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Research of hard-to-reach areas at geodetic works

The use of a mobile platform for the research of hard-to-reach areas in geodetic works is proposed. The mobile platform consists of a quadcopter, video camera and a base.

Measurement and control over territories has arisen from the very beginning. Engineering geodesy arose in the process of human activity in establishing boundaries of land, construction of irrigation canals, land drainage.

The development of urban and road construction, the development of bridges, navigable canals and tunnels led to the development of research methods. It was during this period that the scientific foundations of engineering geodesy began to be developed.

The main tasks of modern geodetic measurements are as follows:

1. Drilling wells to water;
2. Engineering and geodetic research (research of various natural conditions within the area of construction work);
3. Engineering-geological research (geology under the house, topographical survey, geodetic survey);
4. Engineering and environmental research;
5. Geodetic works on construction sites;
6. Perform shooting;
7. Cadastral work;
8. Interpolation of plots;
9. The removal of boundaries in kind;
10. Search of underground communications. [1,2]

For each task of geodetic measurements, different methods are used. Can be used several methods for the measurement of integration. The basic methods of geodetic measurements, regardless of the field of application, are divided into two types:

- Direct measurements;
- Indirect measurements ("indirect" from Russian).

The direct method means the direct contact of the executor with the geodetic instruments and the instantaneous reception of values of the measured values by reference devices, scales.

An indirect method means the use of directly measurable quantities for obtaining through the functional dependence of the values of the desired quantities.

Also, methods are divided into groups associated with the appointment of measured values: linear; angle; high-rise; coordinates.

Linear measurements - the determination of the distances between given points in a specific sequence using special instruments and instruments. The main tools on the construction site are roulette and laser rangefinders. The main errors in linear measurements are errors in the readout of the readings of the device and violation of the temperature regime. Removal of violations of the temperature regime involves the convergence of the temperature of the object and means of measuring equipment and, if possible, the proximity of the coefficients of their linear expansion.

Angular measurements - definition of horizontal and vertical angles between directions using geodetic instruments (theodolites and tachometers). The main mistakes in angular measurements are personal observer errors, errors due to environmental influences and instrument errors.

Elevation method - the definition of excess of one points over the other with the use of special instruments and tools. The most common types are: geometric and trigonometric leveling. The main sources of errors are similar to angular measurements.

Method for determining the coordinates - the location of the measured points. One of these methods is tachometric survey and point coordinate determination using global navigation satellite systems. The sources of errors in these methods are errors in devices, errors occurring in the processing of the information obtained, algorithms for calculating the results of measurements and the impact of environmental factors (especially for satellite systems). [3]

Tachometric surveys are performed using a trigonometric measurement method. When performed, they make geometric determinations of the following quantities:

- instrument height at station;
- altitude of the visage at the observation point;
- horizontal angle from the original direction to the desired one;
- the vertical angle between the directions in which the sloping distances are measured;
- inclined distances between points of the instrument stand and observation.

Calculation of the desired coordinates, including the absolute values of high-altitude marks, are determined by known formulas.

The satellite method for determining the coordinates is based on the reception of radio signals from satellites, in which the data on the location of satellites and the signal transmission time are encoded.

At ground geodetic points with the help of special GPS-receiver devices, these signals (reception time and satellite coordinates) are recorded in files. And thus, the observation lasts for some time. To find the coordinates of unknown points on the earth's surface input data are:

- base coordinates obtained during the satellite observation period at the ground station;
- and the coordinates of the satellites themselves, determined at a strictly fixed time point, using the received multiple signals by GPS receivers at these ground stations. [4,5]

It can be concluded that the measurement method should be:

1. To meet precision requirements for specific types of work;
2. Be economically justifiable and least laborious.

Taking into account the subject of the article, we shall relate to three tasks of geodetic measurements: engineering-geodesic research, engineering geological research, engineering-environmental research.

The main purpose of such studies is to measure the coordinates and heights, as well as the study of the landscape.

The purpose of the article: to offer methods of geodetic research in hard-to-reach places (swamps, bridges, depressions, islands, avalanches, etc.).

Engineering-geodetic research can be divided into several stages:

- 1 Drafting.
- 2 Install the Trimble type base.
- 3 Measuring height and coordinates with errors up to 10 cm. If on the way there are constructions, swamps, water, then measurements are transferred to 55m.
- 4 Records in the GPS data processing program.
5. Link data to seismic processing. Conclusion for acceptance of received data or processing of research.
6. Reference to processing for general analysis of the investigated site.

Figure 1 shows a diagram of an example of geodetic research.

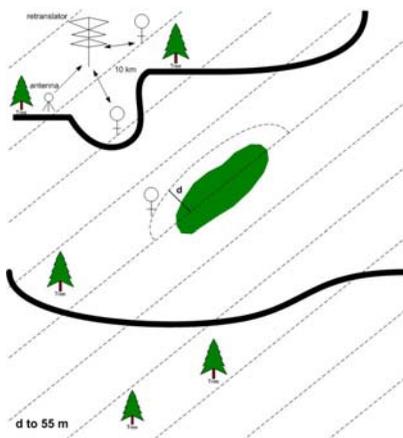


Figure 1 - Scheme of geodetic research

In the conditions of a forest it is expedient to carry out measurements by satellite method. Research area is divided into parallel lines. On these lines, measurements are made. On the line the bases are established. Bases are capable of transmitting/receiving a signal from a repeater up to 10 km. For larger distances, intermediate antennas are used.

The figure shows that there are inaccessible research areas. These are marshes and cavities. Solve this problem by transferring research to a distance of up to 55m.

But this has several disadvantages. In engineering-geodesic studies, engineering geological studies, engineering and environmental studies, it is necessary to analyze the natural conditions.

Therefore, for invisible zones it is suggested to use a mobile platform for research. The platform will consist of quadcopter, video camera and base. Based platform will quadcopter. On the quadcopter, the camcorder and the base will be attached.

Conclusion. The use of a mobile platform will eliminate the problem of coordinate measurements and will enable us to investigate the natural conditions of invisible zones.

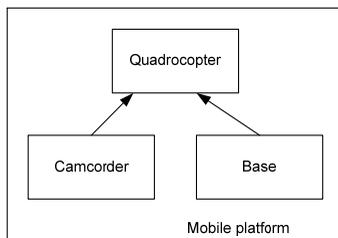


Figure 2 - The block diagram of a mobile platform for the study of invisible zones

The disadvantage of the proposed solution is the inability to stabilize the mobile platform for coordinate measurements. But the quadcopter has a hovering mode that will minimize mistakes.

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