

The Documentation of Historical Monuments in Peru (Geoglyphs nad Petroglyphs in Nazca Region and Sechin Archeological Site)

K.Pavelka

pavelka@fsv.cvut.cz

Dept.of Mapping and Cartography, Laboratory of Photogrammetry, CTU in Prague, Faculty of Civil Engineering, Thakurova 7, Prague 6, 16000

Peru is very interesting country from archeological and historical point of view. Soil drawings in the “Pampa of Nazca” in Peru are well known but not explained. Big soil drawings are called geoglyphs; they consist of lines in many forms: long direct lines, triangles and trapezoids and interesting illustrations. The creation of geoglyphs is easy and could be explained by the kind of soil. The surface of the Pampa is made of brown rubble with some ore in it. But some centimetres lower you can find light-coloured sediments of old ocean soil, mainly sand and clay. If you take away the dark rubble from the top you can clearly see the light-coloured subsoil. Most geoglyphs were created this way. It is not easy to identify the age of geoglyphs. The creation of geoglyphs is usually assigned to the cultural period of the Nazca time, which began approx. 200 BC and ended approx. 800 AC. The meaning and importance is only partly decoded. Some of the lines were probably created as astronomical observation lines; some lines are evidently communications. Special drawings like spirals or animals probably had ritual meaning. The Nazca plain desert with geoglyphs is largely destroyed. The damages have partly natural origin (heavy rain storms with an el-Niño effect cause great soil erosion) and partly human factor (road construction, car tracks and land use). The damages in the last decades are serious and it is important to actively maintain this cultural heritage. The Dresden-born scientist Dr. Maria Reiche tried to disclose the secret around the creation and meaning of the geoglyphs. Her theory, which says that it is a huge astronomical calendar installation, has not yet been proved. But her untiring effort led to the protection of the delicate desert pictures by UNESCO. For extension of the work of Maria Reiche, there have been four German expeditions in Nazca/Peru.

In 2004 staff members and students of the Universities of Applied Sciences in Dresden and Berlin (Germany), member of the TU Prague (Czech Republic) as well as members of our Association Maria Reiche carried out a GPS Measurement Campaign and photogrammetric terrestrial and aerial measurement. The second aim of this expedition was the photogrammetric documentation of petroglyphs – drawings of animals, entities and symbols like spirals or stars on solitaire stones and rocks not far from the Nazca plain. The similarity of some symbols (mainly spirals) between geoglyphs and petroglyphs were investigated. The area of interest is very large and not easily accessible; for this reason, aerial photogrammetric methods and satellite remote sensing for geoglyphs were used. The quality and information efficiency of old black/white aerial photogrammetrical images is not high at present. For this reason, a new type of high-resolution multispectral satellite images was used. First of all the seven separate satellite images from the Ikonos satellite with the help of the field measured Ground Control Points were processed to the satellite image mosaic. The field measurement was made by use of GPS Leica1200. For about 40 photogrammetrical control points and 30 control points for satellite images the preparation of detailed sketches were made and these points were determined. Selected geoglyphs were measured in detail directly in the Pampa of

Nazca too. The Ikonos satellite image mosaic can only be used as an overview of the whole area. For details satellite maps in a scale 1:5,000 were created and completed with some vectors from Nazca GIS (major geoglyphs). Some special photographic flights were undertaken with a Cessna airplane and helicopter. Only digital cameras were used for main geoglyphs documentation (Nikon D100). These images have to be rectified (oblique photo axes), but the resolution is about 10cm/pixel. Later (2006-2007) the images from the QuickBird satellite with resolution of about 65cm were added. The quality of these images is better and major geoglyphs are good visible; these data are under processing today and the results will be approximately in autumn 2008 at disposal. Newly, the Aster satellite (2007-8) data were processed to digital elevation model and geological thematic maps. Nowadays, a new expedition is under preparation (summer 2008 with the aim of collecting of new control points and next measurements).

In the Nazca region, there are directly a few important localities rich in petroglyphs. A big one is the Palpa/Chichictara area. One of the important aims of the expedition in 2004 was the documentation and cataloguing of petroglyphs (petroglyph = engraving on stone). A lot of petroglyphs are located in very badly accessible places; the amount of petroglyphs is very high (hundreds of drawings). For this reason, a simple, inexpensive and fast photogrammetric documentation method was developed. For one photoplain at least 4 control points are needed. When determining control points high precision is not required, because stone as a subbase for the drawing is usually not ideally flat. It is necessary to take 2 photos – first one with a reference figure and a second one without a reference figure. The four corners of a paper sheet are the necessary control points with known coordinates for rectification. The second image without a reference figure is rectified to the first one by uses clear-up image points. The final processing is cutting the output and image enhancement. Line drawing of the processed petroglyphs is debatable – the result depends on the operator. On next expeditions (planned 2008) we suppose next documentation of petroglyphs.

Last project is oriented to the photogrammetrical processing of the Temple Sechín using the methods of intersection and single photogrammetry. The main output is visualization of this site on Internet. In program PhotoModeler the 3D-model and orthophotos of parts of walls with sculptures for photodrawings was processed. This model was finished in CAD system Microstation and provided with textures from original photos. Terrain model of a not excavated material, which is found inside of the temple, was computed in the software InRoads (digital elevation model). Finally the resulting animations were made. Photodrawings of walls with sculptures were finished in the program Adobe Photoshop to the photoplain.

References:

- [1] PAVELKA,K.: *Expedice Nazca/Peru 2004* SFDP+ČVUT FSv 2004 pp. 111–134.
- [2] PAVELKA,K., : *Using Of Digital Photogrammetry, GIS and Internet Technology for Historical Buildings Documentation and Presentation* Bogazici University, Istanbul,Turkey 2000 pp. 199–205.
- [3] PAVELKA,K.: *Fotogrammetrická dokumentace památek v Erbilu/Irák*, SFDP +ČVUT FSv 2006 pp. č. 95–105.
- [4] PAVELKA,K.: *The Documentation of Petroglyphs in Nazca/Peru Region by Photogrammetry* HTW Dresden 2007 pp.59-70

This research has been supported by grant MSM 6840770040 (CTU 34-07401)..