

# DOCUMENTATION OF FRESCOES AND MOSAICS A COMPLETE APPROACH

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## ABSTRACT

The various needs for registration, for stand alone or comparative study and for conservation and protection of frescoes and mosaics pose special documentation requirements, which, very often, surpass the respective specifications for the documentation of the architectural monuments to which they belong. This documentation except the determination of the position, the shape and the dimensions of the object (geometric documentation), should also include, among others, the time and the mode of construction, the materials and the artist, the objects represented, artistic information and information about their status. In this paper a method for the complete documentation of frescoes and mosaics is described and proposed. Initially, image documentative products are being produced using digital photogrammetric techniques. Consequently a specialised data base is designed and developed based on the GIS techniques. In this data base all other pieces of information are being registered in special fields with direct relation to space, since the photogrammetric products are being used as base. This complete and integrated approach was applied to two Greek religious monuments, each with different requirements. The results are being assessed for their completeness and usefulness and the method for its ease of application and cost effectiveness.

## 1. INTRODUCTION

Frescoes and mosaics require special approach for their documentation, because of their importance and peculiarity. The needs for registration and autonomous or comparative study and analysis, in combination with their relative sensitivity, pose special documentation requirements. These requirements, sometimes, surpass the specifications for the documentation of the architectural monuments, of which they are an integral ornamental and, very often, functional part.

Initially the geometric documentation should determine the position, the shape, the form and the exact dimensions of the whole and the parts of the frescoes and mosaics. Furthermore, it should record a number of architectural, historical, archaeological and artistic information about them. At the same time, for the needs of conservation and protection, their present day status should also be recorded, together with the pathology, the probable causes and possible future decays.

Several efforts have been attempted in the past, in order to confront the problem of this documentation. However, the modern technological advances offer new and more efficient and functional tools. In this context, the Laboratories of Photogrammetry and General Geodesy of the NTUA, developed and study the proposed method for a complete solution of the documentation problem using modern methods, tools and products, with emphasis on

cost efficiency, on easy and standardized implementation, on efficiency and on the ability to monitor future developments.

## 2. GEOMETRIC DOCUMENTATION - RASTER REPRESENTATIONS

Up to nowadays, vector drawings of orthogonal projections and/or of developments, whenever this was necessary, have been the usual geometric documentation products.

The developments of the photogrammetric techniques and the modern digital processing tools have made possible the production of imagery products, which combine the mensuration accuracy and reliability of the traditional drawings with the wealth of information carried by the photographs. Hence they may complement the vector drawings, or even replace them completely.

The well known photogrammetric techniques of rectification and differential rectification produce geometrically correct images, which convey metric information at the required scale, no matter what the anaglyph of the pictured surface is.

This is very important, because the frescoes and the mosaics, may be found on flat surfaces (e.g. floors, walls), but also on non flat, curved surfaces, developable or not (e.g. vaults, apses, drums, cuppolas etc.). In this way all

cases of decorated surfaces may be confronted, under the respective well known conditions of taking the suitable photographs and the necessary geodetic measurements to support them. These include the various camera platforms and camera stations, mono or stereo photography, necessary control points, breakline determination, to name but a few.

The geometrically correct images may be used as is, but it is also possible to combine them to photomosaics, in order to offer a more complete aspect of the whole of the decorated surface.

It goes without saying that the photogrammetric images should be of high quality, as they are going to be used for the final representation. Hence, the compromises, which are usual for economy reasons, when line drawings are to be photogrammetrically produced, are absolutely not allowed in this case. Objects and other obstacles should be removed, even if they cover small parts of the surfaces. In most, if not in all, of the cases a specialized photographer should take care of the lighting conditions.

Moreover, depending on the size of the imaged details and the colour multitude, the taking distance and the spatial and radiometric resolution of the digital images are factors which drastically affect the quality of the final product. It is already possible to produce coloured raster products, a fact which complies with the objects in question. However, this may not be possible when low cost photogrammetric systems are used and, in any case, leads to digital files of considerable size.

In the case of non flat surfaces, orthophotography does not completely cover the needs, because it is a product with relative metric information. Surface raster developments are preferable in these cases, as they offer the additional metric information which is very often required. The process for developing of directly or indirectly, using suitable cartographic projections, developable surfaces, presupposes the knowledge of a mathematical surface, which best describes the original one. In the case of vector drawings this process is relatively easy and is already supported by suitable software. For raster images, however, this may only be realized in high end photogrammetric workstations or requires home made solutions.

In the coming years, it is expected that the developments in computational and image processing algorithms will make the production of raster products in digital photogrammetric workstations more accessible and cost effective and also will enable the production of developments and the use of colour.

### **3. DOCUMENTATION OF OTHER INFORMATION - G.I.S.**

It is imperative that a large number of architectural, historical, archaeological and artistic information should also be recorded, when frescoes and mosaics are documented.

Among others, information about the architectural parts and surfaces on which they lie should also be recorded. These pieces of information include the date, the way and materials of their construction, the artist, the rhythm and the type, the content, the context, the figures depicted, the colour multitude and possibly specialized information about the exposed human parts (faces, limbs etc.) and the clothing, but also possible peculiarities and exceptions from rules.

Moreover, as frescoes and mosaics belong to the most sensitive parts of the monuments, it is imperative that information concerning their present day status and conditions should also be recorded, for the sake of their protection and conservation studies.

Additional information that should be recorded include those concerning previous interventions, stratigraphy, construction materials, colour ingredients, pathology, cracking, loss of base material, humidity, temperature, mechanical, chemical or other effects, and, finally, conditions of their preservation and today use.

All these pieces of information are directly related to space and require a systematic and well organised recording procedure. The obvious solution to this problem are the Geographic Information Systems (GIS). They offer the required familiar, easily used, flexible and cost effective tool, which poses no major restrictions and ensures the necessary safety.

The critical question here is, of course, the structure and the various fields of the data base. Its development should be such that the best possible coverage of the object is ensured and that future additions are foreseen. The only restriction would be to maintain the simple descriptive language, familiar to archaeologists and art historians.

In any case the Geographic Information Systems are a very powerful tool. Their ability to answer questions by combining information from various sources is extremely helpful to comparative studies and, for this reason, they have already been applied to archaeological research.

## **4. APPLICATIONS**

For the practical investigation of the aforementioned solution two pertinent applications will be briefly presented. These applications are concerned with two byzantine religious monuments of different eras, both of which are fully decorated with frescoes.

### **4.1 The Holy Koroni Monastery**

The church of the Koroni Monastery is fully decorated with frescoes dating from the 15<sup>th</sup> century A.D.

This has been a pilot application. Raster end products were produced for two interior elevations of the church at a scale of 1:20. For this monoscopic and stereoscopic metric images were acquired. They were digitally rectified or orthorectified accordingly.

For one of the elevations the pathology and the level of humidity were indicatively recorded.

In Figure 1 the photomosaic of the west elevation is presented, as it was produced from the combination of five digitally rectified images. In Figure 2 the vector plot of the frames of the frescoes is presented and in for the most complicated of them the figures are plotted in detail. In Figure 3 the humidity distribution diagramme is depicted.

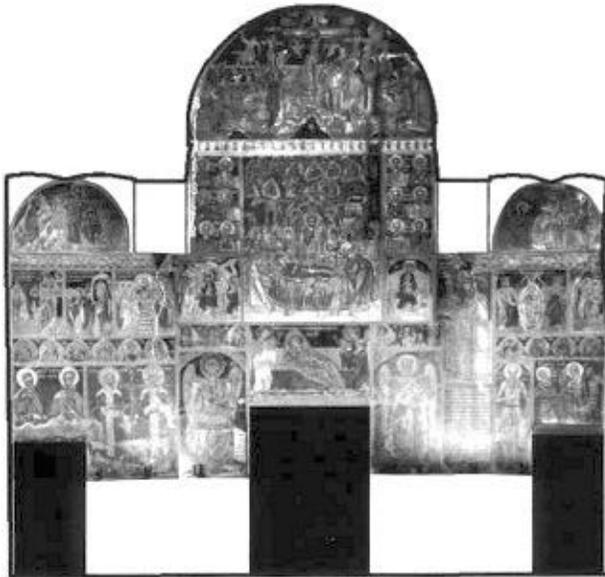


Figure 1 : Photomosaic of the west elevation of the Katholikon

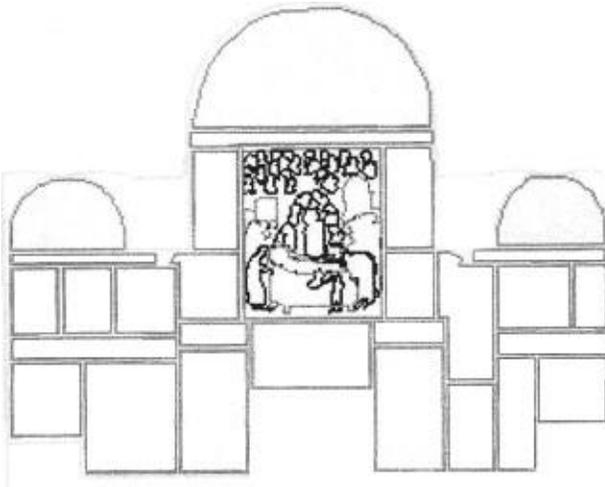


Figure 2 : Line drawings of the frames and the figures

#### 4.2 Drosiani Virgin Mary in Naxos

The church of the Drosiani Virgin Mary presents a unique and relatively rare footprint with three niches and is decorated with frescoes dating back to the 7<sup>th</sup> century A.D.

The procedure in this case was different and more complete. Apart from the raster products in orthogonal projection, which all were produced using orthorectification, the development of the church's interior was also produced. The development of the three niches, all of which are non flat surfaces is of special interest.



Figure 3 : Humidity record

The recording of the pathology was extensive and systematic humidity measurements are also planned by the conservators.

In Figure 4 part of the raster development is depicted, which shows the area of the north niche and in Figure 5 the line drawing of the fresco frames is presented together with the recording of the pathology of this area.

#### 4.3 Data Bases – GIS

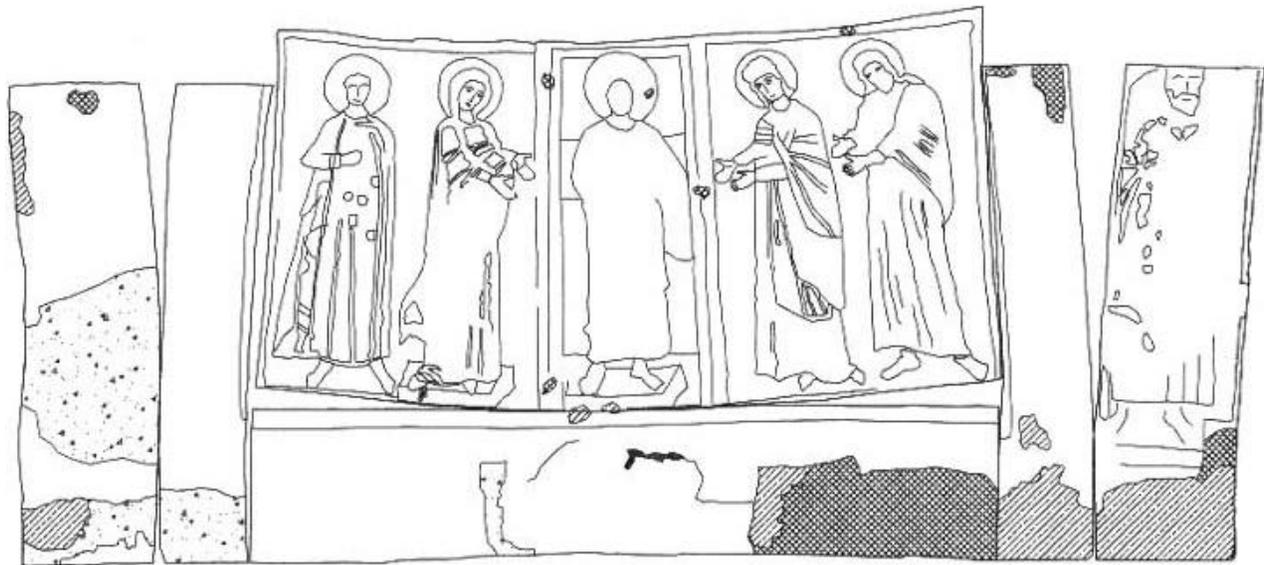
For the development of the data bases AutoCAD – MAP Version 3 by Autodesk was employed, because, among other reasons, combines the following characteristics:

- It allows the insertion of raster images at a specific scale. In this way the photogrammetric raster products form a directly suitable background for the qualitative information (Figures 1 & 4).

- It allows the determination of specific areas and sub-areas defined by closed polygons in vector form (Figures 2 & 5).
- In each of these areas it allows the correspondence and the restitution of specific information and characteristics with the possibility for corrections and additions. (Figure 6).
- It allows the determination and the discrete representation (using colours and hatch) of various thematic areas containing qualitative information, e.g. pathology or humidity (Figures 3 & 5) in vector drawing form.
- It allows the autonomous or combined projection and presentation of the above and the retrieval of specialised information.
- Finally, it is easy to use, efficient, relatively cost effective safe and easily found.



*Figure 4 : Development of the north niche*



*Figure 5 : Restitution and recording of the pathology*

In both applications discrete sections and sub-sections were determined for the development of the data base (Figures 2 & 5). For each of these sections specific information were determined. In general the sections and the corresponding information were:

- The borders of the elevations. Mainly architectural historical and other general information are being recorded.
- The frames of the frescoes. Mainly thematic, rythmologic and artistic information are being registered.
- The human figures in each fresco with details of faces, of limbs and vestment. Names and other details concerning the depictions are recorded.
- Other artistic figures and ornaments.
- The borders of the areas with pathology. The sort of the decay is being registered, together with its state of emergency for rescue operations. As mentioned before this kind of information is supported by vector drawings (Figure 5).
- The borders of the areas with equal humidity, which again are supported by vector drawings (Figure 3). It goes without saying that other recordings may also be performed, e.g. temperature.

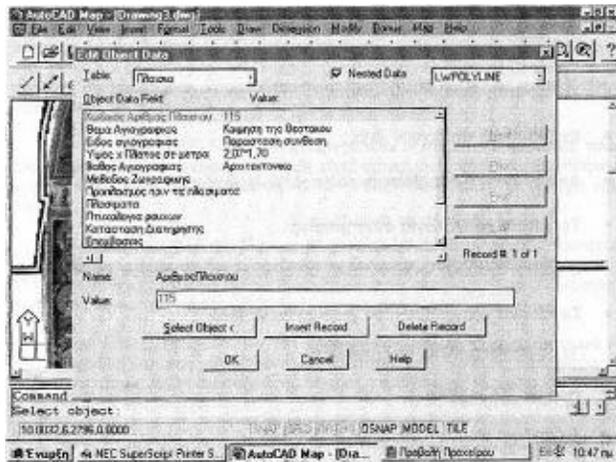


Figure 6 : Characteristic information data fields

Of course, in both cases the data bases are indicative, in order to show the possibilities.

## 5. CONCLUSIONS

The demand for raster representations of monuments or parts thereof, by archaeologists, architects, conservators and other specialists concerned with them, is increasing. Photogrammetry is already in position to provide them and in the future the possibilities will be greater.

These raster products, whether orthogonal projections or developments, whether black-and-white or, even better in colour, are the ideal background for further documentation and study.

The method proposed in this paper allows a complete approach to the solution of the documentation problem via a usable, user friendly and relatively cost effective way. The information and the problems concerning the frescoes and the mosaics may be uniquely and systematically recorded.

Of course the most critical issue is the data base structure. The complete and final development of the data base surpasses the abilities and limits of the photogrammetrists and geodesists and presupposes the involvement of the archaeologists, art historians, architects and conservationists, as they are more suitable to determine the detailed data fields.

There are still a lot of issues for further research. One such issue is the representation of the shape, the dimensions and the colours of the individual stones of the mosaics. Another such issue may be the inclusion in the GIS of more detailed images and restitutions of parts with greater interest. Work is already underway in co-operation with the archaeological service towards this end.

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