

PHOTOGRAMMETRY AND ARCHAEOLOGY:  
A CASE STUDY IN THE ARCHAEOLOGICAL SITE OF PHILIPPOI IN N. GREECE

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ABSTRACT

OLGA GEORGOULA

DIMITRIOS KAIMARIS

GEORGIOS KARADEDOS

PETROS PATIAS

THE ARISTOTLE UNIVERSITY OF THESSALONIKI, GREECE

The present study belongs in the field of Geoinformation's applications, that are related with the documentation, management, protection and promotion of Archaeological sites. The value of these applications in National and World-wide level is obvious, because, the essential tools for the continuous follow-up and management of Cultural Heritage are offered.

The monitoring of the remains of past human activities, especially when they are of complex form and cover large area, is more effective when it takes place from the air. The use of the aerial photography for surveying and documentation of archaeological sites is well known. The application of digital methods of processing, often of a large number of aerial photographs, gives the necessary outputs for the documentation of the historical sites. Of special interest is the case, where the aerial photography is used for the location of buried archaeological remains, which under the proper conditions, are best recognizable viewed from the air. On the other hand, the terrestrial photos are more appropriate for the documentation of man made constructions. The fusion of divers (aerial and terrestrial) data is a very interesting process because it offers an integrated product.

This project has as object the digital photogrammetric process of aerial and terrestrial photos as well and the production of suitable products aiming at:

- The documentation of an archaeological site
- The localisation of buried archaeological remains
- The application of virtual reality techniques aiming at the study and the analysis of archaeological landscape and of man-made constructions as well.

Region of study is the Archaeological site of Philippoi Kavala's in N. Greece.

## INTRODUCTION

The present study belongs in the field of Geoinformation's applications that are related with the documentation, management, protection and promotion of archaeological sites. The value of these applications in national and worldwide level is obvious. Digital photogrammetry, one of the basic tools in this field of applications, is the method, which in comparison with other techniques like topographical survey, 3D scanning etc, offers the most advantages for the identification, understanding, interpretation and presentation of an archaeological site or a manmade construction. The use of the aerial photogrammetry for the monitoring of the remains of past human activities is well known (Doneus 2001, Patias, Karapostolou and Simeonidis 2002, Tozz and Harari 1984). The application of digital methods of processing, usually of a large number of aerial photographs, gives all the necessary outputs for this purpose, as maps, digital

terrain models (DTM), orthophotomaps, 3D models etc. Especially, the orthophotomap, which combines the quantitative information of a map and the thematic information of a photograph, plays a significant role in archaeological research. On the other hand, the terrestrial photos are more appropriate for the documentation of manmade constructions. The fusion of different (aerial and terrestrial) data is a very interesting process because it offers a totally integrated product (Patias, Karapostolou and Simeonidis 2002).



Figure 1 Orthophotomap (zoom out) and the places of the traces that has been interpreted

Figure 2 Extract of the orthophotomap 1:5000

Figure 3 Traces of an unknown buried construction

# Photogrammetry

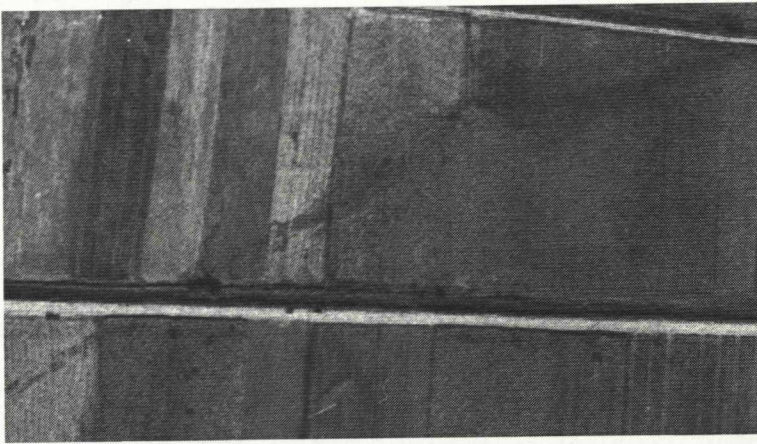


Figure 4 Long trace in dark colour. Covered old stream?

This project has as object the digital photogrammetric process of aerial and terrestrial photos as well, aiming at 1) the compilation of the appropriate cartographic data for a future archaeological GIS for an archaeological site and its major area, 2) the location of buried archaeological remains and 3) the application of virtual reality techniques aiming at the study and the analysis of archaeological landscape and of manmade constructions as well. The paper refers the first result of a project that our group, in the Aristotle University of Thessaloniki, is working on. Our group is interdisciplina-

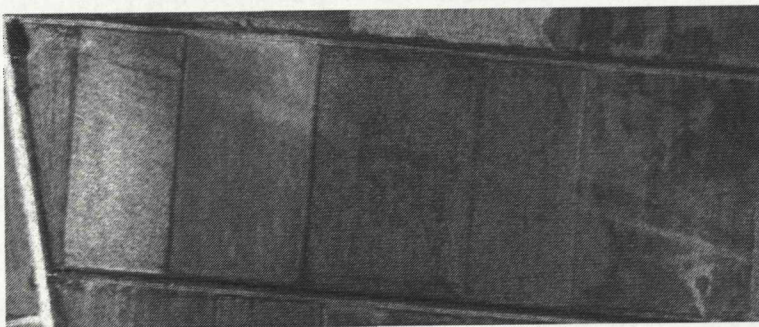


Figure 5 Straight trace of 6m width in light colour. An old road?

ry and is consisted of Photogrammetrists and an Architect-Archaeologist. The area of study is the archaeological site of Philippoi Kavala's in N. Greece, where excavations are taken place for the past 90 years. During the excavations, characteristic monuments of the Hellenistic, Roman and Early Christian period were discovered, like the theatre of Philippoi, a small part of Via Egnatia and the city wall. The project is divided in two parts. The first concerns the archaeological site of Philippoi and the major area of it, where is the place of the battle of Philippoi at 42 BC and the second one is about the theatre, inside the city wall.

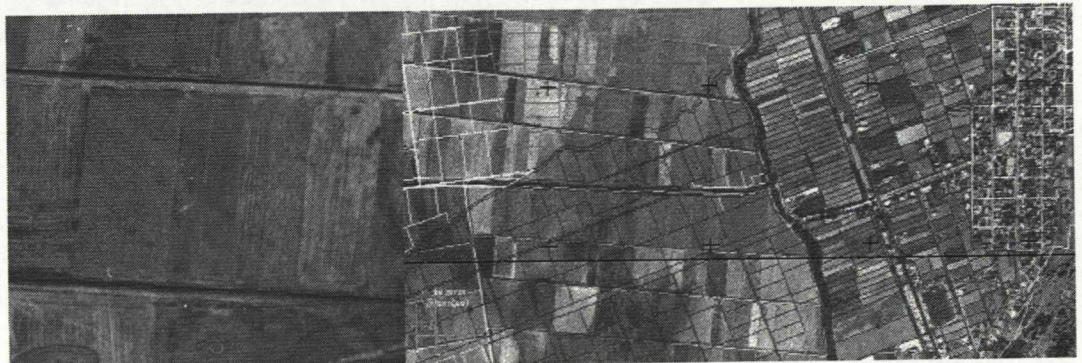


Figure 6 Straight trace of 7.8m width. A construction?

Figure 7 Orthophotomap and cadastre maps of 1928, 1932 and 1940

## THE ARCHAEOLOGICAL SITE AND THE MAJOR AREA OF PHILIPPOI

The data that has been used was of different form and they came from different sources, as photogrammetric data, cartographic data and historical and archaeological data as well.

Photogrammetric data: 4 aerial photos in B/W, scanned at 1200dpi, scale 1:15,000, September 1996.

Cartographic data: 11 cadastre maps 1:5,000, dated from 1926 to 1960, from where information about the changes of the landscape and the fields has been drew off.

Historical sources: very important information has been drew off from the historian Appianos (IV:105-115), who describes in detail the landscape of the major area of city of Philippoi and he gives very interesting information about the battle of Philippoi.

Finally, information from the archaeological excavations has been used. All available information is processed and cross-evaluated. The photogrammetric process in the Digital Photogrammetric Workstation included: a bundle adjustment (7 control points), production of the Digital Terrain Model and production of an orthophotomap at 1:5,000 scale (Figs.1, 2) and the compilation of a vector mp at the same scale (Kaimaris 2002).

During the photogrammetric process, the current images were examined and a lot of traces have been found and they were interpreted as well. In figures 3, 4, 5 and 6, few examples are shown. In this point it must be mentioned the location of a very interesting trace (Fig.3). On the top of a small hill, the evident traces of a buried construction 53 x 47 m, unknown till now even for the archaeologists, are shown. In the next step the traces have been relocated on the orthophotomap (Fig.1). In this way it was easy to have a total view of the whole area with the traces and consequently to correlate various traces and to extract additional conclusions empowering our initial estimations. For example, the spatial arrange-

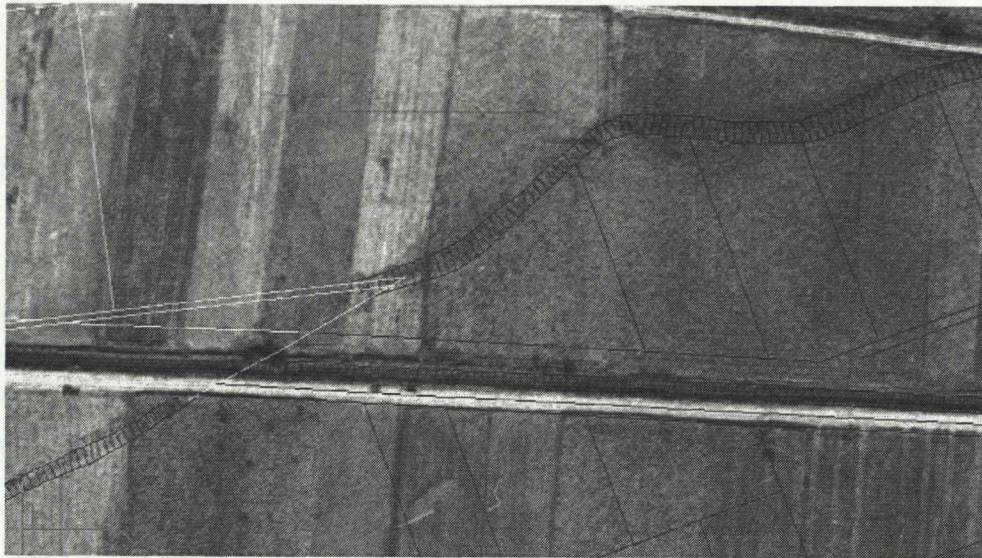


Figure 8 The branch of Gagitis river as is presented on the cadastre maps



Figure 9 The cadastre map of 1940

Figure 10 The cadastre maps of 1940 and 1960

ment of 4 separated traces in connection with the fact that these traces had common characteristics as shape, size and tone led us to suppose that they are parts of a long straight element, a "construction" of 6m width, maybe a road. After that, the attention was focused on the research for the estimation of the chronological period that these traces appeared above the ground. For this purpose old cadastre maps (1928, 1938, 1940, 1957, 1960) has been processed and used. The cartographic process involved: scanning, transformations-georeferencing to the same cartographic system as the orthophotomap, merging of all cadastre maps in one map file and finally superimposition of the merged file on the orthophotomap. On these maps the old geomorphology (old streams, old ownership boundaries etc), which does not exist, is shown (Fig.7). In some cases the initial estimation became true, like in the case of the branch of Gagitis river (Fig.8), which is shown in the cadastre maps of 1932 and 1940. Today is covered, leaving only its traces in the photos (Fig.4). In other cases, the cadastre maps did not help the research at all, because nothing was shown on them, leading to the conclusion that the traces belong to "something" before the time of maps (Figs.9, 10). In these cases significant role was given to historical sources (Appianus IV:105-115) and archaeological excavations.

In his manner it was possible to conclude that some of the traces belong to buried parts of Via Egnatia (Fig.5, 9, 11), and another trace to a part of a fortification wall (Fig.6, 10, 11), constructed by the democrats before the battle of Philippoi (42BC). After that a reproduction of a historical map of the possible landscape of that time and of the battle of Philippoi (Appianus IV:105-115) has been done (Fig.12). The combination of the photogrammetric products as the DTM and the orthophotomap has been used for the creation of an image-draped model. Using the appropriate software and process a fly-through video sequence around the model of the archaeological site has been created as an AVI file format, which anyone can use to fly virtually around (Fig.13). Additionally, MicrostationSE provides the ability to export the textured model of a CAD model in a VRML format file (Bakourou et al. 2002).

#### THE THEATRE

In the theatre of Philippoi the last years extended anastylosis-restoration works are in progress. These works are based on the result of the study of the historical and constructional phases of the theatre and the eastern city wall (Fig.14a, 14b), which is based to the archaeological excavations which are

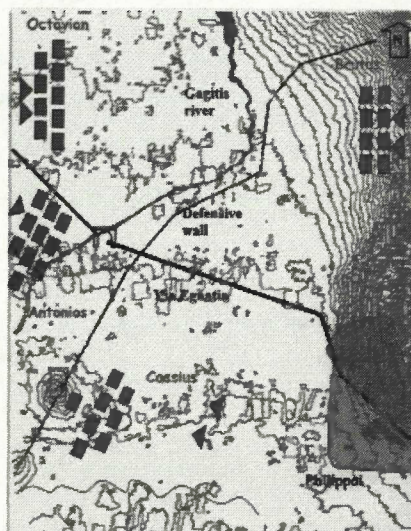


Figure 11 Via Egnatia and defence wall in the plain of Philippoi

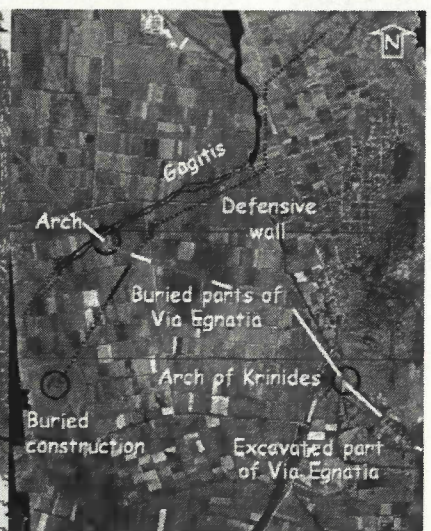


Figure 12 a historical map of the possible landscape in the time of battle of Philippoi (42BC)

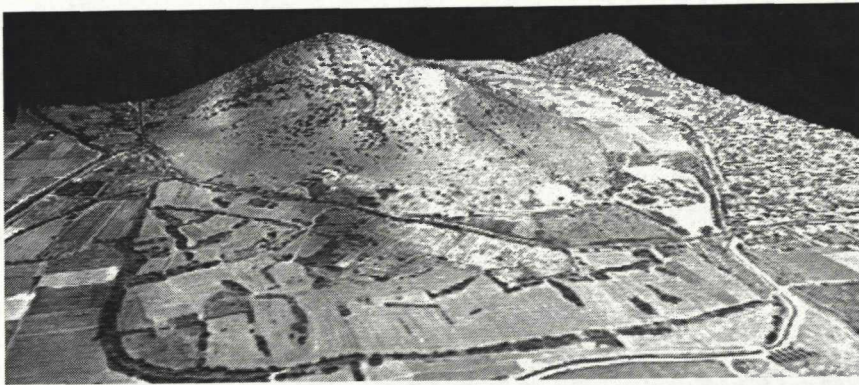


Figure 13 a view of the image-draped model of the archaeological site of Philippoi

continuing. The aim of our project is: 1) to surveying with the aid of photogrammetry the current status of the theatre, 2) to produce accurate 3D models of the different historical and

remains of past human activities, the application of virtual reality techniques aiming at the study and analysis of archaeological landscape and of manmade constructions as well etc.

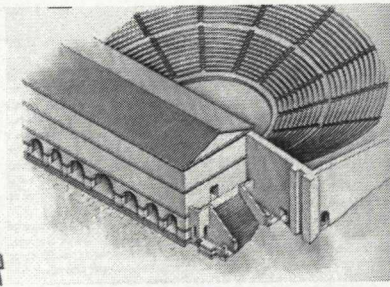
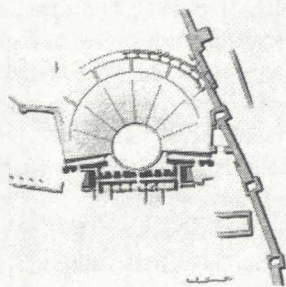


Figure 14a (left) Historical and constructional phases of the theatre  
Figure 14b (right)

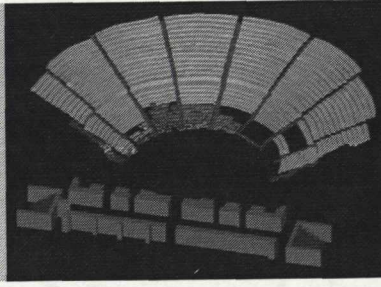


Figure 15 3D model of the theatre

constructional phases of it and 3) to proceed with visualization and virtual reality techniques that provide a better inspection of the theatre in study. Till now, the photogrammetric process of the terrestrial photos of the theatre has been finished and the construction of the 3D models is in progress (Fig.15).

## CONCLUSIONS

Photogrammetry can give more than simple maps. It gives suitable products aiming at the documentation of an archaeological site, the location of buried

These first encouraging results enforce us to continue the research in this area. In the near future we will process satellite images B/W and multi-band of very high geometrical resolution for an extended area of Philippoi.

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