

# PHOTOGRAMMETRY FOR EVERYBODY

Antonio Almagro  
CIPA  
Escuela de Estudios Árabes, CSIC  
Granada, Spain

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## ABSTRACT

Both the need for the recording of cultural heritage and the state-of-the-art of photogrammetric techniques and instruments constitute a challenge for the CIPA in the attempt to promote the extended use of photogrammetry for cultural heritage purposes.

The use of photogrammetry is no longer a matter of high cost investments, nor is it necessary to have knowledge of sophisticated techniques. Analytical photogrammetry has greatly reduced operating difficulties. Digital photogrammetry is reducing the cost of the equipment and increasing the possibilities of application of photogrammetry in the field of documentation of monuments and other cultural heritage.

In our opinion, a more wide-spread use of photogrammetry may be achieved by teaching and promoting its user possibilities among professionals working on cultural heritage preservation. The use of photogrammetric software is not more complicated than the use of CAD software. On the contrary, it is even less complicated. If CAD is used today in most of the offices of architects and other professionals, why can not photogrammetric software based on simple equipment and simple currently existing methods be more widely used? The problem is thus how to promote the idea of the need for the use of photogrammetry and how to teach about the uses of this technique. A more wide-spread use of photogrammetric software will, undoubtedly, promote a reduction in its costs.

## Introduction

Since the last CIPA symposium held in Goteborg, I have worked on many more architectural surveys for the restoration, research and study of the architecture and cultural heritage. I could continue to present some of the cases here, or show beautiful designs of magnificent buildings and architectural works. I might speak of new experiences through the application of one instrument or another or different methods. However, I have decided not to present such things. I would rather describe my experience in the CIPA as well as my work experience in the last twenty years, because I believe that this information could be more useful for our definitive purpose: the preservation of our cultural heritage and the application of the diverse possibilities made available through technology.

The measuring, drawing or representing of buildings provide a way of understanding the edifices. A survey is, and should be above all, an instrument for the analysis and comprehension of architecture or that object which we are representing. Nevertheless, we may ask: with what purpose must we know and understand? The answer is: in order to maintain and transmit that heritage, its significance for us at any given time as a way of preserving it and its integrity. Documenting is a way of transmitting, and is in many cases, the only way with which we can do so.

Representation, through images and drawings, provides us with basic essential information. Traditional methods used in the direct measuring of buildings have

constituted and continue to constitute the most common way of approaching this essential understanding of monuments. They present a great advantage as they necessitate direct contact with the building which allows for a deeper understanding, if properly employed. Nevertheless, they have always presented a series of limitations. Firstly, they are slow and labourious, if an acceptable level of precision is desired. But also, in many cases, due to the nature of the building, its size and decoration, they may simply be inoperable in terms of the objective at hand. As a result, it becomes evident that the necessities implied in the documenting of the Cultural Heritage on a world-wide scale cannot be met if only these methods are employed.

## The use of photogrammetry

From the beginning, photogrammetry constituted an extremely useful assistant to obtain representations of buildings with metric information. It made it easier to solve precisely the most difficult problems the direct measuring systems presented. However, it is also true that due, firstly, to its complexity and, secondly, to the need for the use of sophisticated and costly instruments, photogrammetry has been limited in its applications to large buildings and monuments, in which there are usually great difficulties, but for which it is also possible to obtain the resources needed for its application. Costly and, therefore, scarce instruments also limited the number of people who were able to learn the technique which has only enjoyed real commercial development in the field of cartography.

Meanwhile, the needs regarding Cultural Heritage have increased. An increased social awareness regarding heritage preservation in developed countries and the growing threat in this regards in underdeveloped countries, have increased the demands for greater knowledge and preservation of this heritage. It is not only the rising number of buildings included in the Cultural Heritage which have been traditionally protected on a local, national or international level, but also the attention given to Heritage sites once forgotten, such as is the case of vernacular or industrial architecture, which increase the demands for their study and restoration. The evaluation and study of endangered heritage sites are becoming more and more urgent. The processes of cultural and technological change and growing urbanism are altering ways of life and the necessities of societies, which in turn are threatening the preservation of historical sites. These factors pose more of a danger for the smaller heritage sites than the large monuments. In these cases, it is not so much the difficulties inherent in the large monuments which require costly systems of study and analysis, but the rather large number of smaller buildings that pertain to a wider-range heritage which requires a solution based on its needs. In this case, it is not the problems of the big monuments requiring a high level of accuracy, or the representation of complicated structures or diverse decorative forms that needs to be solved, but rather the need to be able to document, often before the disappearance or transformation of the sites, elements which are undoubtedly also of value to our historic past.

Given the urgency of the situation, organizations and persons involved in heritage preservation should act accordingly. Photogrammetry, after over one hundred years of existence, has reached a sufficient level of development to be able to tackle this problem. Its wide-spread use is not impeded by technical problems, but rather due to problems of comprehension and diffusion. In my opinion, the greatest challenge of CIPA at the beginning of the next century should be to convert to photogrammetry and other related techniques in systems of universal application, taking full advantage of the technical advances in recent years, especially the extension of digital photogrammetry and the possibility of using widely-diffused computer technology whose costs are becoming increasingly less expensive.

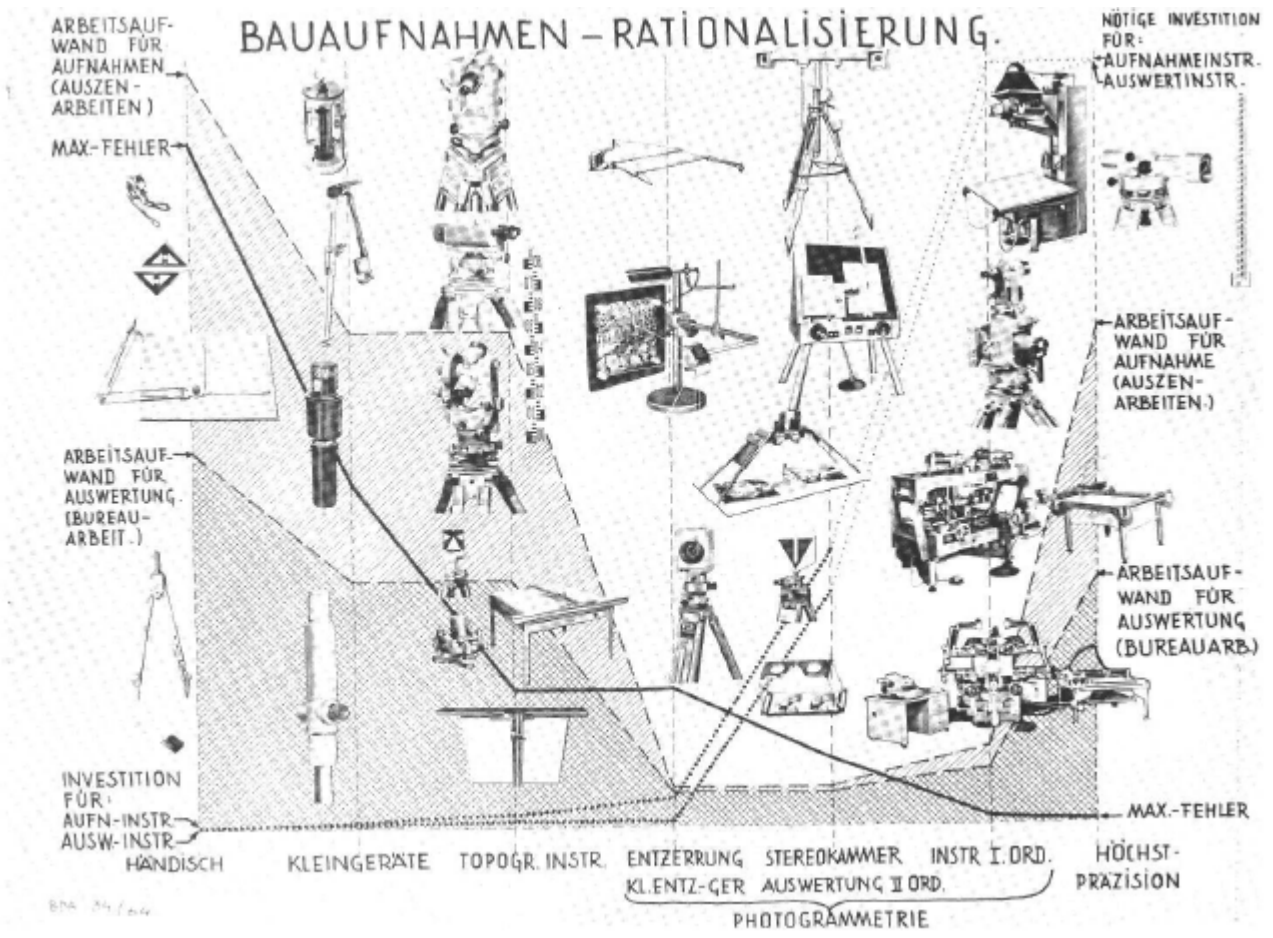
The problem we are faced with today is not the high cost of equipment, but rather finding people who are able and willing to take advantage of the latest improvements. Years ago it was usually not hard to convince architects and technicians of the enormous advantages of photogrammetry even when its final application was very difficult, due to the elevated cost involved in the use of precision cameras and stereo-plotters. Photogrammetry was, for many technicians, out of the question, due to the lack of economic resources needed for its application. In my opinion, today it is necessary to convince these professionals of two new concepts, in addition to the already known advantages. Firstly, they need to be convinced of the fact that costs are not necessarily so high. If the high

precision which has always been associated with photogrammetry is renounced, to a reasonable degree, its costs may become notably lower than those of traditional systems, reducing as well the problems generally associated with the latter systems. In addition, it is necessary to convince them of the fact that this technique is not exclusively geared toward highly-specialized technicians.

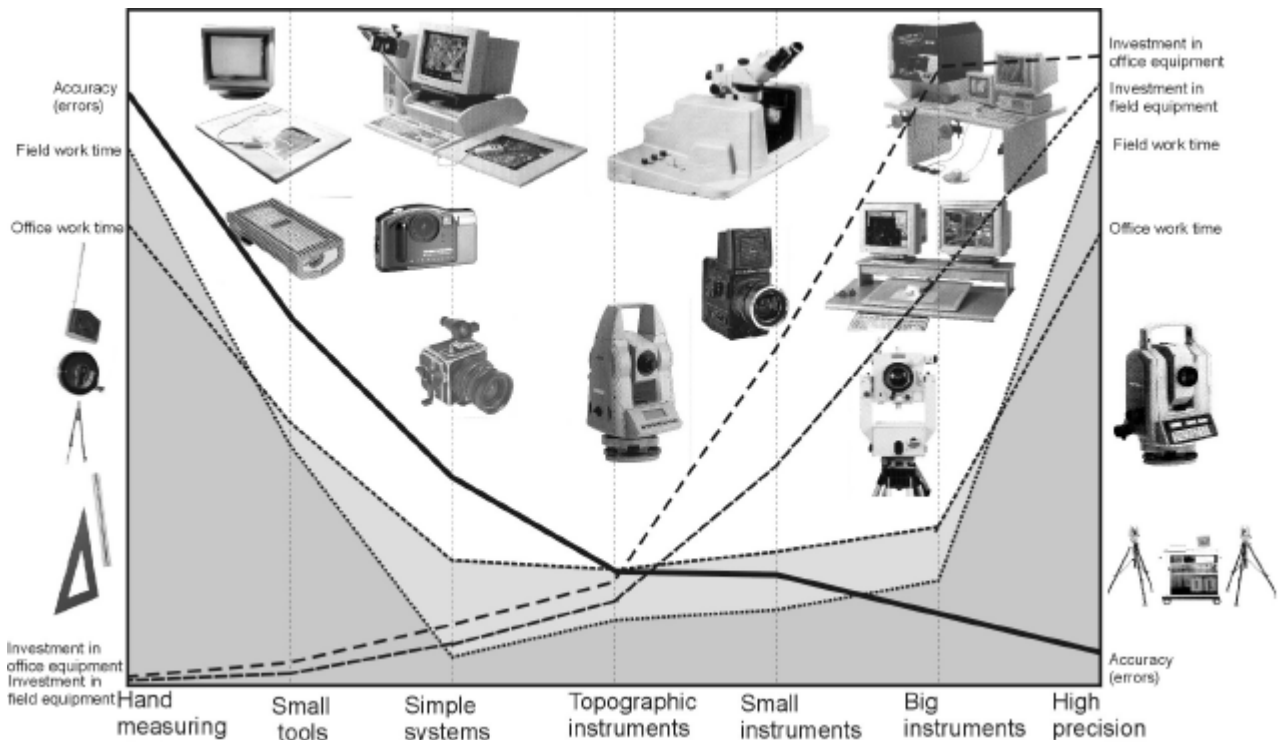
The wide-spread knowledge of computers, including sophisticated CAD software, and image treatments which today are of very extended use, the low costs of hardware and software, and the increased availability of specialized photogrammetric software offer a new technological outlook. Many of the CAD software are notably more difficult to use than any type of photogrammetric software. Its lower price range is simply responsible for its being more widely-spread and having more licenses sold. This is due to their massive application in architects offices and professional studies. Although we may not be able to propose a so very wide-spread use of photogrammetric programs, it is certain that there is nothing to prevent the use of this software in professional studies or administration offices dedicated to the protection and preservation of cultural heritage. Presently, there is only one restriction: the people who use these methods of documentation must be trained. Again, I insist that this problem is not that difficult to solve. Any CAD program is more complex to use than any photogrammetric software. Only basic training in technique and in the program itself are needed. Both are easy to manage by people with minimum background knowledge. According to my experience, the problem is much easier as regards photogrammetric technique training than knowledge of the systems and criteria of the representation of architecture, which should not be forgotten within the CIPA objectives.

As a way of illustrating these ideas, I would like to recall a diagram which was made more than 30 years ago by an enthusiastic promoter of the photogrammetric applications within the field of architecture, a founder member of CIPA and master of many of us, either directly or indirectly, Hans Foramitti. This diagram, although of less exactness as regards detail, clearly illustrated the advantages offered by photogrammetry in the 1960's. It shows in a very graphic way how photogrammetry offers, above all, a notable reduction in the time needed to carry out a survey, as well as how errors are greatly reduced and how the investments needed to implement this technique, were reasonable, yet significant, especially due to the development of simplified instruments promoted by Hans Foramitti himself. A noteworthy fact is the existence of a clear area of confluence of the different graphs which has established an optimal area in relation between investment costs, costs of time and precision which coincide with the use of these photogrammetric systems which have been especially adapted to architectural surveying.

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Optimum use of the different methods for architectural survey today



Optimum use of the different methods for architectural survey by H. Foramitti (1964)

Evidently, the majority of the instruments represented in this graph, although possibly still in use in some places, have been substituted by others of a superior technology. Traditional optical theodolites, metric cameras, first and second order analogous stereo-plotters, photographic rectifiers, etc. Instruments that continue to be admired for their ingenuity and quality construction, but which have been retired from use almost everywhere, a fact which is due especially to the advances in computer science at the beginning of the 1980's.

### The present and the future

Electronic theodolites with automatic data register and infrared distance-metres and, more recently, lasers metres, have marked a substantial change in the topographical techniques used in architectural recording. Computer-assisted analytical photogrammetry revolutionized the field of photogrammetry, above all that related to terrestrial applications, by facilitating the orientation of the models in a rapid and precise manner. With the appearance of CAD, a binomial was constituted which signified an authentic revolution in field of architectural documentation. The analytical stereo-plotters facilitated the use of semi-metric cameras and bundle adjustment methods, to whose development contributed greatly the late Dr. Wester-Ebinghauss, a distinguished member of CIPA, whose decease supposed a huge loss to the scientific community. The semi-metric cameras allowed for cost reduction in one of the components of photogrammetric equipment. The

stereo-plotters, however, continued to be expensive, despite the appearance of new ingenious instruments such as Adam's MPS2, whose almost exclusive use in terrestrial photogrammetry has brought about significant advances in the application of this technique in architectural documentation. However, the necessary incorporation of optical and precision mechanical elements in these instruments continues to constitute an important impediment in the reduction of prices.

Digital photogrammetry has once again overcome these barriers, thus opening up a new panorama featuring reduced costs, as well as simple and easy-to-learn techniques. The use of standard hardware, whose costs are being reduced almost daily, while improving its storage capacity and data manipulation speed has meant a decrease in the use of specially-manufactured instruments which are necessarily more expensive. Moreover, the proliferation of photogrammetric software is generating a competence unheard-of in the previous production of analogous and analytical stereo-plotters, thus opening new options in cost reduction, which is expected to result in a more wide-spread use of these systems.

It is worth mentioning, nevertheless, that the problem of producing quality digital images at a reasonable price has still not been satisfactorily resolved. Digital cameras do not yet produce images of sufficient resolution and the low-priced scanners are not able to guarantee the digitalization of traditional photographs with sufficient metric qualities. We are convinced, however, that both problems will be resolved within a short period of time.

With these new options and advances, it is possible to design a new graph that would update the one that Foramitti made in 1964 and which we are presenting here. As in the previous graph, the optimum price/service range relation for these systems is shown, which corresponds to what we call simple photogrammetric systems, that we have defined as those which require reduced investments (<\$5,000) and have easy-to-learn operational procedures. These systems, whether they be stereoscopic, monoscopic measuring, or photographic rectification, provide solutions to the previously-mentioned problems, without having to rule out the use of more sophisticated systems and the participation of specialists in certain cases.

Perhaps the greatest opportunity offered in the field of architectural documentation is the availability of reasonably-priced systems and the prospect of even lower costs in the future, given that there will be sufficient demand. The potentiality of this demand is large to the fact that the field of architectural heritage is in need of adequate documentation capable of solving problems in areas where more traditional means are unable to produce the same results. The real problem today lies in training the people able to operate those systems. In order to have this opportunity for training individuals in this field, there must be a conscientiousness among trainees and among those who have the responsibility at the different levels, for the preservation and protection of the Cultural Heritage: administrators, architects, archeologists, art historians, curators, and technicians in general. Photogrammetry should be promoted and taught to these professionals, not as a sophisticated and complex systems requiring costly instruments and specialized technicians, but as a methodology that is accessible to all and which is no more costly than other commonly-used computer programs. Photogrammetry should be not only a synonym for precision, but also one for speed and efficiency as regards documentation, an ideal system for producing 3D images in CAD programs, for creating data bases, and offering efficient solutions in emergency cases, etc. In order to achieve this goal, the CIPA and all of the institutions, research and training centres that are willing to collaborate, should implement different actions that may be summarized in

the following points:

- Evaluate different existing systems on the market, explaining their characteristics and affording information related to experiences or projects carried out using these systems.
- Inform as to the different possibilities for the application of photogrammetry in the field of Cultural Heritage through training courses and seminars with field exercises which are actually not difficult to organize.
- Promote and encourage the development of software, the improvement and optimization of existing systems, and the marketing and implementation of systems produced by photogrammetric research and development centres.
- Organize symposia and meetings specifically designed to promote these applications among administrators and professionals involved in the field of heritage preservation.

In conclusion, I would like to refer to my personal experience within CIPA. In my case, CIPA has been the information transmitter from the centres and photogrammetric specialists to users who simply apply what others have developed. Since the beginning of my work in the field of Cultural Heritage preservation, I perceived the urgent need to adequately document the monuments I had been restoring, and later, those which I studied for scientific reasons or as endangered heritage sites. I came to realize that photogrammetry was an irreplaceable instrument and I strove to incorporate it into my daily work routine. Today, that goal is a reality. The information I have received from many specialists through CIPA and its members all along has helped me to achieve my goals. They have helped me to update my knowledge and adapt this new information to my work and research. In my opinion, this type of experience should be developed and extended, and it is my hope that others will be able to benefit in the future from the information and assistance provided by CIPA.

## **Bibliography**

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