

ABSTRACT

**Dissertation for the degree of Doctor of Philosophy majoring in
6D071100- "Geodesy"**

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"IMPROVEMENT OF METHODS FOR ASSESSMENT OF MORPHOMETRIC TOPOGRAPHIC BASE ELEMENTS OF TERRAIN RELIEF AREAS"

Rationale. In the context of radical revision of land relations in the country, related to the introduction of changes to the Land Code of the Republic of Kazakhstan, the issue of transparency in the processes related to land management and land use is the topical issue. To get accurate, reliable and timely topographic data for land and other natural resources at the moment has a high social and economic national importance. The main point of effective activity of topographic services is the quality of topographic and thematic maps and plans the main requirement of which is compliance with international standards and regulations.

A variety of different elements and features of the earth's surface, which is characteristic of Kazakhstan, ensuring reliable accuracy and quality topographic and geodetic feasibility require improving existing methodologies and developing innovative methods for creating topographic products. The assessment of graphic analytic fundamental principles of modeling rugged relief areas, difficulties in the application of mathematical methods and computer automation in surveying are also the basis for the aforementioned.

Uncompetitive methodological framework and formal approaches contribute to the presentation of inaccurate results, including the evaluation of vertical interval and the dynamic spread of morphometric characters of relief, cause unnecessary and inefficient costs in dealing with geomorphological, economic and fundamental problems of earth sciences. Thus, this type of research is obviously required. It goes without saying that scientific problems of improving methods for assessing morphometric parameters and modeling the placement of topographic field area signs, with the purpose to improve the efficiency of use of various types of maps and plans, are highly relevant and promising.

Topographic maps of all sizes can provide one with quite extensive information about the relief. Positive and negative forms of relief, which in many cases correspond respectively to positive and negative structural forms, can be highlighted by the hypsometry peculiarities. Deviations of longitudinal profiles of river beds and terraces are measured and defined by their shape on maps; the general erosion pattern and morphology of the network of valleys on separate sites are studied. The data on the display of the latest tectonic movements, fault and fold structures can be obtained from the erosion pattern and the circuits of rivers and lakes shores. During the office study, the construction and analysis of geological and geomorphological sections are of great importance. They allow one to isolate and correlate, and link mutually the alignment of different origins and ages on large surface area. The locations of positive and negative strains of different surfaces are identified, the overall phasing of relief as well as the erosion breakthrough of the

individual steps that are used to determine the rates of the latest tectonic movements are determined by the geological and geomorphological sections.

A significant change in quality indicators by improving of measurement technologies of planned and elevation data on digital terrain model gave the opportunity to improve measure of DTM in individual regions and throughout the territory of Kazakhstan, will significantly reduce the time to create maps at a scale exceeding a ratio of 1:50000 for the areas with difficult terrain.

Application of remote sensing of the earth's surface from space satellites, shooting from aircraft are becoming more popular in the preparation of DTM, which are the main structural details of the updated cartographic material.

Survey work on the earth's surface structure using digital terrain models based on exact data of the mathematical distribution of the elevation points and derivative values of the angles, positions and angles of slopes, planimetric and altitudinal values of the relief, the geomorphologic data of all measurements are the basis for creating maps.

Today in a map printing, various sources of data measurements of the Earth's surface are used, the latest methods in the design of continuous earth's surface with high-rise characteristics are applied, the application of which yield different accuracy digital terrain models. In this regard, improving the degree of quality digital terrain models will certainly be one of the most pressing issues in geodetic science and mapping process, aiming to significantly accurate measurements of the elevation points with a much higher resolution.

The objective of the dissertation is to improve methods of a complex estimation of morphometric topographic surface elements in terms of difficult terrain.

Main problems are the following:

1. Development of rational methods of determining the height of contour interval in terms of difficult terrain;
2. The study of morphometric characteristics of surface relief with the aim of improving of the optimality and differentiation of the contour interval height.
3. Improvement of methodological basis for the creation of DTM based on effective use of various sources of information: aerospace, ground, cartographic.

The scientific novelty is as follows:

1. The method of determining of height of topographic surface contour interval was developed using informative and geoinicator characteristics and morphometry of the relief.
2. Analytical basis for increasing the optimality and differentiation of the height of contour interval, in terms of difficult terrain was created.
3. The advantages of the integrated use of geoinformational mapping for the creation and processing of a DTM with a high level of detail.

The main provisions for the defense are the following:

- Development of methods of determining the height of contour interval, through the use of informative and geoinicator characteristics.
- Creation of DTM based on the method of GIS mapping in terms of difficult terrain.

Practical value and realization of the work lies in the effectiveness of the proposed methods for rational methods of determining the height of contour interval of topographical surface and DTM generation in terms of difficult terrain. It is reasonable to use research materials and results at topographic and geodetic surveys in the context of

rugged relief areas of the Republic of Kazakhstan. The study materials can also be used by administrative institutions, design and research organizations and other institutions involved in land registration issues, environmental management, environmental protection, production accommodation and territorial organization.

Evaluation of results. The main scientific content of the thesis was discussed at the Scientific and Technical Council of the K. Satpayev Kazakh National Technical University, at the Committee for Land Management of the Ministry of Agriculture of the Republic of Kazakhstan, JSC “National Company “Kazakhstan Gharysh Sapary”.

The main provisions of the dissertation were reported at the following:

- The 7th International Scientific Conference European Conference on Innovations in Technical and Natural Science, Austria, Vienna 2015;
- The International Conference on Geothics, Prague and Pribram, October 9 – 19, 2015
- The VIII International Scientific and Practical conference “Problems and perspectives of modern science” (*“Problemy i perspektivy sovremennoi nauki”*), Number 8, Moscow, 2016. Pages 116-121.

Publications. Based on the research 10 works (3 – in English, 7 – in Russian) have been published, including 4 articles published in scientific journals, recommended by the Committee for Control of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan, 2 articles published in the Scopus database, 4 articles published in the materials of the international and foreign conferences.

During the research the following has been used: GOST 7.32-2001 “Interstate standard. The report on research work. The structure and design rules”, GOST 2.105-95 “Interstate standard. Unified system for design documentation”. “Quality Management System”, the Republic of Kazakhstan state standards, applicable rules and requirements, guidelines to ensure metrological requirements.

Based on theoretical and practical research the scientific and technical objectives solution for developing the methods for determining the effective contour interval and implementation of the method of geoinformational mapping when creating DTM on the basis of materials of remote sensing, aerial and ground surveys in the context of rugged relief areas has been found.

The main scientific and practical results are the following:

1. The features of the graphical and analytical foundations of topographic ground areas surface displaying and the main ways for constructing the terrain contour, taking into account the mutual correspondence between the contours of quantitative indicators of relief, have been identified and highlighted. The method for integrated assessment of the vertical interval spatial variability of varying complexity, where for the first time there considered a regular and random components together, determined on the basis of the actual value of the general characteristics of the sign spatial variation, has been developed.
2. The new method of determining the vertical interval, which allows differentiation of its size for discretely allocated plots of the earth's surface, which ensures accuracy and optimality of topographic maps and plans parameters, has been developed.
3. The peculiarities of the methodological basis for the creation of DTM based on an integrated method of GIS mapping were identified and revealed. The benefits of integrated use of geoinformational mapping significantly improves the performance of works on creation and processing of DTM data, reduces the time and effort

Evaluation of the completeness of the solutions for the set tasks.

The set task of the work is achieved and formulated tasks, including development of methods for determining of rational height of contour interval and the implementation of the method of geoinformation mapping when creating the DTM on the basis of materials of earth remote sensing, aerial and ground surveys in the context of areas with difficult terrain are solved, the results of the research are brought to the implementation.

Recommendations and inputs for a particular use of the results development.

The results obtained are recommended for use in Zhambyl district of Zhambyl region (M-1:500), in Glubokoe district of East Kazakhstan region (M-1:1000), and in Zhaulinsky district of Zhambyl region (M-1:2000).

The comparative evaluation of recommended methods by calculating the differentiated size of vertical interval and the accuracy of its definition has been made, based on the results which confirmed the accuracy of the estimated size of vertical interval, and its comparability with the size of vertical interval set according to the instruction and the cartographic works experience.

Evaluation of the scientific level of the work performed in comparison with other achievements in this field. The review of existing literature and conclusion the on the implementation of the work performed lead to the conclusion that the thesis work corresponds to the modern scientific and technical level.

Content and structure. The dissertation consists of introduction, 4 chapters, conclusion, and list of references (64 items, including 5 in foreign languages), 2 appendices, contains 100 typewritten pages, including 9 tables, 37 pictures.