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Interpolation in smoothing tin model of the earth

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Abstract. This article deals with engineering (strategic site construction, buildings and structures, material cultural heritage sites), project (underground and overhead pipelines, railways, roads, power lines, fields and minerals, irrigation networks, hydraulic structures). Improved interpolation techniques for determining the most commonly used measuring heights in the process of land surveying, solving engineering problems on topographic maps and surveying land cadastral works (agriculture, fisheries) and the state cadaster illuminated. In addition, design of linear, dotted and field-themed objects, the study of absolute heights for volume measurements, the analysis of survey results in software for the geo-information system, the mapping of Earth's dimensions, the determination of unknown altitude and land grinding. Optimized using an improved formula for implementation. In addition, there is a section with a relief section height within each relief interval, and traditional methods used to determine intermediate values have caused discomfort to specialists or users of this formula. In this paper, it is widely used that the formula developed can be used to develop a high-precision study of the absolute value of an unknown height and to develop a sequence algorithm for the implementation of modulation systems in the geo-information system family software.

1. Introduction

Nowadays a number of reforms have been undertaken in higher education institutions to provide qualified experts in the field of technology and supply highly qualified specialists to the manufacturing companies at the level of modern requirements, to radically improve the quality of education and employment flexibility. For example innovative classics, modern teaching and laboratory classes, and techniques and technologies were introduced.

A modern approach to teaching, the introduction of new research, encourages students to strengthen their knowledge and skills, and to further research.

Currently, a number of industrial enterprises and organizations are using topographic maps to address engineering issues, design developments, and cameras.

In 1923, the topographic maps were mapped using a metric system 1: 25000, 1: 50000, 1: 100000, and later the scale maps of 1: 5000 and 1: 10,000 and 1: 200,000. Earlier, the international geographical-nomenclature system was adopted on the basis of 1: 1 million cards, and the topographic maps were created. By the 1950s, the former Soviet Union had topographic maps of 1: 100,000, and in the 60s with topographic maps of 1: 25,000 and 1: 10,000.

Back then, the development of aerospace played a major role in accelerating and improving the creation of topographic maps.

After the October Revolution in Uzbekistan, major cartographic work began almost immediately after World War II. However, the majority of the territory of the country was provided with large-scale, topographic maps. At the same time, natural geographical maps for schools were published. The territory of the Republic is also reflected in the large cartographic atlas published in the former Soviet Union. On the basis of materials of some expeditions, thematic maps of the territory of Uzbekistan



were made, which were used in scientific and practical fields. In the early postwar years of World War II, more attention was paid to the development and publication of study cards. Instead of various topographical maps topographical maps used in educational institutions (geodesy and geoinformatics, cartography and geography faculties, military universities, schools) it is necessary to create different scale educational topographic maps describing the landscape of the Republic (Figure 1).

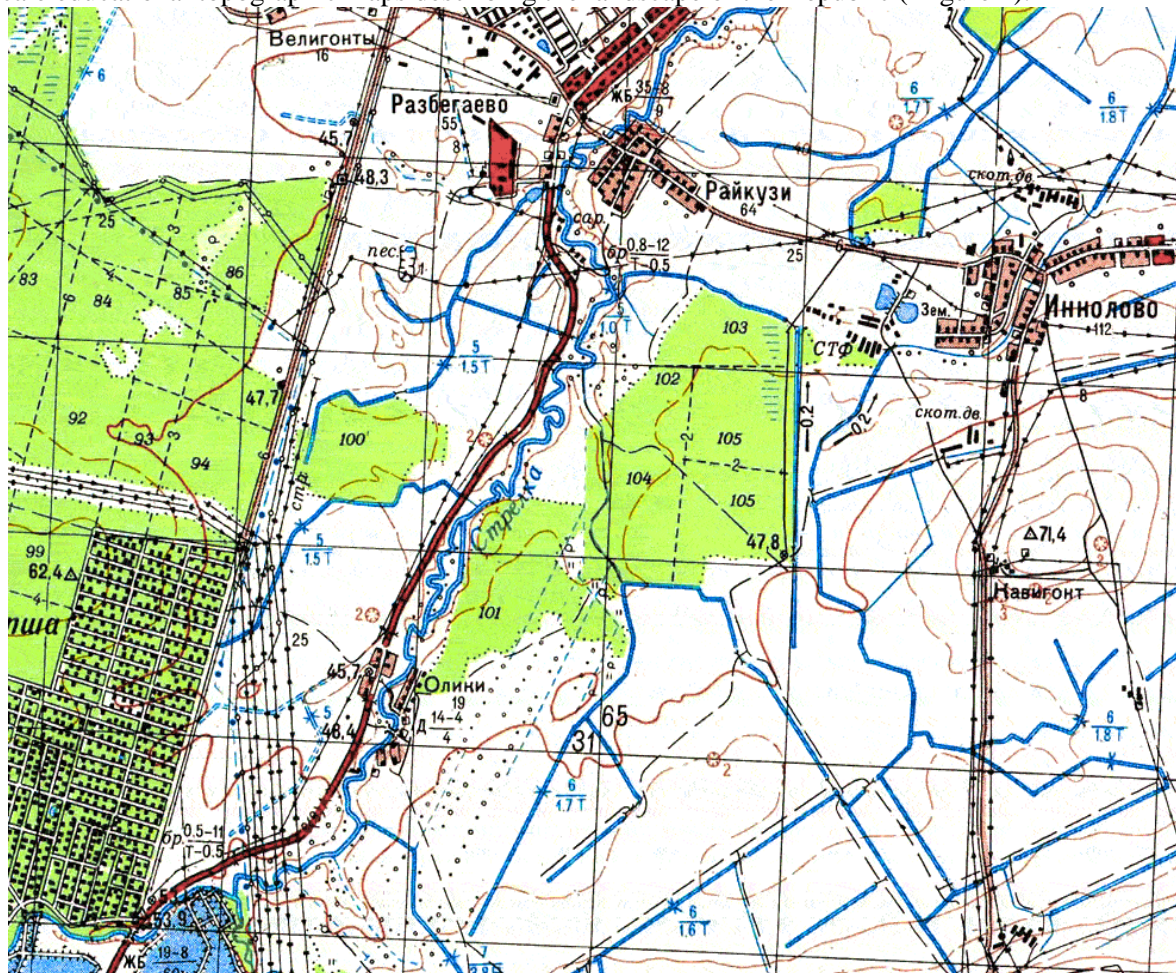


Figure 1. 1:10 000 scale topographic card

1: 1 000 000 scale International Card Design is used for topographic mapping. In the CIS and neighboring countries, topographic maps with a scale of 1: 500,000 or more are based on Gauss-Kruger's cross-sectional cylindrical projection. To do this, the Earth's ellipsoid divides into zones 60 and then rolls into a cylinder. The meridian between the zones is represented by a straight line in the plane.

Topographic maps and plans include location details and reliefs and are most commonly used in engineering. Different engineering structures are designed according to the topographic plan. This requires identifying issues such as slope slope, slope angle, slope steepness in the horizontal plan.

2. Materials and methods

It is required to obtain a digital altitude model from existing data, that is, interpolate the existing data across the entire map area. The difficulty is that on the one hand there is a distributed structure (the distance between two adjacent horizontal lines can be 100 or more pixels), and on the other hand, it is compact because the horizontal data is constantly positioned. In addition, the actual maps may not correspond to the actual height of the horizon to a certain degree of relief. Therefore, it is necessary to

create a relief, that is, an algorithm that corresponds to the main stage with the contour lines of the contour lines. The same raster is used as space rather than triangular disordered network (TIN) for more precise analysis. There are various ways to interpolate information that is spatially dispersed, which differs from the principle of point selection and interpolation function. Based on the point selection principle, we distinguish the algorithms of the adjacent N and the neighbor selection from a particular radial neighbor. Most of the existing algorithms propose to use not all existing ideas, but some of them, for example, at a minimum distance from each other, but relief cannot be achieved (Figure 2).

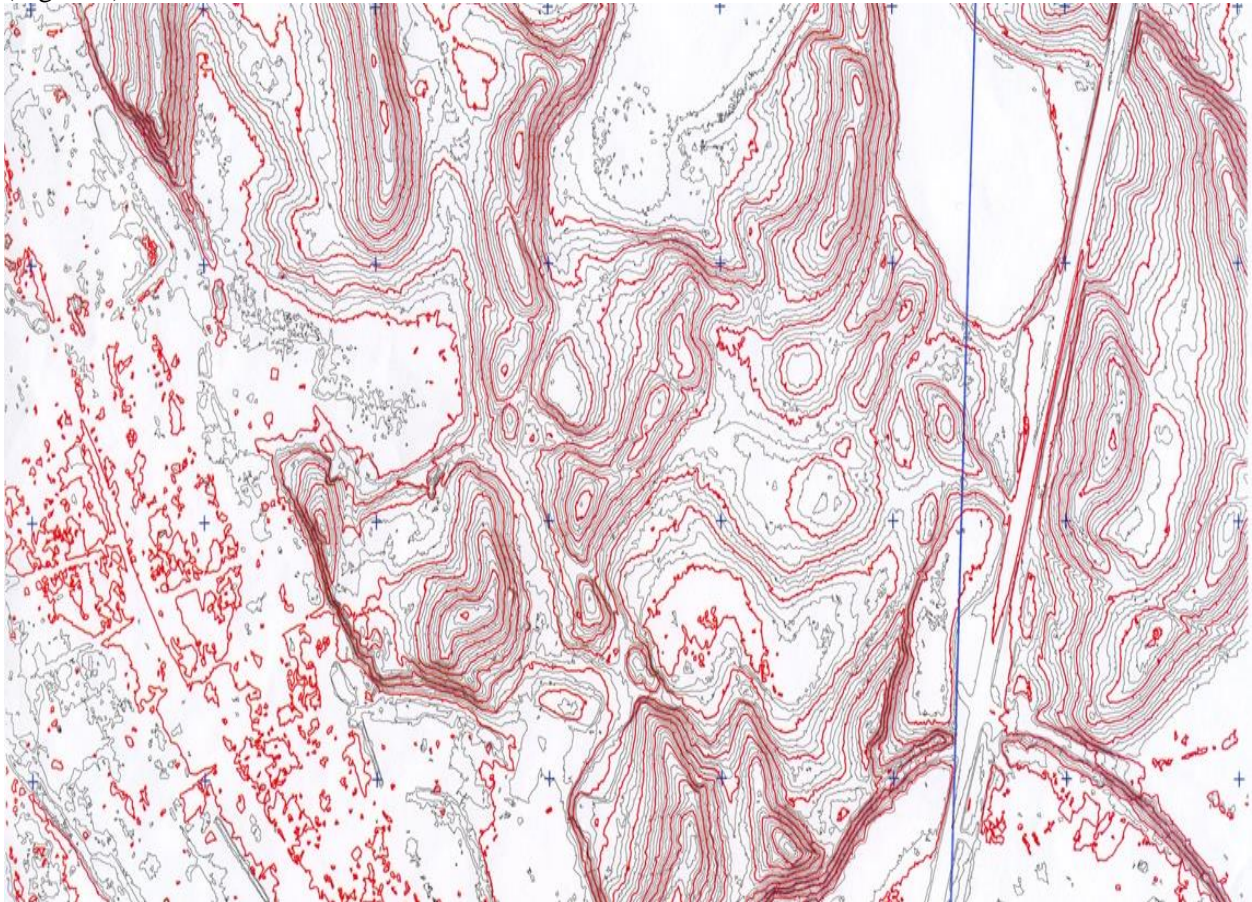


Figure 2. Model of reliefs at a minimum distance from each other

If the point lies above the horizontal axis, its diameter is equal to that of the horizontal axis. When a point lies between two horizontal axes, its axis is defined as: For example, the point M is located between two horizons, perpendicular to these horizons, and the points of intersection of the perpendicular to the horizontal are denoted by K and L. The points of the points are: L and K (Figure 3).

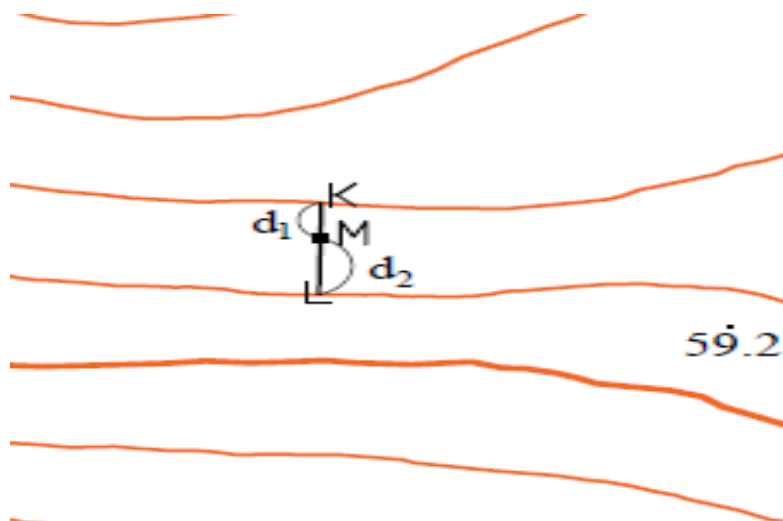


Figure 3. Release position on topographic map

Then the axis of point M is found by K:

$$M=K-d_1 \quad (1)$$

L is defined as:

$$M=L+d_2 \quad (1.a)$$

Where d1 and d2 are the relative height of the given points from points K and L; If the distance M of point M and L is d1, d2, and KL is the length of the line d, that is KM = d1, ML = d2, KL = d,

$$h_1 = \frac{h}{d} * d_1 \quad (2)$$

$$h_2 = \frac{h}{d} * d_2 \quad (2.a)$$

will be

where h is the height of the cross section.

Using this method, project work is performed to determine the height of the unknown point and to analyze the results. However, this method can be a bit more complicated. For example, determining the value of d and the cross-section values of h1 and h2, and their geostatistic analysis, make the process more complex (Figure 4).

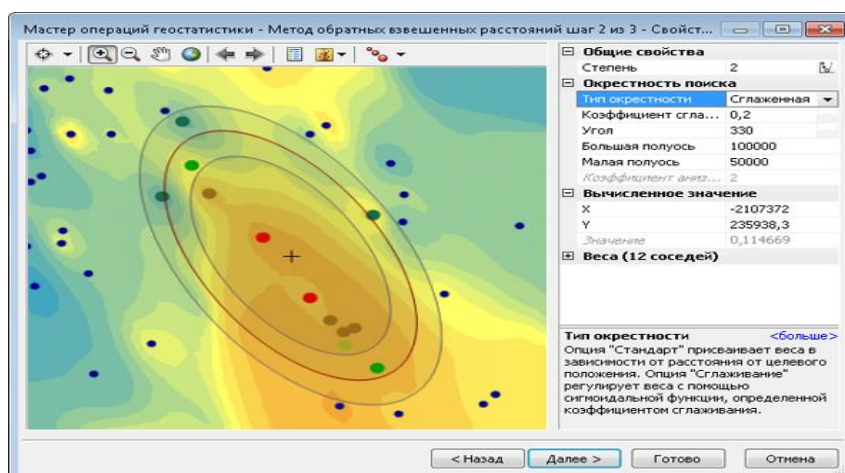


Figure 4. The window of geostatistic analysis

3. Results

As the map space is divided into permanent horizontals, they can be closed either on their own or within the boundaries of the map, and many sub-spaces are taken. For interpolation, these sub-spaces were divided into three types: two horizontal, within the closed horizontal local area, between the horizontal and the boundary of the map. To determine the subspace type, it is sufficient to identify at least one type of point, for this we use the data search of the closest points. If the points found are of two different horizons, then the lower spacing of the points belongs to the first type. If the points found belong to one horizontal area, then the bottom area of the points belongs to the second type. If the points found belong to one horizontal and map boundaries, then the lower bound of the points belongs to the third type. Given the principle of retention for the interpolation of the first type of points, we select a certain number of adjacent points from the nearest horizon, and from the longest horizon we obtain one of the closest points, but at the corresponding number. To calculate the interpolation height, we use inverse weighting methods. However, the closest points are always selected near the first horizontal line, which helps maintain the relief, while the second horizontal line contributes to the overall altitude change (Fig. 5).

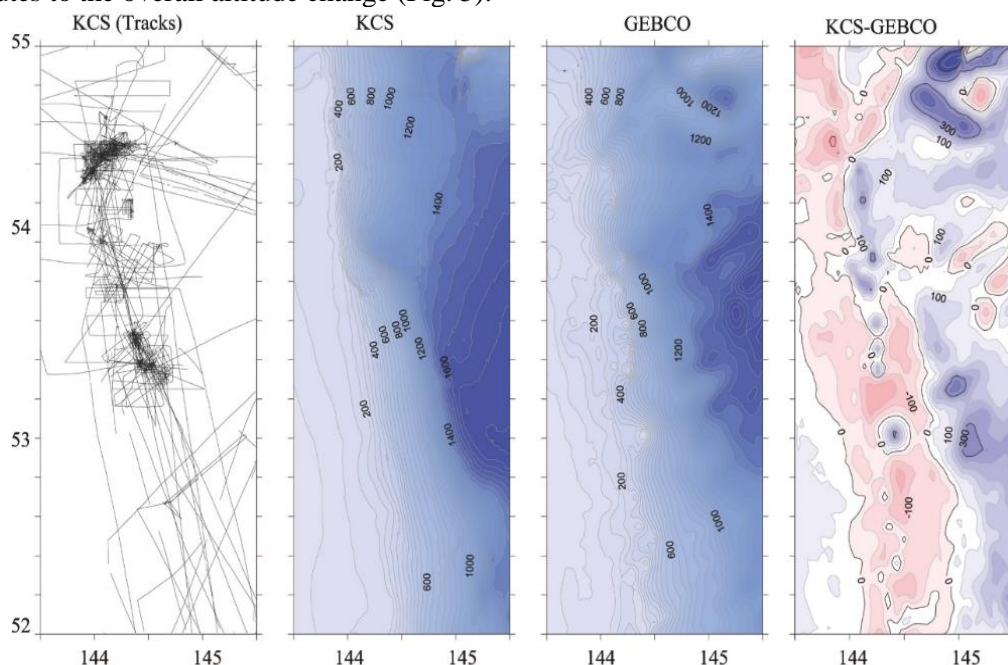


Figure 5. Connecting reliefs and grinding of earth model curves in the interpolation method

Based on the results of the research conducted with the students of the Faculty of Land Management, a new methodology was developed based on a new approach to modulating the method of determining the value of an unknown point of absolute height on the topographic map.

Using the newly developed formula, the simplest method is to find the absolute height of the point, interpolate, construct a digital elevation model, and smooth the ground model curve.

Below is a description of this formula.

It is advisable to know the following rules when classifying this formula;

- The intersection of the points on the two-point punctures marked on the line connecting these points is called the intersection of the points where the horizontal crossings at a given cross section are reached.

The new interpolation method is easy and clear. This method of interpolation helps to identify the card and point markings of each point on the plans. (Fig. 6) Through the above mentioned horizons, we have introduced a new formula:

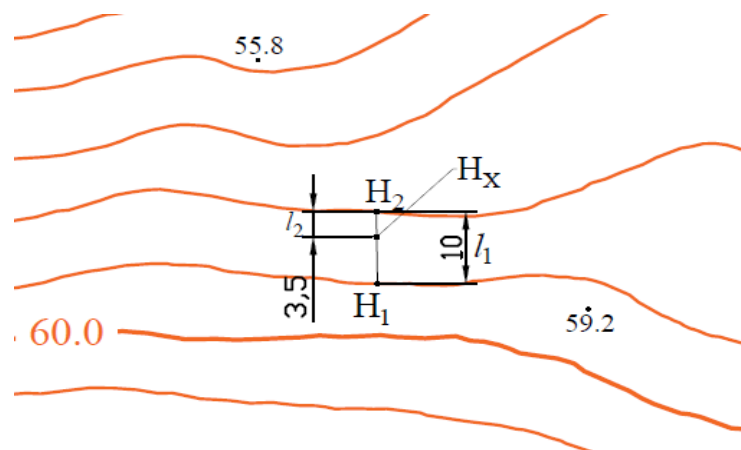


Figure 6. Determination of relief intervals

The new formula is as follows:

$$H_x = \left(\frac{|H_1 - H_2|}{l_1} \right) * l_2 + H_1$$

In this formula:

Hx is the point marker to be defined.

H1 is a horizontal shaft on the adjacent (bottom) point

H2 is the axis of the adjacent (upper) horizontal side of the point.

l1 - Distance between two horizons on a card, measured by a dot (this is measured by a ruler, card or plan)

l2 - The distance from the lower horizontal to the point.

| | - The use of the symbol means that the value we need to find is between l1 and l2 (if there is no module sign, the Hx value is positioned below the lower horizontal).

() - The action inside the sign first helps to find out how much the l1m will increase in millimeters.

The first formula is the basic formula (1; 1.a). You can use additional formula to find a solution to this formula (2; 2.a). When using this formula, distances are expressed as intersections (KM; ML; KL). The same distances are presented in the second method as l. However, in the new method l participated twice (l1, l2). In both formulas, the answer is the same, but we have found that the first method uses basic and auxiliary formulas to find the x-axis. It is necessary to calculate two formulas. In turn, the calculations will double, and the answer will not change.

The advantage of the new method is that it consists of a single formula. (3) The formula does not refer to the relative height, and directly calculates the absolute height. The card and plan are highlighted when you need them. Insert one line: from lower horizontal to dot; From the lower horizontal to the upper horizontal, the count is calculated. This also increases the efficiency of the business.

The proposed formula showed improvement in the quality criteria with a slight decrease in performance criteria. It is important to keep in mind that in the case of moving altitude values horizontally, data loss is inevitable, so it may be difficult to obtain mean values of the mean squared error. Further research on the possibility of using neighboring contour data in the algorithm is planned. The maximum deviation occurs in the areas described in the proposed algorithm as the second type of points (Figure 7).

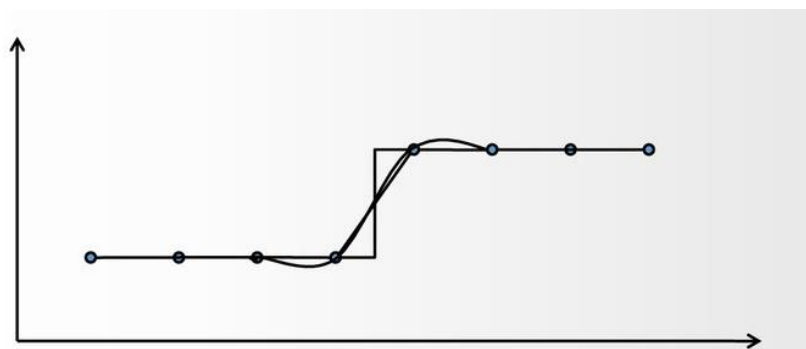


Figure 7. 3D grinding cartogram of the earth on the result of interpolation

4. Conclusion

The above algorithms and formulas help to build the topographic mapping module, namely the Tin model of the location and to clearly visualize as well as to achieve the below given efficiency

1. Ability to analyze electronic digital cards, to plan the construction, to calculate the scope of work, to estimate the inequality and to deform;

2. The interpolation method is used to find the height of the points on the uneven surface of the ground by cameral works;

3. If the curvature of the ground causes complexity of engineering, the above method is not only a solution but also an optimal method between the solutions;

4. The normalization of the height range;

5. Set the horizontal staircase to a size 0.05;

6. Suitable for 1: 50,000 and 1: 100,000 scale maps such as the Chotkol .

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