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IMPROVEMENT OF THE THEORY AND PRACTICE OF MATHEMATICAL PROCESSING OF GEODESIC MEASUREMENT FOR LAND SURVEYING AND CADASTRE WORKS

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Summary: The article summarizes theoretical and practical additions to the components of mathematical processing of geodetic measurements, which are the basis and are used to support work in the field of land surveying and cadastre.
Keywords: Cadastre, land surveying, geodetic measurement, equalization, least squares method, optimization.

Introduction.

The main means of obtaining reliable and relevant data for land management and cadastre is geodesy. Traditional mathematical processing and methodology of geodetic measurements are not suitable for processing results for land management and cadastre needs. The current scientific and practical problem in the field of land management and cadastre in our country is the need for up-to-date and reliable data; usable and impacting land management work The theoretical and practical foundations of mathematical processing of geodetic measurements are incomplete.

Literature analysis and methodology: The following are among the research works of domestic and foreign scientists devoted to the study of the problems of mathematical processing of geodetic measurements: Jo'rayev D.O., Jo'rayeva H.D., Isakov E., Ibragimov L., Bolshakov V.D., Viduyev M.Kh., Voytenkzh S.P., Gauss K.F., Zazulyak P.M., Idelson M.I., Linnik Y.V., Karpinsky Y.O., Kondra H.S., Mazmishvili A.I., Markuze Yu.I., Mohylnyy S.H., Smirnov M.V., Tretyak K.R., Shults R.V. and others. The authors conducted the research on: jointly determining the values and relationships between the parameters of the probability function and the condition of maximum probability of random errors, developing proposals; Establishing patterns and relationships between averages, systematizing them; identifying and improving the dependence properties of random errors, developing criteria and formulas for taking into account rounding errors; analyzing various types of double measurements, developing criteria for systematic error, methods for excluding systematic error and obtaining formulas, substantiating the rejection of the correlation coefficient.

Discussion and results: Mathematical processing. The general process of geodetic data processing can be divided into the following stages:

– primary processing;

– preliminary processing;

– equalization calculations.

Primary processing includes calculations performed directly in the field during measurement. At this stage, the compliance of the measurement results with the requirements specified in regulatory documents is checked. During satellite measurements, primary processing is performed directly on controllers, where the number of satellites, the factor, the "signal/noise" ratio characterizing the geometry of satellite constellations, the quality of radio signals, and the absence of cycle loss during radio signal reception are controlled.

Preliminary processing is performed to quickly assess the quality of measurements on roads, a section of the network, or an object. In this case, the accuracy is assessed by internal similarities, the difference between two measurements, and the lack of correlation between closed forms. The measurements performed are also listed in the catalog. comparison with values or with the results of previous work (for example, measured angles with the difference of direction angles or with those measured by an electronic total station or with coordinates with control distances between certain points by satellite receivers). At this stage, the results of direct measurements are brought to the center of the points and to the plane (for example, to the Gaussian projection), for which corrections are introduced into the measurement results, determined by regulatory documents. At the same time, the results of measurements by artificial methods (coordinate increments, short distances) are brought to the plane, which is the most important feature of the proposed scheme. Reduction of the satellite and its error covariance matrices to the Gaussian-Kruger projection can be carried out according to the method proposed by V. Astapovich. The essence of this method is described below. Since, based on experience, about 10% of satellite baselines need to be re-determined due to non-uniformity, it is advisable to perform the initial processing of the current day's measurements immediately after their completion.

The adjustment is performed when there are redundant measurements to eliminate the discrepancy between the measurement results and the functions of the receiver in order to optimally estimate the sought and measured quantities. The initial processing and adjustment of satellite measurements is carried out in most cases according to the programs of the companies that manufacture satellite receivers, and if necessary, the coordinates are also changed.

The adjustment of satellite and surface measurements in a flat coordinate system is described below.

1. It was found that the theoretical and practical foundations of some areas of mathematical processing of geodetic measurements are incorrect and incomplete, and can be used to support work in the field of land surveying and cadastre.

2. Theoretical and practical additions to the components of mathematical processing of geodetic measurements were developed:

- the condition of maximum probability of simple arithmetic mean and general arithmetic mean random errors in the justification of the least squares method was not used together, and the maximum likelihood method of R. Fisher was determined;

- the criterion value of rounding coordinate errors was determined and formulas for preliminary calculation of exact rounding coordinates when calculating the land area were developed;

- In accordance with the specified characteristics, the average indicators according to the results of equally accurate and unequally accurate measurements were systematized into three groups, their dependence and interdependence on the systematization of groups were determined, the weighted average indicators (except for the simple arithmetic mean and the general arithmetic mean), the third property of deviations from the general arithmetic mean was established; - dependencies were obtained and a method was developed using the Abbe criterion to determine the systematic error and test various hypotheses using only the differences between equally accurate and unequally accurate measurements; - the importance of using only one criterion for the systematic error in equally accurate and unequally accurate double measurements was proved and proposed. Formulas for excluding systematic errors for all cases of two-way measurements have been developed, and the significance of systematic errors is determined not only by the differences, but also by the average values of secondary measurements, which reduce the residuals.

3. The results of the obtained theoretical and practical research have increased and optimized the efficiency of mathematical processing of geodetic measurements not only in the field of cadastre and land planning, but also in any direction of using geodetic measurements.

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