

**ON THE NEW HIGH-PRECISION TECHNOLOGY
OF OBTAINING AND PROCESSING SPACE SURVEY MATERIALS
AND CREATING DIGITAL ORTHOPHOTOS
AND ELECTRONIC MAPS**

Valery Eliushkin
6, Popov pr., Moscow, 107014, Russia
29 Defence Research Institute
Fax: +7 (095) 269 0966

Alexander Martynenko
2 build., 44, Vavilova st., Moscow, 117333, Russia,
Institute of Informatics Problems, Russian Academy of Sciences
a_martynenko@mail.ru

The technology provides for the use of Russian space survey source materials (high-resolution space photos) and various maps. It includes creation of geodetic basis, digital data processing, recognition of photo images, producing digital orthophotos and maps, digital models of terrain features, digital terrain elevation models, spatial (three-dimensional) terrain models, electronic topographic and thematic maps, electronic cadastre maps and electronic city maps. The improvement of quality of source images and supervision of production quality is one of the most important part of the technology.

Digital orthophotos serve as the main carriers of terrain information. The main function of them is to provide maximum amount of data. In contrast to maps, they are not a work of art, and so they have not any cartographic design. A digital orthophoto can contain cloudiness and other defects. The main features of electronic maps is their obviousness and think-through contents that can be achieved by means of symbolization system and methods of cartographic image generalization based on theory of visual perception, engineer-psychological evaluation and modeling. Electronic maps are free of any defects.

The totality of digital orthophotos brought together within the frames of the mapping terrain serve as the high-precision coordinate basis. The most optimal way is to use photos which terrain resolution doesn't exceed 2 meters. Such a coordinate basis allows to mount digital photo images of higher resolution either for local areas or for the whole terrain depending on customer's requirements.

Space survey is characterized by such advantages as the ability to obtain image of any point of the Earth and large field of vision. But it also has some deficiencies: considerable amount of time, especially if meteorological conditions are inauspicious; irregularity of overlaps, different photometric characteristics of photos caused by various lighting of surveyed regions.

The specificity of obtaining space survey materials affects the peculiarities of processing them: there is no need in field operations and geometric corrections of images using special algorithms. Spatial triangulation can be carried out for the whole mapped region. On-board measurements are used as a source geodetic data. Terrain elevations data, as the result of photos stereo processing, provide the high precision of geometric transformations. Using GPS provides conditions for the increase of image processing accuracy and simplification of the technology.

The existing technology allows to create and update topographic maps up to scale of 1:25 000 (1:10 000). It provides mapping of hydrography, terrain relief, roads, settlements and standalone buildings, soils and vegetation, as well as registration of attributes and state of terrain objects (including evaluation of land-improvement installations, agricultural lands and forests).

In Russia the obtaining information about the Earth surface from space has its roots spreading from the Soviet space programmes of the 1960's and 1970's. During the last period up to the present time it had been accumulated the huge stock of space survey materials which cover vast territories of numerous countries of

the world. The most interesting for the international cartographic association from the accumulated and having been accumulating hitherto stocks of space materials are the photos had been obtained by Space Cartographic Complex (SCC). SCC includes the apparatus TK-350 which is for obtaining photos due to phototriangulation net construction and relief models creation, and the apparatus KBP- 1000 which is for obtaining countour of land object sets. The SCC photos by their major technical characteristics (resolution possibilities, geometric accuracy, width of the area covering) are better than the best photos of worlds' space remote cartographic systems.

The joint photogrammetric processing of the TK-350 and the KBP-1000 photos make the abilities for the creation and renovation of the topographic map at 1:50 000 scale. The using of the additional data and due to the technological essence in processing of these photos make possible the creation and renovation of the lager scale topographic maps. If we use SCC photos besides topographic maps can be created some other geospatial data which are in need as for the mapping tasks solving as for the economics of any country.

The prospective implementing technological way of space photos materials is the creation of coordinate basis in the form of digital orthophoto plans using SCC photos. As for today the creation of such basis is the most important and central direction of many cartographic activities.

In Russia as well have been developed and serial implemented technological and software digital processing means (DPM) which provide the digital orthophoto plans creation using SCC photos. The basic mathematical methods are implemented for the activity modeling of SCC as the system having complex image geometry which unable to process by using many abroad software packages.

That's why it is considered that in the future the created digital photo-plans as for accuracy parameters as for the information completeness and the modern content will serve in the capacity of the cartographic basis for the different geospatial forms of data production. It is obvious that the only digital orthophoto plans created by the modern photos of 1-3 years old space survey imagery can be the cartographic basis and which can satisfy the request for their up-to-date content.

However, quite enough large part of the high resolution accumulated photo stock are attributed to the space survey imaging of 5-20 years old but not enough satisfied the request for their up-to-date.

What are the prospectives of these photos using? The possible outlooks of SCC photos technological using for territory mapping can be performed by the flow-chart.

As a result of the analysis of the technological possibilities it is necessary to distinguish that the TK-350 photos can be used for the creation of height and contour (geodetic) basis and for the relief models creation via the tech-nologies implementing for different territories mapping tasks, independently of the survey data ages. This conclusion is founded on that the relief is practically invariable during 5-20 years and that the preserved contour details are enough for the phototriangulation nets creation.

As a result of the TK-350 photos photogrammetric processing as of the 1-3 years old as of the 5-20 years old space survey imageries the plane and height coordinates can be obtained and can be created the digital photo plans. The same technology can be used for solving some other mapping tasks with the plane and height accuracy characteristics satisfied to the accuracy of the topographic map at 1:25 000 and 1:50 000 scales. The photos of 5-20 years old imagery is also advisable to use for the analysis of the land surface change dynamics which is necessary for the thematic mapping tasks solving.

The principal abilities of KBP-1000 photos in accordance with the remoteness of survey imaging can be realized at two technological ways.

The first way is that by using modern KBP-1000 photos (the 1-3 years old survey imaging) and by using the processing results of the TK-350 photos are made digital photo plans which in future will serve as the cartographic basis for the creation and renovation as the topographic as the digital maps.

The second technological way envisages the KBP-1000 5-20 years old imagery photos using for the digital photo plans creation as well, but as the "outdated" in the content one. Then by using remote sensing (monitoring) means such details of the land surface exposed which have the variables in the contour part.

The modern space- or airphotos are obtained for these parts of land surface and then by using the "digital photo-mosaicing" method (using DPM means) the renovation are made of the outdated photo plan. Later on the renovated digital photo plan is used in the topographic and electronic maps creating and renovating technologies.

The available and having been analyzed from the technological and economical points of view practice of job for the cartographic basis creation, in accordance with the adducing flow-chart showed the wide possibilities and technological prospectives for using SCC photos accumulated stock.

Attached to assumed the realizing of the technological solutions based on the system using as the TK-350 as the KBP-1000 photos provides the optimal reaching of the "cost-effectiveness-practicableness" integral criterium.

In comparison with traditional technologies, the problem of mapping is being solved with much less financial and temporal expenses, with better quality and reliability. The most favorable conditions for the opportune and high-quality work with new space photos are preliminary placed orders for necessary space images (not later than one year before anticipated date of accomplishment) and payment for the photos before the beginning of the survey.