3D MAPPING OF THE NASCA LINES

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Abstract:

The famous Nasca Lines in the peruvian dessert are one of the most famous cultural heritage sites in the world. The preservation of this ancient monument is a costly undertaking and seems hardly feasible in view of the actual situation in Peru, the environmental pollution and the mass tourism. Therefore in 1995 a special research project was started at the University of Applied Sciences Dresden in order to preserve this cultural heritage at least in digital form and to provide an easy digital access to the public at large.

One of the possibilities to preserve cultural heritage in digital form is the use of Geographic Information Systems (GIS). For that reason a special GIS application, termed NascaGIS, was developed. The primary requirements of any GIS application are the data. One of the most practical solutions to capture geographical information of this huge area (more than 1500 km^2) to an adequate accuracy is the photogrammetric approach. The poster shows the photogrammetric approach as one of the most practical solutions to capture data.

1. INTRODUCTION

One of the most fascinating mysteries of the world are the famous Nasca Lines in the southern desert of Peru, which have their seeds in the pre-Columbian Nasca culture (approx. 200 BC – 650 AC). Several hundred square kilometers of rock strewn desert are covered with thousands of lines, large biomorph figures and various geometric shapes. Because of the dry and stable climate, the light-colored traces have remained nearly unchanged during the last 2000 years. But today this unique artwork is threatened with destruction. In order to help to protect and preserve the cultural heritage of Nasca and Palpa a scientific project was originated by members of the Faculty of Spatial Information at the University of Applied Sciences in Dresden/Germany in 1995.

The major aim of this Nasca project is the preservation of this cultural heritage at least in digital form. For that reason a NascaGIS application was developed. The primary requirements of any GIS application are the data. The photogrammetric approach is one of the most practical solutions to capture these data.

2. DATA PROCESSING AND ACQUISITION

2.1 Aerotriangulation

For research purposes 179 black and white aerial photos (scale 1:10.000) covering the main area of the Pampa of Nasca were provided by the University ETH Zurich/Switzerland. These images were scanned with a resolution of 20 microns.
Because the accuracy of the delivered Ground Control Points (GCP) was too low, new GCP were measured during a GPS campaign in 2004. After that fieldwork the Aerotriangulation was computed by using the software ERDAS Imagine LPS. The accuracy of the Aerotriangulation is shown in Tab. 1; the number of

GCP and Check Points (CP) respectively the number of observations are added in parenthesis. The achieved total RMS error is 0.19 m for GCP's and 0,43 m for CP's.

Table 1 : Accuracy of Ground Control Points (GCP) and Check Points (CP) [1]

	Ground [Meter]			Image [Pixel]	
	RMS (x)	RMS (y)	RMS (z)	RMS (x)	RMS (y)
GCP	0.103 (39)	0.091 (39)	0.131 (38)	0.658 (186)	0.662 (186)
CP	0.302 (9)	0.155 (9)	0.267 (8)	0.463 (52)	0.520 (52)

Many problems occurred whilst using the automated tie point extraction with LPS. Because about 80% of the images are covering low textured areas (desert) the digital image correlation algorithm did not fit very well. Therefore a lot of tie points had to be measured manually. [1]

2.2 Digital Terrain Model and Orthophoto mosaic

After finishing the aerial triangulation a Digital Terrain Model (DTM) was generated. All experiments of fully automatic DTM extraction failed because the surface of the desert is very homogeneous in texture and the contrasts are too insignificant. The DTM derived automatically was really very poor and full of errors, especially in the mountainous regions. That means the photogrammetric DTM generation had to be corrected manually by using ERDAS Imagine LPS, which was a very time-consuming process.

Based on the aerotriangulation and the manually corrected DTM an orthophoto mosaic with a resolution of 25 cm (4.4 GB) was generated. With this mosaic in combination with the DTM it's possible to realize 3D views, virtual over flights and to produce orthophoto maps.

2.3 3D mapping

Because the main objective of the Nasca project consists in the development of the NascaGIS, the most important task is the vector data capture of the ground drawings at the Pampa of Nasca. The archaeological objects at the Pampa can be divided into lines, areas, figures (so-called geoglyphs), stone objects, burial places and settlements. All these objects including their topographic surroundings were completely mapped with high accuracy for the very first time.

The problems encountered during the vector measurement were multifaceted. Many lines and figures are discontinuous due to destructions and erosions. Very often objects cut or cover each other, that means parts of the older drawings are not visible anymore. Sometimes it's difficult to distinguish between lines and dirt tracks, in other cases destructions makes it impossible to verify objects. Therefore the mapping of the archaeological objects requires special knowledge in order to map the different objects correctly.

Unfortunately the photogrammetric data are covering only the centre area of the Pampa of Nasca. For this reason the use of very high resolution satellite data is an alternative to capture data in the remaining region with a reasonable accuracy [2]. All the vector data and attributive information about the lines and figures at the Pampa of Nasca and Palpa are stored in the NascaGIS. [3]

For further information see: www2.htw-dresden.de/nazca/

3. REFERENCES

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