PHOTOGRAMMETRY - REMOTE SENSING ON THE STUDY OF MONUMENTS AND HISTORICAL CENTERS. THE EFFECT OF HAZARDS. THE CASE OF DELPHI HISTORICAL CENTER.

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ABSTRACT

Monuments and historical centers, because of their particular importance, are studied in multiple ways. The study concerns different scientific disciplines and technology. Photogrammetry and remote sensing contribute essentially to this study, because of the valuable qualitative and quantitative information they offer. In this paper we search through the possibilities of very high resolution satellite imagery on historical centers study, referring to Delphi historical center. The study concerns image enhancement techniques and visual interpretation of Ikonos satellite imagery. Image enhancement techniques facilitate visual interpretation, detection and recognition, of the physiognomy and spatial arrangement of Delphi historical center and offer information about physical and architectural features in the wide area of the historical center.

INTRODUCTION

Monuments and historical centers of different time, form and size, feature cultural heritage, which is studied in national and international level. Physical phenomena in addition to human actions have caused damages - disasters to that part of cultural heritage through time.

Different scientific and technologic disciplines have to cooperate for the study of monuments and historical centers in order to acquire “information” – “data” about them, analyze, identify their situation, make possible restorations, decide for protection measures and form relative archives.

In this effort, scientific areas of photogrammetry and remote sensing have proved effective tools [6, 7]. Acquisition of data (images) in photogrammetry and remote sensing is achieved mainly with photographic, thermal, photon, and electron systems. Image may be taken from the surface of the earth, from airplane or satellite, considered plain or in the form of stereoscopic pair and it may concern different bands of electromagnetic spectrum (visible, infrared, thermal, microwave etc. – photographic, thermal, multispectral, radar images) [1, 4].

Image study includes image interpretation, visually or/and with digital analysis (photointerpretation – remote sensing), and quantitative processing (photogrammetry), that is alignments, contours, sections, coordinates of points (x,y,z), digital terrain models, orthophotography, perspectives, etc.
Advances in technology, as for example terrestrial laser scanning, are particularly useful for subjects of surveying, documentation, modeling and further exploitation [5].

**DELPHI HISTORICAL CENTER STUDY**

Delphi historical center is one of the most important historical centers of Greece. Previous papers of ours concerned:

- Photogrammetric study of Iniohos statue with terrestrial photogrammetry - use of stereocamera [2]

- Photointerpretation study of the historical center and its surroundings with aerial photographs in different scales in order to detect and identify drainage network, mainly in the upper area, resulting in landslides that continue to appear and cause problems to the historical center and the road network [3].

Advances in satellites and the resolution (spatial and spectral) of sensors arouse interest to study satellite imagery for historical centers.

For Delphi historical center study we used satellite imagery of very high resolution, that is, Ikonos satellite imagery (acquisition date/time 2007-11-25, 9:25 GMT) Pan-Sharpened (PSM). Pan-Sharpening combines the spatial content of the 1-meter panchromatic data with the spectral content of the 4-meter multi-spectral data, giving a colour image at 1-meter resolution. The image is a geometrically corrected product, without image distortion due to collection geometry and it is resampled to a uniform resolution and map projection.

The satellite image is studied at desktop computer with Erdas Imagine 2010 software. Image display and its study with the help of software capabilities (zoom in, zoom out, contrast adjustment, dynamic range adjustment, true color composite, false color composite, etc.) give information about the spatial arrangement of the historical center, its general physiognomy, the geomorphology of the area and other natural and architectural features. Image enhancement using decorrelation stretch (adjustment of the color differences found in the input pixels) and spatial filtering contribute to better understanding – recognition of the structure of the historical center and the detailed monuments.

The figures that follow, present basic displays from the above digital processing. Figure 1 presents a true color composite of the area, annotated with stadium, theater, temple of Apollo, sacred way and the museum. Vegetation is easily differentiated in false color composite (Figure 2) and monuments are more discernible. The sacred way and the temple of Apollo are shown with more detail. The wide area of the historical center of Delphi (dashed area) is presented in Figure 3, overlayed with basic drainage (cyan lines) that causes problems to the area. The theater and the temple of Apollo are presented in scale 1: 2000 in Figure 4 and Figure 6, applying dynamic range adjustment and edge enhance with 3x3 filter, respectively. Edge enhance makes some parts of the theater and the temple detectable. Finally, decorrelation stretching results in a very interesting display that is presented in Figure 5, where besides the detected parts of the center, the appearance of vegetation is impressive.
Figure 1: Delphi historical center in scale 1:3500 (true color composite)

Figure 2: Delphi historical center in scale 1:3500 (false color composite)
Figure 3: The wide area of the center with basic drainage

Figure 4: The area of the theater in scale 1: 2000 (dynamic range adjustment)
DISCUSSION

Scientific areas of photogrammetry and remote sensing have a great advance (in methods, equipment, products) that contributes essentially in the study of monuments and historical centers.

In this paper, we search through the possibilities of very high resolution satellite imagery with techniques of digital image processing, mainly image enhancement techniques. The resulted information, presented in Figures 1-6, concern the historical center and its surroundings, particularly various physical and architectural features as relief, drainage, vegetation, spatial arrangement of the historical center and different monuments. The detection and recognition of the above features are assisted by true and false color composite image displays, contrast
enhancement, decorrelation stretching and edge enhancement.

Further study (as image classification techniques) of very high resolution imagery seems that it may offer additional information, mainly in subjects of monitoring the area of the historical center. In addition, very high resolution imagery may be the base map of the historical center area, on which different layers of thematic information (concerning monuments, surrounding area) can be superimposed, in combination with suitable geographical information system.

REFERENCES