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USING DATA OBTAINED BY REMOTE SENSING METHODS WHEN COMPILING MAPS

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Remote sensing methods of obtaining information are based on recording absorption, reflection or radiation of the electromagnetic waves of the examined objects in different sections of a spectrum. These phenomena are quite different depending upon some physical-chemical and structural peculiarities of the objects.

The multispectral survey in some sections of a wave spectrum is used to obtain the derivative data. The multispectral survey and the spectral distribution analysis of the recorded radiation in comparison with the classical methods of observation (for example, photographing in one spectral band) provides good recognition of the variety of the examined objects, reliability of the obtained thematic data being simultaneously increased.

Multiband photographic equipment, optic-electronic devices with mechanic and electronic scanning, radar, radiometric instruments are applied to provide multispectral technology.

Variable equipment for remote sensing in different sections of a spectrum, a considerable survey altitude and high orbital velocities of space vehicles permit to obtain much videoinformation having different, sometimes compound ways of an image construction.

When using the remote sensing data with respect to cartographic applications the development of the interpretation methods of the survey data in different directions, determined by the thematic variety of maps, are the most compound and important task.

The traditional methods of image processing and interpreting don't satisfy with qualitatively new requirements, first of all, concerning joint quick processing different kind of information. Thus, the available methods and means of processing the data must be developed and completed to arrange complex remote sensing data processing.

The task of interpreting the recorded results can be solved if it is possible to determine a function type of distri-

buting spectral brightness of the objects according to the remote sensing data.

The problem of arranging the ground processing station for the thematic cartographic purposes is enough compound. The digital methods of processing and displaying videoinformation are more universal. They provide practically any kind of transformation of the initial data and efficient result reproduction.

Among the main directions of the investigations in elaboration of the digital automated processing methods of space videoinformation the following ones are of great concern:

1. Preliminary processing and normalizing space videoinformation;

2. Automation of interpreting space imagery using computers and optic-electronic equipment;

3. Elaboration of the mathematic models of the complex estimation of a state and forecast of the environmental changes during the economic development of the regions when compiling maps for long or short term forecasts.

We shall consider the mentioned problems in detail:

1. Elaboration of the algorythms and the image reception and reproduction problems by means of computers, putting the initial information into a united form, that is geometric and photometric distortion correction, image transformation according to the definite cartographic projection are the most important task of the preliminary stage of the investigations.

The special program complex providing initial image transformation with respect to dynamics of image registration, methodic and instrumental distortions of airborne and ground equipment, the peculiarities of the survey and examined object conditions (the Earth curvature, a relief of the Earth surface) has been elaborated to solve the task.

Processing the imagery taken by the scanning optic-mechanic systems is of special concern. Using computers is needed in this case on principle. An experimental technology of scanned image transformation providing the required transformation preliminary defined more precisely on the control points of some orbital elements, corrections, which determine real angular image orientation, and some calibration parameters, has been elaborated.

Exhabited here is the results of that direction experiments, computer obtained.

The other experiments concerning image processing automation are directed on solving the problems connected with the algorythm development of compiling photomaps on an image series, computer assembled, relief plotting according to a stereopair, determining identic points, photometric corrections, etc. Solving these problems is of great importance because it provides full image normalization in a required form, comparison of the imagery of one and the same region, taken at different time, calculation of the object squares, distinguished on an image, definition of their border line stretch, and processing the multispectral surveying data.

2. The automation problem of data interpreting is one of the most important problems with respect to processing space information for thematic cartographing, so far as it is directly connected with the cartographic object distinguishing task. This problem is many-sided and compound in respect to data interpretation and identification. At the present time using the up-to-date methods of data recognition and classification has many difficulties connected with creating "the banks" of the cartographic object signs and identifying the objective data according to them, finding the optimum system of these signs and estimating their informativity.

Elaborating the man-computer identification procedures to provide the most efficient usage of the up-to-date computing technique qualities and "unformal" thinking an interpreter is a rational approach to solve this task.

The algorythm complex of preliminary image processing to provide transformation of an image into more informative and visually suitable form was examined on the initial investigation stage.

The imitative image characteristics were improved by means of computers. The required type structures were picked out on an image. Then they were preliminary classified. Some measures were carried out (estimation of squares, plotting the curvature etc). The mentioned algorythms permited to show separately an image element with respect to the mancomputer dialogue, to carry out redistribution of high speed image surface bright-

ness, to show the slightly visible contour elements and to distinguish the isolated ununiformity of an image.

Experimental image processing according to the above scheme indicated that such preliminary image preparation facilitated significantly further interpretation made by specialists-interpreters, and was of great efficiency.

It ought to be pointed out that the ground processing complex must be supplied with highly developed universal and specialised equipment for videoinformation reflection and transformation.

Elaborating the universal digital methods and "man-computer" data processing for thematic cartographing requires as follows:

- preliminary digital transformation of different kind of information (aero-space imagery, maps, tables, graphs, descriptions);
- clear description of all the formal stages of data processing (algorythmization);
- further digital result transformation to use and store these results;
- arrangement of data reflection to provide further intellectual analysis;
- arrangement of a back connection "man-computer".

All the above requirements indicate significant dependence of the image processing efficiency upon the transformer characteristics which complete universal digital equipment.

Optic-electronic devices appear to have great potential for direct and indirect transformation "an optic image .. the digital data".

The up-to-date level of the optic-electronic technology development provides not only digital transformation of the data but a whole row of the functional possibilities of an image analysis (brightness, contours, borders, contrasts, structures).

Further development of optic-electronic devices and supplying them with specialized computer technique permits to arrange so called hybrid devices, which are based on universal devices with automatic connections. Depending in a kind of the input data and a special task, such structure which provides

the best task solution is formed. Using optic-electronic television interpretation devices has some advantages on the initial stages of choosing and compiling the interpreted sign systems. These devices provide many kinds of processing, the results being quickly obtained and well displayed. In fact, the functional possibilities of television devices provide one of the main tasks of thematic mapping, that is compiling thematic maps by code color.

A short time needed for training nontechnic specialists to handle with these devices is an important advantage of specialized optic-electronic equipment.

The mentioned main directions of optic-electronic image processing provide mean accuracy of an image analysis concerning brightness and space parameters. Further digital correction and map control is needed to realize clearly the results of image processing and to give a statistical estimation of them.

3. The regularities which characterize the objects in a fixed state are discovered by means of computers used for the tasks of data normalizing and interpreting. On data collection using computers permits to make clear the dynamics of the data changes. The obtained information are a base for the up-to-date environmental thematic maps, compiled according to constantly renewed space surveying data.

Beside solving those tasks, elaborating the methods of determining the man-made environmental changes for long term forecasts and processing the data (including the cartographic ones) which reflect the forecast results, is of great concern at the present time. The elaboration of forecast maps for 10-20 years is most in need of up-to-date planning.

Forecasting the environmental changes when economic developing a region, natural resources exploitation with respect to compound and variable processes of the Community and Nature relationships, requires the elaboration of new research methods on principle. Mathematic simulation is more efficient and perspective method of such a study.

The experiments concerning the imitative simulation of the processes within the large natural-economic complexes are carri-

ed out to solve these tasks. Particular attention is paid to studying the possibilities and perspective of the remote sensing data used for simulation. The investigations show that these data are of immense value to study a land use character, environmental distruction, and to forecast the economic development of a region.

The experiments permited us to elaborate methods and the mathematic simulation system to analyse the alternative versions of the regional development and transformation of a structure of ground fonds. The samples based on space information will permit us to choose the variants providing the required volumes of agricultural and industrial product, and the optional regional development directions as a spatial basis for the location of industry, communications, urban and recreation zones with respect to regional economy and ecology.

The mathematic simulation system is the upper level of complex automated processing space information. It is final in a logical chain: observation-control-forecast-output of recomendations concerning land use management. The sample block-scheme and the algorythm structure are exhabited here.

Creating such type system promotes profound studying the regional-industrial complex structure and the dynamics of the processes observed in these complexes. It atlas promotes to make clear potential value of forecast maps, to increase their informative possibilities, to improve registration and reflection of more important man-made processes.

Maps for a long and short forecast and the results of the mathematic simulation promote choosing more rational planned with respect to prudent limitation of unfavourable environmental distructions, realization of contemporary measures on control, protection, and reproduction of the natural resorces.

Using remote sensing data taken by space vehicles illustrates a new stage of the development of Cartography on principle.

It has become possible to study hardly reached Earth, Moon and planet regions.

Available international experience shows a great potential of remote sensing data for cartographic applications needed in

Economy, scientific researches, and in planning environmental protection measures. For instance, there was no example of compiling middle scale and small scale maps when traditional methods of obtaining the data were used. Aeromethods permited to compile only comparatively large scale photomaps covering a limited area within which there were no visible changes of the survey conditions. The remote sensing methods provided the possibility of compiling topographic and thematic photomaps of any scales and coverages which contained valuable information with respect to different branches of Science and Economy. The new methods are invaluable to develop the cartographic methods of the natural resorce study, the environmental protection, and the elaboration of the new types of estimated maps and maps for long and term forecasts.

The results of the investigations indicate that using space information considerably reduces the first stage of preparation of traditional kinds of cartographic products, their actuality, scientific and practical value being simultaneously increased. Space equipment provides a new level of quick information acquisition for compiling any kind of maps. When examining the Earth from Space any kind of observation under practically simultaneous object and process fixing in their natural correlation within the landscape can be used. That is of great potential for providing full and complex cartographic reflection of all the variety of the Earth surface phenomena. Necessary repeatness of examining the Earth surface which provides quick look photos, continuous coverage of an area, and its scale, and supports the up-to-date level of maps, can be reached by suitable choosing the orbital parameters, space vehicles and airborne equipment.

Qualitatively new peculiarity of the initial space information is optical image generalization concerning any cartographic scale, which makes compiling maps much easier, and increases the reliability and objectivity of cartographic products.

At the present time using space survey data is more effective for compiling maps and their revision, which reflect the phenomena and elements of an area, recorded by photographical, optical and radiotechnical methods. Chorographic maps, natural condition and resources maps, some social-economic and special

maps, (navigation, agricultural maps, maps of location of the population, railway maps, and others) are the examples of these maps.

Table 1 indicates average reduction of labour expenditures in per cent for the main processes of the author's, editorial and compiling operations taken as a result of applying space survey data and using modern equipment of cartographic production.

Table 1

tasks	Reduction of labour expenditures in per cent		
	auther's elaboration	editing	compiling maps
Chorographic map compiling	-	50-60	10-20
Thematic map compiling	50-60	20-30	10-20
Chorographic map revision	-	50-60	10-20
Thematic map revision	60-70	40-50	30-40

The development of the automated processing systems of the remote sensing data is of great potential to provide complex cartographic inventory of natural resorces within large natural-economic regions and cartographic control of environmental changes.