The Experience of Practical Using PHOTOMOD in Researching the Archaeological Monuments of Volga-Ural Region

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Recent years the photogrammetric technologies in archaeological researches are used in increasing frequency. They are used to create the detailed digital terrain model (DTM), orthoimages, making 3D model of historical monuments and solving attendant problems.

In present work there are taken some examples of practical using digital photogrammetry system PHOTOMOD with the help of digital nonmetric cameras solving photogrammetry problems, which were held on the archaeological monuments of Volga-Ural region in 2008-2010 years. The unique “royal” barrow complex Kyryk Oba (Western Kazakhstan region, Republic of Kazakhstan), presumably dating to the early Iron Age and the mysterious medieval Zolotarevskoe Gorodishe (Penza region, Russian Federation) are the objects of the research.

Stereophotography was carried out by nonmetric digital cameras SONY Cyber-shot DSC-F828 (8.0 megapixel) and Canon EOS 5D (12.0 megapixel), with the help of the system of parallel mixing. The base of the stereophotography was changed according to the task of the research (on average from 56 mm to 108 mm). The calibration of the digital cameras was carried out by the method of Moscow State of Geodesy and Cartography (MIIGAiK). Control points were measured with the help of laser ruler DISTO lite by Leica with accuracy of about 5 mm. These points were marked by special markers on the characteristic contour of photographing area. Besides, there was used laser level LJ35 Laser Cross Level for marking out the areas, leveling the areas, marker lightening and carrying out other photographing operations. The basic survey was conducted at the distance of about 20-30 meters. Certain objects and parts of relief were surveyed at the distance of about 50-60 meters. On the whole there were taken 1248 pairs of images in RAW, TIFF and JPEG formats, which in the sequel were used for the measuring the scene of the survey with the help of programs ERDAS Stereo Analyst and PHOTOMOD. These programmes are somehow different in the sphere of usage, but cope well with the editing of the images of the objects, which have distinct visual details: exact solid angles, dividing the layers or surfaces of the object; different plane marks on the flat surfaces, etc. At the same time, in practice, the objects with smoothed surfaces (for example barrow, bank) or the objects, which have no distinct angles (for example arches, round buildings, towers) are needed extra editing with the help of special models, till conducting
photo- and video filming.

It turned out in the conditions of field researches, that PHOTOMOD (v.4.4) is more adapted and flexible than some other specialized digital photogrammetry systems. It makes possible to correct and control fulfilled operations at all stages of the editing the project. However, the lack of the support for certain functions, in particular in the sphere of close and multispectral photogrammetry, reduces the effectiveness of the product in archaeological researches. Nevertheless, we can expect the appearance of additional features in new versions of PHOTOMOD. Here are some features and results of the research.

**Kyryk-Oba.** The burial mound Kyryk-Oba is situated 80 km eastward from the city Uralsk and is a part of the Poduralskoe plateau. The burial ground consisted of a several dozens of huge burial mounds, stretched out wide strip of tens of kilometers. The three main, as they named “royal” barrows, stand by themselves and are distinguished by their gigantic size. The mounds have diameter from 80 to 150 meters and height from 8 to 20 meters. There are deep craters on the tops of them and they are the marks of ancient robberies. Virtually unaffected by human activities, the territory of the ancient burial ground of its natural landscape, together with the flora and fauna, represents a promising area for the establishing of a natural, historical and cultural reserve.

The task of the research was to create DTM based on the remote sensing, to calculate the volume of the soil ejection of the predatory excavation of the First burial mound, to reconstruct the geometrical shape of the mound, to get the image of the cross-sections of the false mounds (“sticks” as they also named) and others.

If the creating of DTM based on the remote sensing was a normal solvable task, the calculation of the volume of the soil ejection required the data of the magnetic exploration. The spatial mapping of the magnetic measurements (up to the area and the power of emissions) on the topographic maps of the mound, their surface markings and the subsequent photogrammetric panoramic shot made it possible to calculate the volume of displaced soil. As a result, obtained data permitted making of the 3D reconstruction of the original form of the mound.

Another result of the effective application of photogrammetric technology was to obtain the cross-trench cut of the “sticks”. The full image of the slice was formed on the basis of individual photos.
Pic. 1. The reconstruction of the face of the “royal” mound №1.
A – present days (hight – 18,6 m), B – the reconstruction of the mound (hight – 22 m), C – the reconstruction with stone cover

Zolotarevskoe Gorodische is located in the upper reaches of the river Sura 1,5 km westward from Zolotarevka settlement on the high cape (up to 20 m) in the dense forest. Gorodische is surrounded on the edges of the cape by the shaft with a ditch and 4 shafts with ditches across the cape. The preservation of the monument is extremely high. In fact, after 7.5 centuries medieval landscape is fully preserved. Not only the landscape was preserved, but also a numerous of humans’ remains, animals’ remains, remains of items of equipment, weapons, etc. A serious obstacle for the photogrammetric survey of the area is the high grass cover, bushes and wild trees.

The tasks of the research came to making DTM based on local stereophotography and detailed specialized topographic map, on which the lifting materials (arrowheads, scatter utensils, etc.) should be spatially fixed.

At first, DTM was supposed to make using satellite imagery. In this case, the signs of the hights, while the photogrammetric processing of stereopair, are put on the tops of the trees and the average of their heights is taken, for further leadind to the earth’s surface. In the case of high-resolution images (1 m or less) a serious mistake is accumulated. In addition, there can be other difficulties. Therefore, another approach has been implemented on the basis of the short-range photogrammetry. The recording was carried out consistently from the height 3 - 6 m along the route network. The subject was cleaning from grass and labeled. The recording was making. In processing the data in the module PHOTOMOD AT internal and relative orientation was done, together with the measurement of control points on the images. The quality of the measurements of tie and control points was monitored by the residual cross parallaxes. At the present the making of DTM of Zolotorevskoe gorodische is continuing basing on the local stereophotography data.

Literature:

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