

## Modern Methods for using Single Images in Conservation

by

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### Abstract

As a submission of the Co-Chair of CIPA Task Group 2, this paper deals with practical experiences from using single images in conservation.

In particular it deals with modern methods for using single images in conservation as gained from surveying the eldest houses of Parliaments of the Western hemisphere, which is part of the antique sites of Patara (Turkey).

It is the main intention of this paper, to provide a photomap of the scale 1:20, which shall replace the old fashioned conventional archaeological stone maps, based on manual sketches and measurements, at least for objects showing almost plain surfaces.

Therefore, the introduction into the area and the surveying task to be solved is consequently followed by discussing the advantages and disadvantages of traditional archaeological sketches versus extremely large scale photomaps.

To obtain ground control, including regular grid points, video based Monument-Tachymetry successfully has been applied.

Finally the photomap showing the scale 1 : 20 is generated, based on the French facet method in a modified digital manner, by successive rectification of images or image parts, showing the 4 m x 4 m grid, as marked by color or colored sticks. This work will be followed up by mosaiking the final photo map.

In this sample it is anticipated, the final photo map will contain some thousand stones of the antique ruin, mapped in the scale 1:20.

### 1 Introduction into the area and the surveying task to be solved

This investigation has been carried out within the antique sites of Patara (Turkey), which currently even has been mentioned as a candidate for Plato's lost Atlantis, situated on the Turkish Mediterranean coastal zone area, approximately on the opposite side of the isle of Rhodes (Greece). Recently the situation of an extremely huge antique king's palace has been identified in Patara. According to Herodotus, Patara, known as the birthplace of Apollo, and Delos seasonal changed in hosting the oracle of Apollo, comparable to the well known oracle of Delphi (Greece). There are 4 candidates for the Apollo temple of Patara, which is not yet verified. A coin, recently excavated in the Necropolis of Patara, shows the female oracle of Patara in action, as indicated by an owl, sitting on a ball, by a snake and a burning tree (aspergillum). Furthermore, high altitude photography shows ancient roads and terrace pattern, which indicate, at roman times Patara was an extremely huge town. According to Prof. Fahri Isik, Patara is at least comparable with Ephesus and Athens! It is reported, Patara saw the emperors Alexander of Macedonia as well as the roman emperor Trajan, saw Cleopatra's lover Marc Antonio, as well as St. Peter, the first pope. Later Patara became the birthplace of Santa Claus, who mainly acted in the town of Myra, close to Patara. The exact birthplace of Santa Claus in Patara is still not identified. The early global map from Epstorf (Germany) seems to show walls of Patara like a fortress.

Different Byzantine walls show periods of permanent reducing of the City of Patara, until a complete disappearing of the inhabitants. Due to extremely moving of sand dunes, see also Fig.1, Patara's proud ancient harbor lost access to the Mediterranean Sea. On the other hand, Patara's dunes still cover large ancient parts of the town and thanks to this dunes, ancient parts of Patara are still conserved, even until the present. Obviously the greatest parts of Patara have been destroyed by earthquakes and by war events.

This research in particular is concentrating on the reconstruction of the remaining ruins of the largest antique houses of parliaments of the Western hemisphere, the so called Ecclesiastion ("capitol") or Bouleuterion ("town hall") of Patara, the antique capital of the province Lycia, see Fig. 1.

In this case the main reasons for a systematic surveying of that particular antique site are

- the documentation and interpretation of the archaeologists and
- the computer aided reconstruction of the ancient houses of parliaments in Patara.

Important surveying results for different excavating epochs are finally the 3dimensional coordinates of the complete ancient object, traditionally carried out as

- maps in the scale 1:20, which show the situation and details of more than thousand remaining stones left around in the ruin field of the antique houses of parliaments and as
- a sufficient dense series of profiles, allowing to derive the complete height information needed, with sufficient accuracy and showing in particular all remaining parts of walls.

As far as possible and as a contribution of CIPA Task Group 2, both tasks shall be solved using single images in conservation. Alternate surveying methods like Stereo Plotting and Laser scanning are not part of this investigations.

According to Archaeologic traditions the object is covered with a 4x4m grid, see Fig. 2.

This is a local grid, counting from the center of the object in Fig. 2 and along the object axis. The grid is verified by setting out the 4x4 m pattern, putting wooden sticks of red color in the edges and not by using real perpendicular strings.

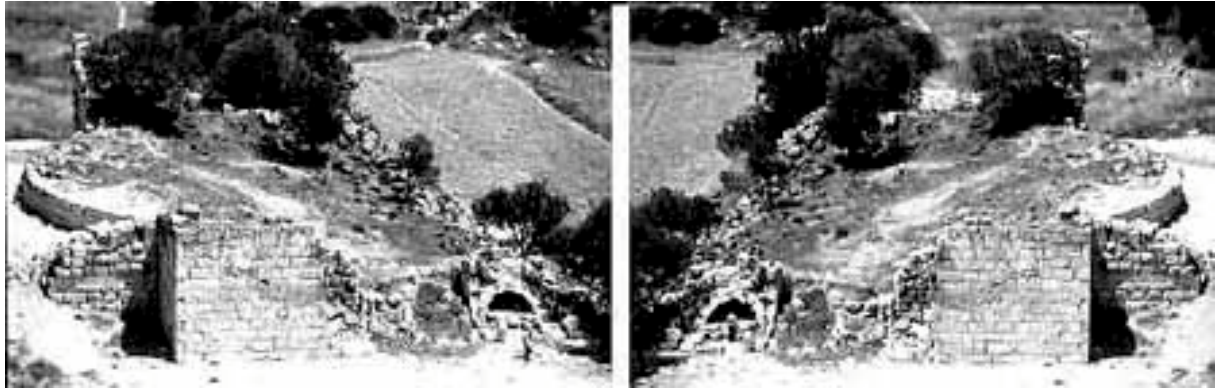


Fig. 1 The left image shows the ruins of the largest antique houses of parliaments, situated in Patara (Turkey); for stereo viewing observe the left hand picture with the left eye and the image(!) of the right hand picture in a perpendicular mirror

This work is based on 5 new ground control points, defining a polygonal ring, surrounding the object, which is polar connected to the global coordinate system via 3 control points. In addition 4 points, defining the axis of the object are polar connected to the polygonal points.

This allows to calculate global coordinates for all controlpoints, including the 4 points defining the axis of the object. Knowing the **global** coordinates for the 4 axis points of the object, the **local** coordinates for this 4 axis points counting from the center of the object and along the object axis are elementary determined. Now a coordinate transformation based on the 4 axis points allows to calculate the local coordinates for all controlpoints. From there the grid will be determined and set out in the local coordinate system, see Fig.2.

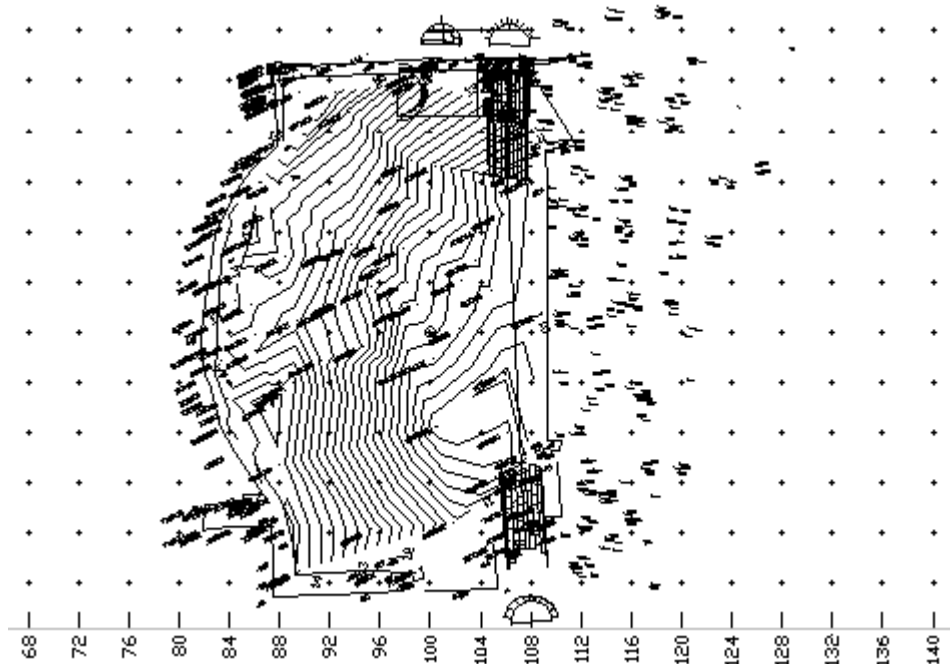


Fig. 2 Synoptically overview of the situation of the largest houses of parliament in Patara (Turkey) containing the 4x4 m local grid

## 2 Traditional sketches of archaeologists versus (extremely) large scale photomaps

A real obstacle for a broad application of single images in Archaeology is the anachronistic competition between objective photogrammetric mapping and subjective Archaeologic interpretation.

As a matter of fact the typical today's surveying results of Archaeologists are still manual sketches in the scale 1:20, where details are roughly measured and even estimated within a 4 x 4 m grid!

State of the art results of the surveying of the ground situation of objects showing partly plain surfaces are rectifications based on extremely low aerial photography, imaging object parts together with at least 4 corresponding controlpoints.

Of course, partly stereo Photogrammetry can be required. It would already be a big progress, if the archaeologists would at least use the high resolution photography for mapping purposes! Surveyors should refuse, promoting manual sketches of any kind, as they are not state of the art. It is liked to emphasize, the alleged superior of manual sketches, supposed to be proofed by the comparison of detailed sketches with poor photographs, is completely nonsense and has nothing to do with the today's ability of photographic techniques.



Fig.3 Typical manual sketch to be replaced or by a state of the art photomap, see Fig. 7

### 3 Obtaining ground control using video based Tachymetry and verifying a 4 m x 4 m grid.



Figure 4. Replacing of signalized points by video recording of the ground surveying in Patara (Turkey)

It is liked to emphasize, the signalizing of controlpoints partly can be replaced by video recording the queue of ground survey points, when engaged with the reflector staff, see Figure 4. These controlpoints, can be clearly interpreted on the video screen and transferred to the corresponding synoptic photograph for, e.g., rectification purposes. It is also very important, clearly to assign the point number on the video tape, at least by voice recording.

#### 4 Digital photo map generation, based on the modified facet method

The facet method has been used in France until about 1970 in an analogue manner, even for precisely cadastral mapping purposes. The characteristic terrain surface is adapted by multiple polyeder projection.

For a modern flexible application of a modified facet method, in particular to survey an Archaeological site, the "polyeder" can show a regularly (4 x 4m) grid as well as random edges, see Fig. 5.

- The edges of these polyeder pattern are marked with wooden colored sticks.
  - The object surface must be suited to be adapted by a polyeder pattern
  - The three dimensional coordinates of the regular or non regular situated edges of the polyeder pattern are set out and/or determined using the conventional terrestrial polar surveying method.
  - Extremely low altitude aerial photography, successive taken with a amateur camera from a telescope beam of approximately 10m height, must show the particular polyeder or grid plain of about 4 x 4 m in nature, as indicated by at least 4 corresponding marked points of the polyeder respectively of the grid.
  - The exposure is verified from the ground using modern infrared control or ball exposure.
  - Continuously the images, defining the polyeder, will be digitized and digitally rectified, based on at least 4 controlpoints, e.g., using the Rollei MSR rectification program.
- Of course an alternate method is analog optical rectification using a rectifier.
- Finally the rectified images are digitally or manually mosaiced to achieve the complete photomap of the archaeological site.

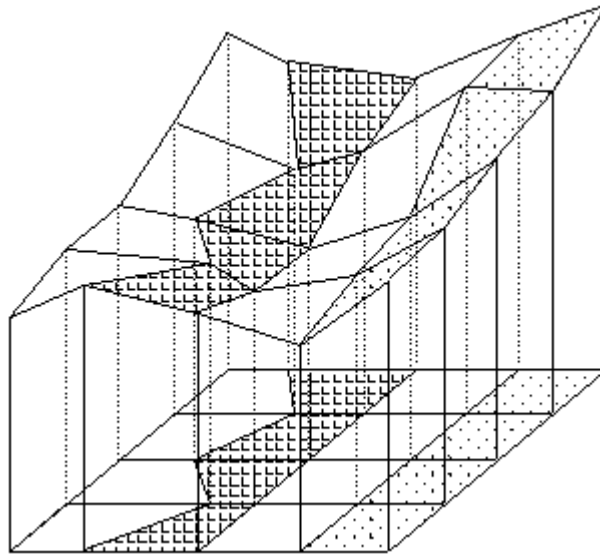


Fig. 5 Principle sketch of the modified Facet method for obtaining a rectified photo-mosaic by approximating the object surface with regular and/or non regular grid pattern and successive processing of digital or analog image rectifications



Fig. 6 The unrectified amateur photography of a 4 x 4 m grid, as taken from a small camera "telescope-crane" with a 3.3 Mill. Pixel Canon Power Shot G1 Camera with Remote Control, is one "stone" of the final rectified mosaic, see Fig. 7

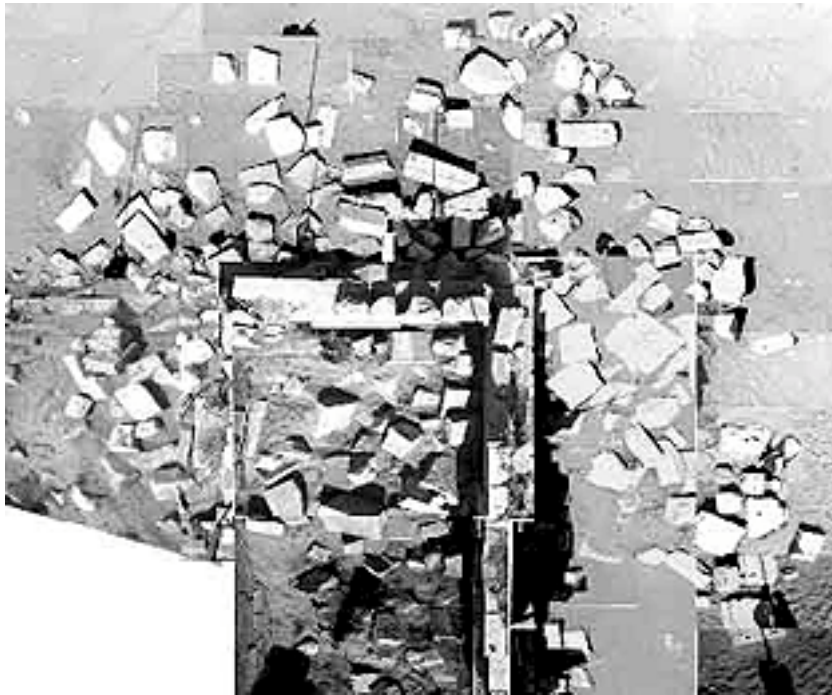


Fig. 7 First result of mosaiced 4x4 m grids, showing a part of the final photo map of the original scale 1:20, compare with Fig. 3!

## 5 Conclusions

The successful application of single images in conservation has already a long tradition. So far little work has been carried out with respect to a systematic research in this field. It is highly recommended and expected by the CIPA users community, to publish a handbook for the use of single images in conservation, stating real useable practical advises and samples. The authors like to point out, that they permanently gain practical experiences from "learning by doing", which is obligate in this field.

In this respect unexpected success gained from inventing the video based monument tachymetry on the one hand and from a consequent applying of the low cost extremely low altitude photography by using a telescope beam platform on the other hand.

Both inventions have been stimulated by applying single images in conservation within the antic ruins of Patara(Turkey), even a candidate for Atlantis. These both inventions promise a great future.

More than 150 years after the invention of the photography and applying digital photography even on an amateur level, for every serious archaeologist, the time is more than overdue, to replace subjective interpreted manual sketches by objective high resolution photomaps.

It is liked to emphasize, though medium range laser scanners show extremely dense but random surface points, early results, as obtained with the callidus device at the University of Applied Sciences in Magdeburg, still suffer under unacceptable resolution and are quite far away from a precise and detailed photo map.

## 6 Literature

WALDHAEUSL, P. and OGLEBY, C: 3-by-3 Rules for Simple Photogrammetrie, ISPRS Comm.V Symposium, Melbourne, Australia, 1994