Volume 2, Issue 5, May 2024 **ISSN (E):** 2938-3757

PROSPECTIVE SOLUTION OF TECHNOLOGY OF COMBINATION OF LASER SCANNING OF ARCHAEOLOGICAL MONUMENTS AND GNSS TECHNOLOGIES

Suyunov A. S.
Samarkand State Architecture and Construction University

Isakov E. X.
Samarkand State Architecture and Construction University

Mirzayev A. A.
Samarkand State Architecture and Construction University

Yakubov A. K.
Samarkand State Architecture and Construction University

Samonkulov S. R.
Samarkand State Architecture and Construction University

Abstract
This article describes the process of using GNSS technology to survey architectural monuments and open cultural heritage through the simultaneous use of GNSS technology with a ground penetrating radar scanner. Particular attention is paid to processing the data obtained during the scanning process and creating drawings based on them. Attention is paid to obtaining the most objective results about the condition of historical architectural monuments, as well as obtaining detailed drawings to determine the geometric integrity and damage of the object. Review of problems, current state and main trends in the development of archaeological research based on the widespread use of modern geoinformation technologies.

Keywords: Archaeologist, surveyor, surveyor, geologist, laser scanners, topographic survey, geographic information systems, GPS/GNSS receivers, monument, paleontologist, PHOTOMOD, raster, vector, pit, monitoring.

ARXEOLOGIK YODGORLIKLARNI LAZERLI SKANERLASH VA GNSS TEXNOLOGIYALARI BILAN KOMBINATSIYON S‘YOMKASINI YARATISH TEXNOLOGIYASINING ISTIQBOLLI YECHIMI

Suyunov A. S.
Samarqand davlat arxitektura-qurilish universiteti

Isakov E. X.
Samarqand davlat arxitektura-qurilish universiteti

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Mirzayev A.A.
Samarqand davlat arxitektura-qurilish universiteti

Yakubov A.K.
Samarqand davlat arxitektura-qurilish universiteti

Samonkulov Sh.R.
Samarqand davlat arxitektura-qurilish universiteti

Annotatsiya:
Ushbu maqolada ochiq havoda joylashgan arxitektura yodgorliklari va madaniy meros ob'ektlarini "Ground Penetrating Radar" rusumli georadar skaneri bilan GNSS texnologiyasini sinxron qo'llash orqali amalga oshirilgan topografik s'yomka orqali o'rganish uchun foydalanish jarayoni tasvirlanadi. Skanerlash jarayonida olingan ma'lumotlarni qayta ishlash va ular asosida ob'ektda olingan chizmalarni yaratishga alohida e'tibor beriladi. Tarixiy me'moriy yodgorliklarning holati to'g'risidagi eng ob'ektiv natijalarga erishish, shuningdek, ob'ektni geometrik yaxlitligini, buzilishini aniqlash uchun batafsil chizmalarini olishga e'tibor qaritilgan."Arxeologiya va geoinformatika" zamonaviy geoaxborot texnologiyalarini keng qo'llash asosida arxeologik tadqiqotlarni rivojlantirish muammolari, hozirgi holati va asosiy tendensiyalarini ko'rib chiqishga bag'ishlangan.

Kalit so'zlar: Arxeolog, geodezik, geodezik, geolog, lazerli skanerlar, topografik suratga olish, geografik axborot tizimlari, GPS/GNSS qabul qiluvchilar, yodgorlik, paleontolog, FOTOMOD, rastr, vektor, chuqur, monitoring.

Аннотация
В данной стате описан процесс исползования технологии GNSS для обследования памятников архитектуры и культурного наследия открытого типа путем одновременного применения технологии GNSS с георадарным сканером "Ground Penetrating Radar". Особое внимание уделяется обработке данных, полученных в процессе сканирования, и созданию полученных на их основе чертежей. Уделяется внимание получению наиболее объективных результатов о состоянии исторических памятников архитектуры, а также получению деталных чертежей для определения геометрической целостности и повреждений объекта.Обзору проблем, современного состояния и основных тенденции развития археологических исследований на основе широкого применения современных геоинформatsионных технологий.

Ключевые слова: Археолог, геодезист, маркшейдер, геолог, лазерные сканеры,топографическая съёмка, геоинформatsионные системы, GPS/GNSS приёмники, памятник, палеонтолог, PHOTOMOD, растр, вектор, шурф, мониторинг.

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INTRODUCTION

There are many open archaeological monuments in the territory of the Republic of Uzbekistan, cultural heritage is an integral part of the historical past. Searching, studying, restoring, protecting and passing on cultural heritage to future generations remains one of the important issues of every country. By the 21st century, as a result of the development of geoinformation systems, digitization of data collected by archeology and systematization of problems in such a way that in addition to the question "where are archaeological objects located", more and more new demands began to be made: "They In what period did it appear and who are there?, How are their graves located there?".

Therefore, the requirements for archaeological research are also changing. In this case, the information about the archaeological monument itself should be supplemented with historical, geographical and archaeological information about a specific area. All these requirements ensure the full coverage of the naturalistic and cartographic components of archaeological research. As a result of the analysis of many foreign experiences and publications of the last 15-20 years of research, such modern technologies and geo-information systems have been used for the first time in the field of local archeology in the Republic of Uzbekistan. This technology is aimed at wide use of advanced geoinformation technologies based on the problems of archaeological research, the current situation and the main trend of development.

OBJECTIVE OF THE RESEARCH

It is necessary to digitize architectural monuments, as well as create specialized maps reflecting the results of their systematic and comprehensive operational analysis. Geographic information system (GIS) technologies are one of the most effective ways to solve this problem, which means the creation of an electronic database (attributive data, textual, digital, etc.) and the integration of geoimages (scanning method). Laser scanning technology is based on the result of reflection of laser beams from objects on the ground or from the surface of the earth. Laser scanning is a technology that allows you to build a complete 3D model of the desired object or relief in a very short time (days and even hours, depending on the size of the object and the complexity of its design).

Work on laser scanning of archaeological remains was carried out in two stages:

I stage. Complex fieldwork was carried out at the workplace, and surface laser scanning consisted of the following types of work:

- reconnaissance
- development of survey bases in the project coordinate system;
- general view of the object and its detailed photography;
- laser scanning of the earth's surface

II stage. Digital data processing;

- alignment of points obtained as a result of laser scanning with the coordinate system of the project;
- classification of laser scanning points;

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RESEARCH METHODOLOGY

A 1:500 scale topographical plan of the archaeological site was created using GNSS technologies. For this, 3 temporary reference stations were installed. Then, the "Ground Penetrating Radar" georadar scanner was launched and the archaeological object was scanned. This subsurface radar scanner is capable of detecting objects and structures at depths of up to 3 meters, providing valuable information for underground excavation and exploration.

The data obtained by the Georadar scanner "Ground Penetrating Radar" was processed with the help of special programs, and the coordinates of the object were connected to the reference stations and an accuracy of 3 mm was achieved. This measurement process allows for accurate placement of underground objects on the topographical plan. As a result, before the excavation process, it will be possible to show the exact location of the archaeological remains on the topographic map.

During the planning period of the excavation works, on the basis of the prepared topographical plan and the data obtained from the Georadar scanner "Ground Penetrating Radar", the exact points where the archaeological remains were located were determined. This method made it possible to carry out excavation works precisely and purposefully, without destroying historical objects. Such an approach allows to significantly increase the effectiveness of archaeological research by accurately determining the type and location of remains before digging an archaeological site.

The implemented method helps to conduct archaeological research more efficiently and accurately, and minimizes possible damage as a result of excavation work. Research conducted with the help of modern technologies opens up new opportunities in the preservation and study of our historical heritage.

RESEARCH RESULTS

Several scientists have conducted their research on the topics of laser scanning and 3D topographic maps. The advantage of laser scanning technologies is that the product obtained as a result of scanning is not a photo, but a real three-dimensional model. Such a three-dimensional model consists of many points, each of which has its own semantics in three-dimensional space. (Fig. 1)

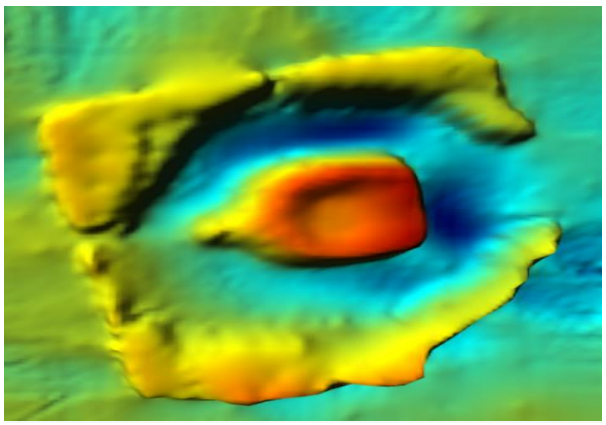
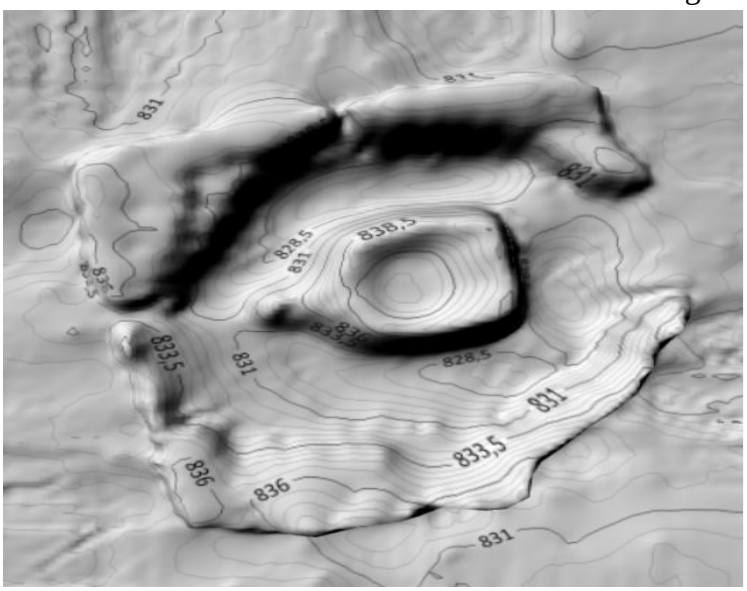


Fig. 1. 3D image of the area of the Kofur Castle archaeological monument taken with a laser scanner

There are several types of laser scanning: - mobile laser scanning;
- from the air; - from the ground.
Using the points obtained as a result of a dazer scan of the object, the following information was obtained:
1. 3D model of the object;
2. A model of a complex terrain with the most accurate dimensional parameters;
3. Accurate three-dimensional model of cultural heritage objects.



Picture 2. 3D torographic map of the area of the Kafur Castle archaeological monument obtained as a result of a combination of laser scanner and GNSS technologies

The Kafir fortress monument is located 18 km south of Samarkand, on the left bank of the Dargom canal, and its total area is 16 hectares. The monument consists of parts of the arch, city and rabad. The dimensions of the arch are 76x76 meters, the height is 25 meters square, and the sides are 360 meters.[1]

CONCLUSION

Most of the archaeological and cultural heritages in the territory of the Republic of Uzbekistan have not been researched based on new technologies. The theoretical significance of the research allows for the development of methods for processing the results of surface laser scanning for the modeling of archaeological and cultural heritage objects, the study of underground and surface infrastructures, buried objects in a three-dimensional spatial view. The fact that the results can be used as a tool for making important decisions in the field of archeology is important in studying the relevance of information and the historical condition of objects.
Thanks to the high precision of the measurements obtained by terrestrial laser scanning, it is possible to create final products with unparalleled photographic detail. Determining the location of small elements in an object using traditional measurement forms is a very difficult process, thanks to modern laser scanning, this problem can be considered solved. All objects under the ground, even the smallest details, can be determined with exact coordinates, and based on them, their drawing plans can be accurately reflected. All items, even the smallest details, are accurately coordinated and accurately represented in the drawings.

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