

## IMAGERY INFORMATION ON THE STUDY OF CULTURAL HERITAGE

M. Lazaridou, E. Patmios

Aristotle University of Thessaloniki, Civil Engineering Faculty, Lab. of Photogrammetry – Remote Sensing,  
P.O. Box 465, 541 24 Thessaloniki, Greece  
lazamari@civil.auth.gr, epatmios@civil.auth.gr

**KEY WORDS:** photogrammetry, remote sensing, aerial photographs, satellite imagery, cultural heritage

### ABSTRACT:

In this paper we present in summary our studies about monuments and historic centers for the Greek area with photogrammetric, photointerpretation and remote sensing methods. In this way multi-temporal monitoring of monuments and historic centers is possible. Simultaneously the wide surroundings of the monuments are studied. Satellite images of very high resolution are also used.

### 1. INTRODUCTION

Preserving and highlighting cultural heritage (monuments and historic centers) require multiple information, qualitative and metric, and multi-temporal monitoring that permits effective interference.

The relatively used photointerpretation and photogrammetric methods have developed through time.

Multi-temporal monitoring of cultural heritage (monuments and historic centers) with photointerpretation and photogrammetric methods and formation of relevant archives contribute effectively, in the effort of preserving and highlighting them.

In this paper, we present, first, in summary, our experiences of photointerpretation and photogrammetric studies for monuments and historic centers in the Greek area, with aerial photographs and terrestrial takings. Next, we present the possibilities of studying monuments and historic centers with satellite imagery.

### 2. AERIAL PHOTOGRAPHS AND TERRESTRIAL TAKINGS

#### 2.1 Historic center of Mystras

(Patmios, 1981a; Patmios et al. 1981b; Patmios, 1991)

- Aerial photographs  
Scale 1: 15,000  
Horizontiographic details and contour curves in scale 1: 1,000 for the whole area of the extensive historic centre.
- Terrestrial photogrammetric takings
  - External parts  
Stereocamera, phototheodolite: faces of churches, other architectural details  
Photogrammetric restitution, rectification – church of SS Theodore, church of Evangelistria, fortress.

- Internal areas

Stereocamera, phototheodolite: church of Perivleptos, Cathedral – plane and curved surfaces: photogrammetric restitution, rectification, DEMs (deformations of Cathedral dome).

- Inaccessible areas

Area of destroyed fortress: phototheodolite, analytical solutions.

#### 2.2 Athos peninsula (Agio Oros)

(Patmios et al, 1982b; Patmios, 1992; Patmios et al, 1992)

The study included:

- Photointerpretation study of aerial photographs covering the peninsula, geomorphologic features, geologic formations, geotechnical subjects, land uses, road network, monasteries.
- Digital Elevation Models in areas of monasteries with rough relief.
- Integrated considerations.

#### 2.3 Ancient Theaters (Philipi, Dio, Nicopolis, Dodoni, Delphi, Epidavros, Delos)

(Patmios et al, 1988a)

Different stages of photointerpretation and photogrammetric study, concerning:

- a) the wide surroundings of the theater and the “relation” of the historic center with it
- b) the historic center and the “relation” of every monument with it
- c) every monument, in general and in detail.

#### 2.4 Concentrative photointerpretation and photogrammetric data

(Patmios et al, 1982c)

An "atlas" may include:

- Aerial photographs and terrestrial takings of monuments and historic centers
  - single ones
  - in pairs, oriented for stereoscopic observation
- Basic elements of graphic photogrammetric restitution.
- Annotations.

#### 2.5 Historic Center of Delos

(Patmios et al, 1982a)

- Terrestrial photogrammetric takings for:
  - the study of the theater.
  - determination of coordinates of points in characteristic architectural details, that are also visible in historic aerial photographs without ground control points, in order to metrically exploit them.
- Aerial photographs of the area of the lake – rectification.

#### 2.6 Delphi historical center

(Patmios et al, 1988b, Patmios, 1987)

- Aerial photographs for the study of landslides in areas of the historic center related with drainage network.
- Terrestrial photogrammetric takings for the study of the heater and Eniohos statue in the museum of the historic center.

### 3. SATELLITE IMAGERY

Sattelite images can offer important information for the monuments and their wide surroundings. From their "nature" they are a digital document. Paper prints - hardcopies of sattelite images give a product equivalent to aerial photograph.

These hardcopies may be produced in various scales and serve in many ways the study of monuments and their wide surroundings.

In all the cases, the resolution achieved by sattelite instrumentations is determinative. It is very interesting to get familiar with hardcopies in different scales and with the relevant possibilities.

This is presented for the case of the city of Thessaloniki and the monuments it includes, that are of different time, kind, size and ruin.

The list of the monuments and their location in the central area of the city are presented in a previous paper of ours (Patmios et al, 2002).

In this paper, sattelite images in three different scales are presented.

The used sattelite data are hardcopy images of Ikonos sattelite (CARTERRA™ GEO 1-PSM, Space Imaging Europe, acquisition 2000).

The area of the monuments in the central part of the city of Thessaloniki is presented in figure 1, in scale 1: 20,000.

Figure 2 presents some monuments with their surroundings in scale 1: 5,000.

The area of a specific monument, Ancient Agora (Roman Forum), is presented in Figure 3.

Sattelite imagery results in significant information, depending on the scale of printing.

Scale 1: 20,000 reveals general information about the wide area in which the monuments are located (urban network, general land uses, location of each monument).

In scale 1: 5,000 information become more detailed and in scale 1: 2,500 characteristic details of the monument are recognized.



Fig 1. Central area of Thessaloniki, in scale 1: 20,000.

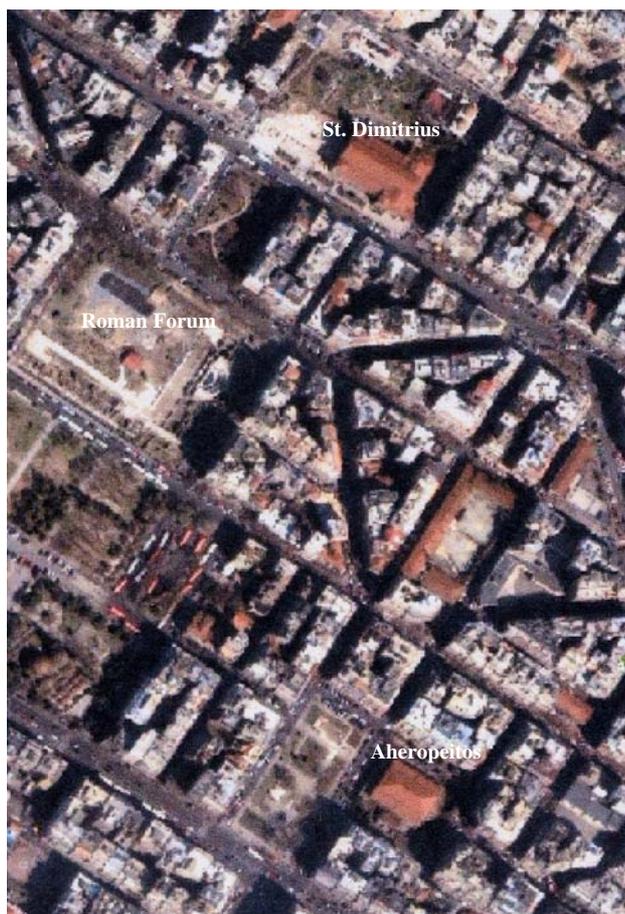


Fig. 2. St. Dimitrius church, Ancient Agora (Roman Forum), Aheropeitos church in scale 1: 5,000.



Fig. 3. Ancient Agora (Roman Forum) in scale 1: 2,500.

#### 4. DISCUSSION - CONCLUSIONS

The study of an extensive and important historic center must be done systematically, from general to particular. Various photointerpretation and photogrammetric methods and instrumentation are used according to the case (2.1 Mystras).

Extensive areas including cultural features need an integrated study to preserve and highlight the monuments (2.2 Athos peninsula – Agio Oros).

The study of monuments in “groups” (2.3 Ancient theaters) indicates more suitable organization of methods-instrumentation depending on the particularities of each group.

Stereoscopic pairs of images showing monuments and historic centers in a form of an “atlas” offer perception of the “physiognomy” of the monument. The addition of some horiontiographic and elevation data contributes to the effort of organizing further systematic study of the monument-historic center (2.4 Concentrative photointerpretation and photogrammetric data).

Progress in the scientific and technologic areas of photogrammetry photointerpretation and remote sensing is undoubted.

From this aspect, the study of satellite imagery can contribute in many ways for the study of single monuments and group of monuments in the framework of wide surroundings (3. Satellite imagery).

The above methods and instrumentation resulting products (photointerpretation, photogrammetric, satellite imagery) can be used as input data in Geoinformation Systems directly or after suitable preparation (digitization, scanning) and can be further processed.

The study of cultural heritage – monuments and historic centers, because of its particular importance, is faced at different levels (from national to local, from universities to private efforts etc). The results of these studies in a multi-temporal consideration are valuable also for an integrated facing of the subject of studying cultural heritage with the contribution of photogrammetric, photo-interpretation and remote sensing methods.

#### REFERENCES

- Patmios E., 1981a. Small scale air photographs in researching monuments and historic centers (Mystras, Peloponnese, Greece and Palace of Faistos, Crete, Greece). In: *Photogrammetry applied in architecture, monument preservation, archeology, science of arts*. Symposium, Wien.
- Patmios E., Tsakiri – Strati M., Chalkias Th., 1981b. Methodology of terrestrial photogrammetric takings on churches faces and part of fortress at historical centre Mystras. In: *XVI International Byzantine Congress*, Vienna, Austria.

Patmios E., Tsakiri – Strati M., Ceorgoula O., 1982a. Etude Photogrammetrique sur les Centres Historiques de Delos et de Mystras (Grece). In: *International Symposium on Photogrammetric Contribution to the Documentation of Historical Centers and Monuments*, Siena, Italy.

Patmios E., Tsakiri – Strati M., Ceorgoula O., Lazaridou M., 1982b. Photogrammetric methodology to littoral studies. Photointerpretation in Athos peninsula, Greece. In: *Fifth International Symposium on Computer – Assisted Cartography and ISPRS Com. IV*, Virginia, USA.

Patmios E., Tsakiri – Strati M., 1982c. Photogrammetric methods on environmental studies. Basic photogrammetric elements and photointerpretation. In: *International Geographical Union – Brazil National Commission*, Rio de Janeiro.

Patmios E., 1984. Photogrammetric study of statues. In: *XVth Congress of ISPRS*, Vol. XXV, Tome A5, pp 605-611, Rio de Janeiro.

Patmios E., Lazaridou M., 1988a. Photogrammetric and photointerpretation methods on the study of monuments and historic centers in the Greek area. Cases of theatres. In: *IAPRS vol. XVI, Com. V*, pp. 498-501, Kyoto, Japan.

Patmios E., Lazaridou M., 1988b. Photogrammetric and photointerpretation of Delphi Historical Center and the surrounding area. First stage. In: *International Symposium on Engineering Geology on related to the study, preservation and protection of Ancient Works, monuments and Historical sites*. Proceeding pp 2159-2161, Athens, Greece.

Patmios E., 1991. Photogrammetric Study of curved surfaces of monuments. Examples of the historical centre of Mystras. In: *XIV Symposium of CIPA*, Delphi, Greece.

Patmios E., 1992. Contribution to the DTMs study (DTM on drainage studies). In: *IAPRS vol. XXIX, Part B2, Com. IV*, pp 823-831, Washington D.C.

Patmios E., Lazaridou M., 1992. Subjects relative to an intergrated study of Athos peninsula (Greece). In: *IAPRS vol. XXIX, Part B2, Com. VII*, pp. 16-18, Washington D.C.

Patmios E., Lazaridou M., 2002. Satellite Image of Very High Resolution on the study of Monuments and Historical Centers and their wide Surroundings. In: *IAPRS, vol. XXXIV, Part 5, Com. V*, pp. 446-450, Corfu, Greece.