

SINGLE IMAGES IN CONSERVATION

by

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Abstract

As a submission of the Co-Chair of CIPA Task Group 2 this paper prepares a collection of photogrammetric means and examples for successful applications of single images in Conservation.

Typical tasks in this respect are, e.g., the

- Monument restoration like the reconstructions of destroyed facades, caused by man-made or natural disasters or the

- Monumentprediction of so far undetected or lost monuments.

Due to a lack of additional information, to solve this problems, in many cases only ordinary single photography is available.

Highlighting a draft 10 point programme, this paper deals with experiences in the field of using single images in conservation, from which in particular restorers, archaeologists and architects will benefit. This "open" 10 point programme, will become the nucleus of the new homepage of CIPA Task Group 2, to be discussed on an international level. In addition this 10 point programme of CIPA TG2 is also the queue of the 7 chapters of this paper:

Starting with a report on successful projects, this paper gives an idea of the market potential for using single images in Conservation.

This chapter is followed by definitions and basics for using single images in conservation. Consequently there will be a report on available Images via WWW, existing Image Archives etc., to be used in conservation. In addition image generation based on conventional and non conventional Sensors is described.

Within the chapter on image geometry it is reported on a method to partly replace the signalization work by video recording of the queue of ground survey points, when engaged with the reflectorstaff. In addition simple image geometry approaches for using single images in conservation are dealt with. Procedures for Mapping with single images are briefly mentioned, as well as improvements in interpretation of single images in conservation.

1. Applications of single images in Conservation.

Currently the reconstruction of destroyed important buildings within the Kosovo region is a very popular application task for the use of single images in conservation. Here the use of such Photography mainly shall consider the reconstruction of facades, sealing and paintings.

Though these are typical acute samples for applications of single images in conservation, the real spectrum for the application of this kind of imagery shows a larger extent:

In order to find a systematic approach for research within the field of single images in conservation, it should be distinguished between applications using images for documentation purposes, for partly or complete restoration purposes.

In an addition it should be distinguished between existing (historic) and currently taken and/or even planned images, in colour or black and white, using conventional and nonconventional sensors etc.:

a) As the first goal for the applications of existing and mainly for currently taken single images should be mentioned the full documentation of all international (!) objects of cultural interest, including buildings. As a matter of fact, at this time the facades of existing buildings in Germany are completely(!) photographed by a private enterprise, with planned private access to these images, which are digitally stored on CD-ROM. Unfortunately these actions do not even fulfill the 3-by-3 rules as carried out by WALDHAEUSL.

b) Typical samples for partly restorations are damaged paintings, including sealing-paintings, which hopefully have been imaged before the damage. Usually these photographs must be rectified, at least,

due to attitudes. In case of lack of digital and analog projectors, the rectification can be replaced by an unregular grid, creating a pattern by crossing arbitrary straight lines, which connect corresponding control points, remaining on the object and visible in the image. The detailed content of the single fields of this pattern continuously must be transferred from the image to the object or, before, to a working sketch, estimating the geometric and radiometric situation.

c) In opposite to a partly restoration a complete restoration to be carried out according to surviving photography, normally cannot be based on any remaining object parts. A very popular sample is the complete restoration of the Russian amber room.

d) As for the Leibniz-House in the EXPO 2000 town of Hannover in Germany, not only one, but a queue of old photographs remained. Therefore in this case the eldest surviving photograph became the most authentic source for the reconstruction of the facade of the Leibniz house as carried out by Polish architectures.

e) In case of current photographic and photogrammetric campaigns it is very important, to influence these activities at least with respect to minimum photogrammetric requirements.

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

As a matter of fact the typical today's Archaeologic measurements are still manual sketches in the scale 1:20, where details are roughly measured and even estimated within a 4 x 4 m grid! For surveying the ground situation, the solution should be rectifications based on very low aerial photography, showing at least 4 gridpoints and the object. 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.

2. Basics of single images in conservation.

Cartography, Photogrammetry and Remote Sensing contribute to the inventory and to the detection of monuments, as basis for further monument protection. It shall be pointed out, valuable documents for this purpose are in particular imaged local indications, historic maps and photos, but handed down texts only with low priority.

In view of the increasing dilapidation of handed down monuments, Photogrammetry and Remote Sensing techniques can support the protection of these monuments by

- permanent control of existing historic monuments, including the inventory,
- by advanced interpretation of discovered monuments,
- by prediction of so far undiscovered monuments and
- by the reconstruction of partly and/or even completely destroyed monuments.

For serious systematic investigations after the reasons for the increasing disintegration of monuments it is absolutely necessary, to start with an inventory, to document the recent conditions of the monuments.

In order to judge the success of, e.g., chemical monument protection, a future permanent control of the monument condition, using suited photography, is definitely required.

The most suited way to verify this is a Monument Information System(MIS).

The interpretation of discovered monuments can be increased by

- the correlation of monuments with existing buildings or reconstructions,
- the correlation of the arrangements of existing buildings with standard situations, like the today's appearance of the ground situation of City blocks in comparison with the situation of roman castles.

- The correlation of different objects for advanced interpretations of discovered monuments

The prediction of so far undiscovered monuments can be based on

- traces of human activities,
- historic and recent maps and measurements
- historic and recent photography

The quality of the interpretation of the situation of so far undiscovered monuments can only be judged by excavations or excavations substitutes.

3. Photographic Archives

A list containing the worldwide Photographic Archives is more than overdue. This proposed list should become a part of CIPAs internet presentation. At least these photographic Archives must be related to single images in conservation. Very important is the access to these Archives and even the searching for lost photographs, as very impressive reported by GERNSEHEIM, used to become the owner of the first surviving photography, showing the private house of Niepce in 1827.

As an important sample for a state of the art Photography archive the Bill Gates archive with over 1 million images in particular shall be mentioned. The Bill Gates archive is an integrative part of the Corbis

collection. Corbis claims to be the leading provider of photography and fine arts on the Internet and maintains one of the largest image collections in the world with 25 million historical, contemporary, celebrity and fine art images. More than 1.5 million of these images are available on-line, designed to offer a full range of visual solution.

To be mentioned are also the Ancient Greece Photographic archive in Indiana, USA, the Photographs-collection of the Civil war in the United States, the Photo Archive for buildings etc., of the Carnegie Mellon University in Pittsburg, Philadelphia, USA and the Photo Archive - Buildings - of the Butler University in Indianapolis, USA.

Of great importance are also Archives with local character, like the Old Colorado City Photo Archives or the Photo archive of the Mariott Library of the University of Utah, USA, containing Aerial Photographs and Photographs showing Architecture, Buildings and Archeological sites.

As a typical situation in Germany, beside numerous governmental, company owned and private Archives, at least 16 governmental Archives for historic Photographs are maintained on a provincial level, containing collections of images for conservation purposes of that particular area. As the digitizing of this material has just started, currently these are mainly still analog photographs.

4. Image Generation

It is highly recommended, to digitize the available single imagery and to store it on CD-ROM. The combination with a data manager programme has big advantages for a systematic data access. And for some applications the digital print of that photo might be sufficient, while the original is kept for exclusive operations.

Due to very high solution requirements, so far still conventional cameras are in use for documentation purposes in conservation.

CCD-Cameras, showing about 1500 x 1500 Pixels, nowadays can almost replace slide cameras. Their colour and colour truth is even superior.

The Konica Land Master GPSCamera shall be recommended as the first public camera to be used for single imagery, which records additional frame informations, including the position, the date and time and the imaging direction belonging to that particular photograph. The Konica Land Master GPSCamera as introduced occasionally the ISPRS congress in Vienna in 1996 is linked to a data bank, screening the position and the direction of every single photography in a map.

Such a system at least supports the indication of the proper position and age of that particular photography, which is one of the biggest problems fore existing single imagery,

For unconventional sensors it is reported on, single thermal infrared imagery successfully indicated traces of so far undetected paintings, which appeared under the layer of the current painting.

The increasing use of sonarimagery for the detection of wreckages is a spectacular sample for the use of unconventional single imagery in conservation after gaining high GPS positional accuracy.

For Radarimagery, beside early reports on the penetrating of the dry surface to detect "ancient landscapes", so far there is no sample to state the successfully use of single Radarimagery in conservation.

Namely for surveying purposes for single objects, currently the real time bodyscanner appeared on the market. Like in the VITRONIC imageprocessing system, a laser-profile is projected onto the object surface. This profile is single imaged with a video camera and, calculating the knowledge of the camera position and attitude, the focal length and the camera distance to the profile plane, the metric values and the shape of this particular profile can be gained in real time.

In praxis a 360 degree laser profiler is used and, by a relative moving of the object and the laser profiler, the queue of single images obtained, allows a full shape surveying in real time!

5. Image Geometry

It is liked to point out, the signalization of controlpoints partly can be replaced by video recording of the queue of ground survey points, when engaged with the reflectorstaff., see Figure 1. These controlpoints, can be clearly interpreted on the videoscreen and transferred to the corresponding synoptic photograph for, e.g., rectification purposes. It is also very important, clearly to assign the pointnumber on the video tape, at least by voice recording.



Figure 1. Replacing of signalized points by video recording of the groundsurveying in Patara (Turkey)

The use of single images in conservation can benefit from existing digital imageprocessing devices and suited software, as well as from analog rectification devices. For low attitude values the latter even could be overhead or slide projectors.

In case of missing image processing devices simple image Geometry for using single images in Conservation, like traditional analog Methods can be applied for sufficient plane surfaces: e.g., Pointtransfer by the Paper-Strip Method, Moebius Net, Anderson-Method, Pantographs, Sketchmaster, Rectifiers and image projection onto elastic film.

The paper-strip method for the Pointtransfer requires plane objects and 4 identical control points, known in the image and known with their coordinate values. The coordinate values can be gained directly on the object or from existing plan sheets. In case, there cannot be determined directly 4 objectcoordinates, often assumptions can be made, e.g., about a rectangular facade. In that case the natural length and height of the facade are a substitute for the 4 control points, as required.

In order to avoid coordinate measurements, on new photographs should be imaged 2 rectangular rulers, to be positioned in the object plane.

From the positioning of 3 skip-jacks on the moon, which replaced groundcontrolpoint coordinates even for 3 dimensions, the imaging of 2 parallel rulers, situated in the object plane is also sufficient.

In addition simple digital rectification Methods, called "Novakeln", are based on shape, distances, controlpoints, additional photography, Monostereogrammetry and dealing with single images of symmetric objects etc., including the discussion of accuracy.

This catalog gives first ideas for additional futural research in the field of single image geometry in conservation.

It shall be pointed out, enlargements are no maps! Mapping with single images of plane surfaces should be based on four point rectifications. This can be carried out by analog rectifiers and analog Mosaiking. In case of low attitude values the analog rectifiers partly can be replaced by overhead or slide projectors. Of course the digital rectification method including digital Mosaiking is preferable.

6. Conclusions

The successfully 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 the antic ruins of Patara(Turkey), even a candidate for Atlantis, are one important field for applying single images in conservation.

7. Literature

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