PHOTOGRAMMETRIC SUPPORT FOR MONUMENT PROTECTION IN ARCHAEOLOGY

by

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Abstract:

The objective of this paper is on the benefit of photogrammetric and remote sensing techniques for the discovering and interpretation of archaeologic monuments as a basis for further monument protection.
To solve this task,valuable documents,like photogrammetric and remote sensing imagery, historic photos, maps and measurements, as well as local known reference,have been evaluated.In this context, based on remote sensing imagery, samples for aimed detections and excavations of irretrievable monuments of historic importance,will be demonstrated.
For a permanent availability of these results, in particular in view of the consideration of monuments within environmental planning processes, the establishment of a digital Monument Information System ("MIS")is recommended.

Abstract:

Key Words: Archaeological, Photogrammetry, Remote Sensing Application

1. INTRODUCTION

Handed down monuments, detected or still undiscovered, increasingly dilapidate under environmental influences.
Photogrammetry and remote sensing provide decisive aids to antagonise this situation by speeding up the localisation of historic monuments and/or its permanent control(including inventory).
The results serve as basic documents for a future improved protection of known monuments as well as for a progress in aimed detections and excavations, in particular of irretrievable monuments of historic importance.

2. MONUMENT PROTECTION

The localisation of so far undiscovered monuments can be supported by surface visible or detectable traces of human activities, like

- influences in the relief - energy (e.g., remaining dams, ditches etc.) and/or
- activities which cause differences in vegetation- heights and -quality (caused by, e.g., less fertile soil under former stone-walls),in shadow, in temperature and in radiation, but also in magnetism, in gravity and in the electric and seismic behaviour etc. of an area.

Therefore, the localisation of so far undiscovered monuments, beside others, can be supported by the following means, compare Schuhr et. al.(1986):

2.1 Monument prediction using aerial photography

Currently conventional oblique low altitude aerial photography is flown systematically throughout the whole country of Germany. As a sample, in figure 1 is shown the geometric distorted original photo of a probable archaeological site (as indicated by the dark lines in the field), situated near the City of Osnabrück (Germany), as carried out by O. Braasch.

This photo was taken close to the recently discovered parts of the battlefield of the legendary Roman army under their famous commander P.Q.Varus of the year 9 A.C..

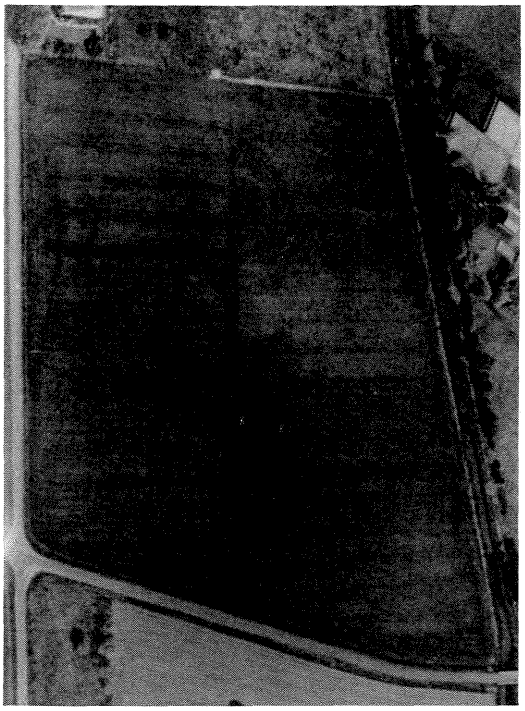

Fig. 1: Original oblique photo of an archaeological site, taken by O. Braasch (1991)

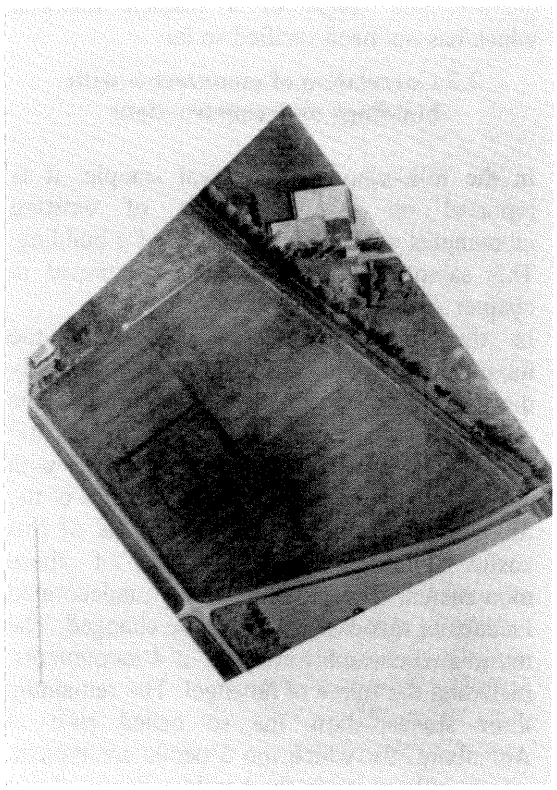

Fig. 2: Digitally geometric rectified oblique photo of an archaeological site

In figure 2 is shown the corresponding result of a digital geometric image rectification, including the resampling of the digitised image of figure 1, see also Wester- Ebbinghaus (1986).

As a final product the edge enhanced situation of the archaeological texture, as already available in digital, easily can be transformed into existing maps or GIS (MIS) systems, see chapter 4.2. This program operationally runs on a Sun 5 Workstation and is in the stage of PC adaptation. In addition a low cost software - version for the transformation of archaeological texture into existing maps and / or GIS (MIS) data, based on vector-data, exists at the Institute for Photogrammetry of the University of Hannover.

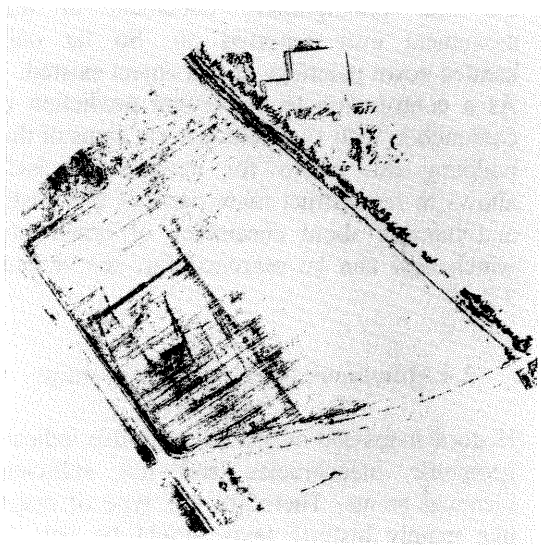

Fig. 3: Result of the edge enhancement of a digitally rectified oblique photo, containing archaeological textures

2.2 Monument prediction using remote sensing imagery

To image and to interpret the natural and artificial contrasts of the thermal radiation of the earth surface, an infrared line scanner or suited CCD -sensors are needed.
In addition to this more operational remote sensing techniques, the archaeological and even the cartographic potential of radar imagery still is a matter of research. Not yet completely solved are the proper conditions and the deepness of soil penetration of microwaves. For dry terrain a radar penetration of about 40 m has been observed from ground truth measurements. From space borne radar a ground penetration of about 10m is expected. On radar images of dry desert areas might appear ancient rivers, currently covered by sand, which are not visible on conventional photography. This can lead to indications for probable locations of former settlements.

2.3 Monument prediction using terrestrial photos

As a sample for a historic terrestrial photo, in figure 5 is shown the destroyed castle of the City of Varel (Germany) in the situation of dismantling. This photo is dated 1861 and was recently discovered in private property. It is the first photographic document of this monument ever reported on. So far only handed down paintings of this object existed.
As a contribution to monument prediction in conjunction with available historic maps of this building, this photo for instance precisely allows to reconstruct main parts of this castle and informs about ensembles of ornaments, which now can be searched for, see chapter 3.2.

2.4 Monument prediction using maps

Historic maps and measurements often indicate geometric inaccuracies and not sufficient identical points. Therefore this type of maps, like mainly historic texts, might be only of qualitative rather than of quantitative value.
In cases, where historic maps promise a successful transformation of the situation of topographic details into the actual situation, within the map local varying scales might appear, which must be taken into account, as well as local changes in orientation. To indicate archaeological sites in the field with some probability from this kind of distorted maps, all available historic maps of a probable archaeological site are fitted piece wise with respect to each other and to recent maps as well as to rectified aerial photographs, as far as available.
Nowadays this fitting procedure will be carried out digitally, based on digitised historic maps and / or photos. The digital vector- and/or raster-data interactive is fitted to the up to date situation based on ground control points and on texture information.

3. INTERPRETATION OF DISCOVERED MONUMENTS

3.1 Correlation of monuments with standard situations

As an example, the rectangular pattern of the monument discovered in a field by aerial photography, as shown in figure 1, 2 and 3, with some probability might indicate the characteristic shape of a Roman fortress, which has not been verified so far.

3.2 Correlation of monuments with buildings or reconstructions

In the following, as a typical sample, it is reported on the correlation of existing monuments with a historic photo of a building. This sample already has been mentioned in chapter 2.3.
In this case, further correlation of the monuments shown in Fig. 4 with a recently discovered historic photo of the portal of the destroyed castle of the City of Varel (Germany), dated 1861, see figure 5, with some probability identifies them as parts of the missing ornaments of the main portal of this castle. Due to the existence of these monuments, recent reports on undecorated facades of this castle, have to be changed. The introduced ensemble consists of 4 monuments, including the figure of an angel. The remaining three stones show the so called rose of Aldenburg, for which the 5 petals are typical, which still appear in the heraldic figure of that town.

Fig. 4: Ornament ensemble of a lost portal as a candidate for monument correlation

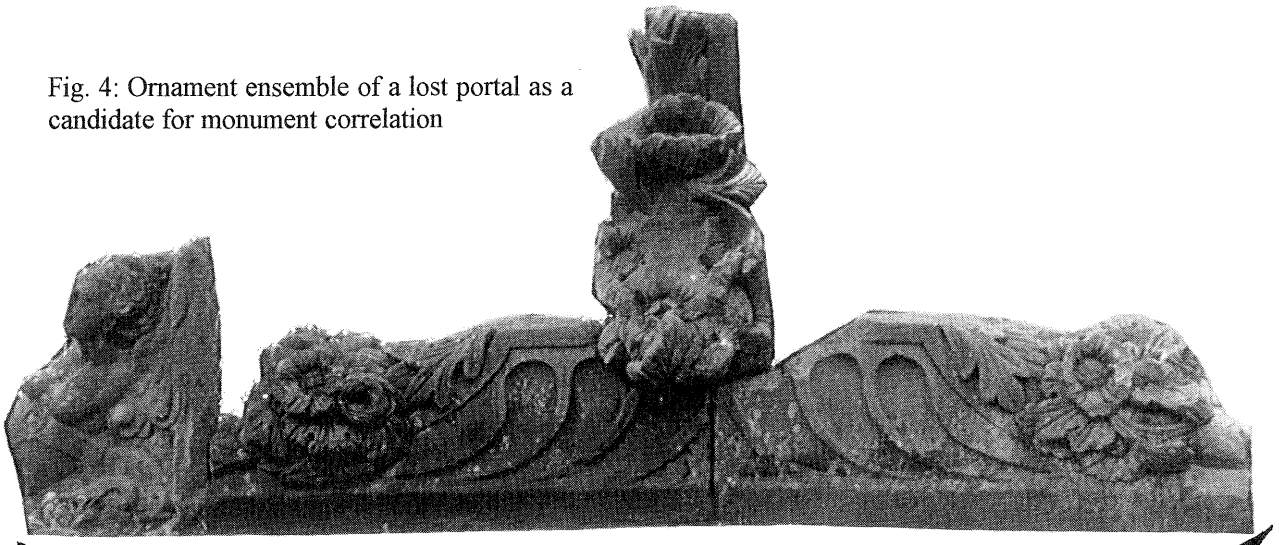

Fig. 5: Recently discovered photo, dated 1861, of a destroyed castle

3.3 Correlation of different objects

Figure 6 shows a Roman coin of the year 7 BC., found in Adulia (Africa), showing a portrait of the legendary Roman centurion "P.QUINCTILI VARI" (same as mentioned in chapter 2.1),in comparison with the inscription of a silver casserole of the Hildesheim treasure, excavated in 1868, see Schuhr et.al.(1984).

Notice the corresponding characteristic scripting of the sequence of the letters "TI" ("I" on top of the "T" in both cases(!)), as indicated by the arrow, which with high probability leads to the result, that between both objects might exist a relation.

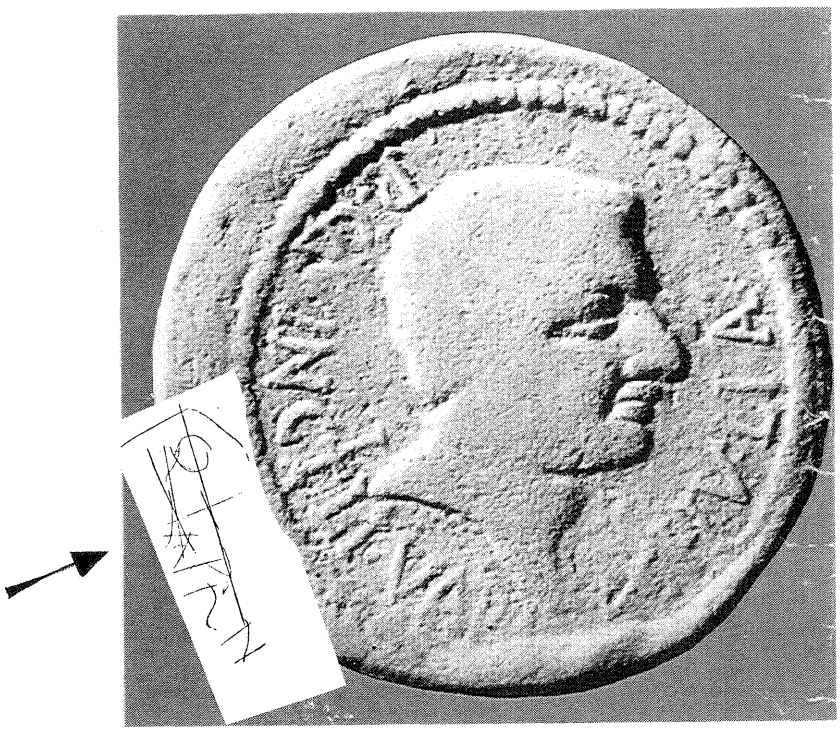

Fig. 6: Correlation of a coin legend with the inscription of a historic casserole

4. CONCLUSION

4.1 Monument protection

Photogrammetry, remote sensing and cartography provide decisive aids for the detection and/or inventory of irretrievable monuments of historic importance, as a basis for further monument protection.
Therefore historic maps, photos and measurements for this purpose in particular, are very valuable, but handed down texts only with low priority.
The reliability for the interpretation of the situation of so far undiscovered monuments only may be judged by excavations or by substitutes for excavations.

4.2 Monument Information System (MIS)

For a serious investigation of the reasons for the increasing monument dilapidation it is absolutely necessary, to start with an inventory to document the recent conditions of the monuments.
To judge on the success of (e.g., chemical) measures for monument protection, a continuously repeating of the (photogrammetric) documentation of the condition of the monuments shall be carried out in future.

For a permanent availability of these results and also in view of the consideration of the monuments within environmental planning processes, the establishment of an up to date digital Monument Information System ("MIS"), based on available GIS-Systems, like the ARC/Info, as already established in different countries, is highly recommended.

5. REFERENCES

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