Figure 3. Sequence of measurements using the "Static" method on the Chcnav i90 GNSS receiver

Length of sessions, i.e. the longer the measurement time, the longer it takes to determine the length of vectors between points. Even when the distances between points are 50-100 km, the accuracy of their measurements is high. Atmospheric fog, rain, strong wind and other conditions will not affect the operation of the receiver and the results.

The results of observations at points of the network of cultural heritage sites are sent from the receiver via a USB cable to the computer memory in the form of a summary in the ".RENIX 3.02" format. [104].

4. Discussions

Foreign scientists V.V. Hoffman, J.A. Yunes, T.Sh. Chan, H. Lichtenegger, J. Collins worked on the issues of construction and development of high-precision satellite networks in the areas of location of cultural heritage sites, as well as refinement of parameters of general and reference ellipsoids according to satellite data, Karl-Rudolf Koch, P. Vanicek, F. Helmert, Teixeira de Carvalho A.A. and others, who conducted scientific research. K.M. Antonovich, F. Molodensky, A.P. Gerasimov, D.D. Gedeonov, P.K. Zalessky, I.I. Pomerantsev, A.A. Genike, G.G. Pobedinsky, V.A. Boldin, B.B. Serapinas, V.F. Khabarov, A.V. Yuskevich and other scientists from the CIS countries and the development of state and regional geodetic networks, who conducted research on the use of technologies, take part in the construction. Among the scientists of our republic, H. Muborakov, E. R. Mirmakhmudov, T. M. Abdullaev, Z. D. Okhunov and others are engaged in research work on issues of reconstruction of the state and local geodetic network of Uzbekistan using satellite observations and implementation of the openness of the world. reference coordinate system in the republic.

The above-mentioned scientists differ from the above studies in that they focus on improving the theoretical and practical issues of increasing the accuracy of the traditional geodetic network of large cities with historical and cultural heritage sites using GNSS satellite observations based on experimental work.

During the study, three-dimensional models of cultural heritage sites were developed in the territories where observation work was carried out. In this work, materials related to the objects in field and photo camera conditions were collected and analyzed. The obtained materials are of great importance for obtaining information about cultural heritage sites, organizing tourist routes along them and developing measures for their protection.

Corresponding Author:
Yusupjonov Otabek
Geodesy and geoinformatics
National University of Uzbekistan
100174, Uzbekistan
Тел: +998903590604
Email: yusupjonov_otabek@mail.ru

References

1. Muborakov X., Yusupjonov O.G‘., Ro‘ziev A.S., Mirmaxmudov E.R. Nekotorie trebovaniya k sozdaniyu natsionalnoy referensnoy sistemi koordinat Uzbekistana. O‘zbekiston Geografiya jamiyati axboroti. 58-jild. T., 2020. B. 316-322.
2. GKINP (ONTA)-01-271-03 «Rukovodstvo po sozdaniyu i rekonstruksii gorodskix geodezicheskix setey s ispolzovaniem sputnikovix sistem GLONASS/GPS». M., MIIGAiK, 2003.
3. ГКИНП (ОНТА)-02-262-02. Инструкция по развитию съёмочного обоснования и съёмке ситуации и рельефа с применением глобальных навигационных спутниковых систем ГЛОНАСС И ГПС. 2002.
4. GKKINP 02-067-03 «Instruksiya po topograficheskoy s’yomke v masshtabax 1:5000, 1:2000, 1:1000, 1:500». T., NSGK, 2003. – 199 s.
5. Antonovich K.M. Ispolzovanie sputnikovix radionavigasionnix sistem v geodezii. Tom 1. – Moskva.: FGUP “Kartgeosentr”, 2006. – 341 c.
6. Антонович К.М. Исползование спутниковых радионавигационных систем в геодезии. М.: Картгеоцентр, 2006, Том.2.
7. Genike A.A., Pobedinskiy G.G. Globalnaya sputnikovaya sistema opredeleniya mestopolojeniya GPS i ix primenenie v geodezii. Izd. 2, pererab. i dop. – M.: Karttgeosentr-Geodezizdat, 2004. – 355 s.
8. Muborakov X., Yusupjonov O.G‘., Ro‘ziev A.S., Toshonov B.Sh. Yirik shaharlar geodezik tarmoqlarini global sun’iy yo‘ldosh kuzatishlaridan foydalanib qayta qurish haqida (Toshkent shahri misolida) // Geodeziya, kartografiya va geoinformatika. 1-son. – T., 2024. – B. 65-71.
9. Uvrayimov S.T. Islom sivilizatsiyasi madaniy meros ob’ektlarini xaritaga olishning ayrim masalalari // O‘zbekiston geografiya jamiyati axboroti. 59-jild. – Toshkent., 2021. – B. 161-169. (11.00.00; №6).
10. Uvrayimov S., Prenov Sh., Ibraimova A. Islom sivilizatsiyasi madaniy meros obyektlarini GAT texnologiyalari asosida xaritaga olishning ayrim jihatlari // O‘zMU xabarlari. – Toshkent., № 3/1. 2023. – B. 340-343. (11.00.00; №7).
11. Uvrayimov S.T., Safarov E.Y., Egamberdiev A., Salohitdinova S.S. Quyi Amudaryodagi «Chilpiq qo‘rg‘oni» (I-IV, IX-XI asrlar) va unga yondosh arxeologik yodgorliklarning geoaxborot bazasini yaratish hamda xaritaga olish // O‘zbekiston geografiya jamiyati axboroti. 64-jild. – Toshkent., 2023. – B. 249-254. (11.00.00; №6).
12. Yelchaninov A.I. Kartografirovanie kulturnogo i prirodnogo naslediya Rossii /Geoinformatsionnoe kartografirovanie dlya sbalansirovannogo territorialnogo razvitiya // Materiali VIII nauchnoy konferensii po tematicheskoy kartografii (Irkutsk. 21-23 noyabrya 2006 g.) – Irkutsk: Izdatelstvo Instituta geografii im V.B. Sochavы SO RAN, 2006. – Tom. 1. – S. 26-29.
13. Jitova Ye.N., Shlempa O.A. Podxodi k sozdaniyu elektronnogo atlasa «Kulturnogo i prirod- nogo naslediya Chuvashskoy Respubliki» // Geoinformatsionnoe kartografirovaniya v regionax Rossii: mate- rialы vseros. nauch.-prakt. konf., Voronej. – 2009. – s. 83–85.
14. Lure I.K. Geoinformatsionnoe kartografirovanie. Metodi geoinformatiki i sifrovoy obrabotki kosmicheskix snimkov. Uchebnik. – M.: KDU, 2008. – 424 s.
15. Shebshaevich V.S., Dmitriev P.P., Ivansev N.V. i dr. Setevie sputnikovie radionavigatsionnie sistemi / pod red. V.S.Shebshaevicha. — 2-ye izd., pererab. i dop. — M.: Radio i svyaz, 1993. — 408 s. — ISBN 5-256-00174-4.
16. https://www.wPreobrazovanie.formatovfaylovRINEX-ukovodstvo polzovatelya GFZRNX 2.1.10 (gfz-potsdam.de)
17. https://chcnav.com

13/09/2024