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ISSUE
№8

EUROPEAN OPEN
SCIENCE SPACE

COLLECTION OF SCIENTIFIC PAPERS

1st INTERNATIONAL
SCIENTIFIC
AND PRACTICAL
CONFERENCE

INNOVATIVE SOLUTIONS IN SCIENCE: BALANCING THEORY AND PRACTICE

OCTOBER 28-30, 2024, SAN FRANCISCO, USA

EUROPEAN OPEN SCIENCE SPACE

Proceedings of the 1st International Scientific and Practical Conference

"Innovative Solutions in Science: Balancing Theory and Practice"

October 28-30, 2024

San Francisco, USA

Collection of Scientific Papers

USA, 2024

UDC 01.1

Collection of Scientific Papers with the Proceedings of the 1st International Scientific and Practical Conference «Innovative Solutions in Science: Balancing Theory and Practice» (October 28-30, 2024. San Francisco, USA). European Open Science Space, 2024. 183 p.

The conference is included in the Academic Research Index ReserchBib International catalog of scientific conferences.

The conference is registered in the database of scientific and technical events of UkrISTEI to be held on the territory of Ukraine (Certificate №504 dated 18.09.2024).

The materials of the collection are presented in the author's edition and printed in the original language. The authors of the published materials bear full responsibility for the authenticity of the given facts, proper names, geographical names, quotations, economic and statistical data, industry terminology, and other information.

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CONTENT

Section: Geography, Geology and Geodesy

GEODESIC WORKS USING MODERN DEVICES AND SOFTWARE

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In modern conditions, geodetic work has changed significantly thanks to the introduction of innovative technologies and software. The use of high-precision equipment, such as GNSS receivers, total stations and laser scanners, allows to significantly increase the accuracy and efficiency of measurements. Along with this, software complexes for data processing and analysis, such as AutoCAD Civil 3D, ArcGIS, Leica Geo Office, provide deeper modeling and analysis of geospatial data.

1. The main types of modern geodetic devices and their functionality

Modern geodetic works are based on the use of high-precision equipment that ensures maximum accuracy and reliability of measurements. The main devices include:

GNSS (Global Navigation Satellite System) – used to obtain coordinates with high accuracy. Multi-frequency GNSS receivers can work with several satellite systems (GPS, GLONASS, Galileo), which allows to ensure accuracy down to millimeters. They are used for topographic surveys, cadastral works and deformation monitoring.

Electronic tacheometers combine the functions of a theodolite and an electronic distance measuring system, which allows you to measure angles and distances simultaneously. Tacheometers can automatically perform measurements, significantly reducing the time for work.

Laser scanners are used for three-dimensional scanning of objects and territories. These devices provide high accuracy and detail of scanned data, which is important for creating digital models and architectural and construction projects.

Drones with geodetic cameras allow aerial photography of large areas in a short time. The use of UAVs (unmanned aerial vehicles) with high-precision cameras and sensors significantly expands the possibilities for geodetic work.

2. Algorithms for working with data obtained using GNSS systems and laser scanning

Data obtained from GNSS systems and laser scanning require special processing to achieve high accuracy and create accurate cartographic materials. The main stages of working with data:

- GNSS data processing:

GNSS data collected in the field are transferred to specialized software for post-processing. Correction of differential errors, filtering of signals and integration with other satellite systems allows obtaining coordinates with high accuracy.

RTK (Real-Time Kinematic) is also used to obtain high-precision coordinates in real time.

- Processing of laser scans:

Laser scanners generate point clouds that must be filtered, aligned and connected to create a single 3D model.

Automatic classification algorithms allow you to separate objects (for example, buildings, roads) from natural elements (forests, reservoirs), which simplifies further analysis.

3. Advantages of using specialized software in geodetic practice

Software plays a key role in surveying, automating processes and improving efficiency. The main advantages of using such solutions:

Accuracy and speed of processing: GNSS and laser data post-processing programs can significantly reduce the human factor, providing more accurate results in less time.

Integration of different data sources: Most modern software packages, such as AutoCAD Civil 3D, ArcGIS, can combine data from different sources, which allows you to create complex models of territories with high accuracy.

Analysis and modeling: Software packages allow you to perform complex geospatial analyses, calculate the scope of work, create three-dimensional models and integrate them with engineering projects.

Automation and simplification of processes: Modern programs contain tools for automating routine tasks, such as building profiles, creating maps and plans, which greatly facilitates the work of surveyors.

4. Examples of data integration for building three-dimensional terrain models

The integration of different types of geodata obtained with the help of GNSS receivers, laser scanning and aerial photography allows to create highly accurate three-dimensional terrain models. Examples of such integration:

Combining GNSS and laser scanning: Data from GNSS systems are used to map point clouds from laser scanners to real-world coordinates. This allows you to create accurate digital models of the terrain for the design of roads, bridges and other infrastructure facilities.

Use of drones and GNSS: Aerial photography from drones combined with precise GNSS coordinates provides highly accurate 3D models of large areas used for construction planning, agricultural land and forest monitoring.

Integration with GIS systems: Combining geodetic data with GIS systems allows you to get full-fledged analytical models of territories that can be used for urban planning, land management and environmental monitoring.

5. Prospects for the development of geodetic technologies in view of the introduction of automation and artificial intelligence

The future of geodetic works is closely related to the automation of processes and the use of artificial intelligence. Main perspectives:

Autonomous surveying systems: The use of drones and robotic instruments that can perform mapping and measurement tasks independently without human intervention is becoming increasingly popular.

Artificial intelligence and data analysis: Machine learning algorithms allow you to automatically analyze large sets of geodata, identify patterns and make predictions, which helps to perform engineering tasks faster and more accurately.

Digital duplicates of territories: The technology of digital duplicates allows you to create exact virtual copies of objects and areas that can be used for forecasting the development of infrastructure, modeling the impact of natural factors and planning construction works.

Internet of Things (IoT): The integration of IoT devices with geodetic systems will make it possible to obtain real-time data on changes in terrain, settlement of structures or ground movements, which will significantly improve the accuracy and timeliness of monitoring infrastructure objects.

These prospects will provide significant changes in approaches to geodetic works, increasing their efficiency and accuracy.

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