

## PICTORIAL RECONSTRUCTION OF PALOMINO'S CEILING BY DIGITAL TECHNIQUES

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### ABSTRACT

The case of the Palomino's frescos in the church of Santos Juanes, in Valencia, Spain, is a challenge that requires new alternatives to traditional mural painting restoration for several reasons. The destruction and alteration of more than 50% of the 1000 m<sup>2</sup> of pictorial surface, what is preserved has two levels of materiality. Part of it is detached and adhered to wooden boards, while another part is preserved in situ in its original plaster. Finally, as a place of worship in use, it is necessary to make the symbolic message represented in the mural legible. Based on the digital treatment of the image, we put forward the use of video mapping and an image transfer method for the recovery of the pictorial and ornamental ambiance previous to 1936.

### Keywords

Digital reintegration; Image transfer; Digital coloring; Videomapping.

### 1. INTRODUCTION

The Palomino's frescos in the church of Santos Juanes (fig.1) have suffered different events that have affected their state of conservation. A large part of the paintings was destroyed in the fire of 1936. Part of the burnt paintings were detached and partly relocated in the vault later. In the previous decade, one third of the paintings that were not detached have been restored as part of the technical approaches that seek to provide a solution to the pictorial set. At present, a new phase of intervention has begun in which an aesthetic



**Figure 1** – Photograph of the vault taken by J. Alcónat the beginning of the 20th century.

reconstruction system generated by digital images is being used. This technique aims to recover the pictorial and functional ambiance of this religious space.

For this reason, through new technologies, we understand that it is possible to find a global solution for the entire pictorial set of the church, adapting the process to each one of the different cases presented by the mural set. First, we find in the vault the paintings that have already been restored recently and that did not undergo any previous intervention after the fire<sup>2</sup>. Secondly, the continuation of the vault with fragments of detached paintings, repainted and placed on wooden supports nailed to the wall and finally, an apse in which there is no trace of any painting.

The objective of this process is not only to revalue the aesthetic aspect of the valuable preserved fragments but also to recover its meaning and facilitate legibility, all while respecting its historical value. All this process, starting from a black and white photograph and the reference to other works still preserved by the same author, Antonio Palomino.

These investigations are part of the development project for the restoration of the mural paintings, sculptures, stucco, ornamentation, and altarpieces of the Santos Juanes church set, currently carried out by the Instituto de Restauración del Patrimonio (IRP) of the Universitat Politècnica de València (UPV) coordinated by Ph.D. Pilar Roig Picazo, with funding from the Hortensia Herrero Foundation.

## 2. MATERIALS AND METHODS

### 2.1 Global Chromatic solution

To fulfil the objective of trying to give a global solution to Palomino's work, it is necessary to find a chromatic solution to the apse of the church due to the absence of its original frescos (fig. 2). In this case, based on the digital treatment of the image, we put forward the use of video mapping for the recovery of the pictorial and ornamental ambiance previous to 1936.



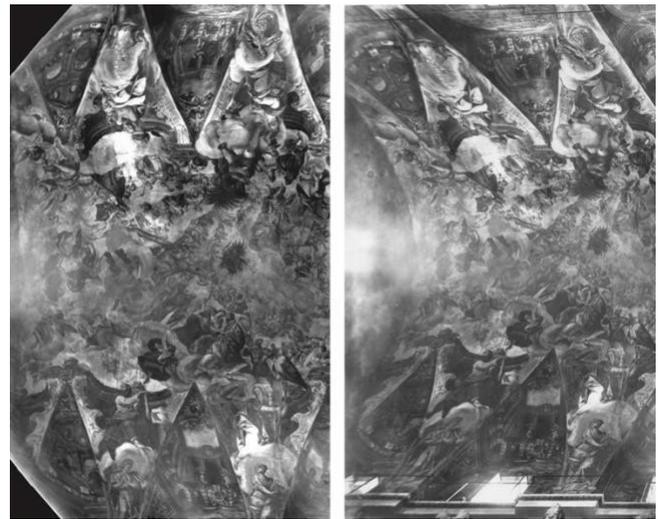
**Figure 2** – Current indoor view from the Santos Juanes church.

Using a B&W photograph and taking chromatic and iconographic references from other pictorial works that are in the same space-time context as the original work and are executed by the same author, an aesthetic approach to the work would be realized through video

mapping technique. Knowing the point where the reference photograph was taken, through the optics of the projectors and calculated deformations of the image, it is possible to make the fit of the image to the concave surface of the apse.

From the geometric model generated through a 3D scan, a study is made to carry out a videomapping proposal. For the projection design, it is necessary to carefully study the space requirements and analyze the position of the projectors, seeking a balance between simplicity, budget, and image quality.

In the case of the retouching of the vault paintings, where fragments of original painting are still preserved, other graphical historical B&W photograph, taken by J. Alcon before the fire, were used to start the work. To be able to adapt the image to the semi-cylindrical surface of the vault, a digital processing was carried out in several ways such as straightening, rectifying, and scaling of the historical photograph. All this thanks to the calculation of the point of capture of this photograph<sup>3</sup> (fig.3) [1].



**Figure 3** – Straightening, rectifying and scaling of the old photograph.

After the previous process, the following step was a digital colouring based on the superposition of the captures of the existing fragments to the picture taken by J. Alcon, taking the colours of the original painting as a reference (fig. 4). The creation of the virtual final image also requires colour management calculations to be transformed into a printed reality. So that the print

is adjusted to the tonal characteristics of the mortar used and that the colours, once transferred, reproduce the real colour of the images.



**Figure 4** – Left: preserved fragments after cleaning and consolidation. Right: digital reconstruction and colouring.

The last step was to print and transfer the image to the wall. This was done with Papelgel®, a temporary support for the transfer of inkjet and pigmented printing inks. The mordant of the ink is that of its own formulation, generally of the alkyd type. Papelgel® is only a temporary printing medium that does not provide or require mordant.

In the previous phase carried out in 2008, where the painting had not undergone previous interventions, this transfer was made without any type of adhesive. It was applied directly to the wall so that the small amount of mordant in the ink and the porosity of the wall acted as a receptor coating. In this way, the transpiration of the wall is prioritized, and the incorporation of other materials was avoided [2].

In the current phase of the intervention this system is intended to be applied to the rest of the vault, where we find fragments of paintings that were detached and placed on a wooden support and nailed to the vault in the 1960s. Once the removed fragments are relocated to their original position and on a new support adapted to the shape of the vault, the process of transferring the image generated from the coloured photograph is carried out. In this case, a transfer system is used that is the same as in the previous phase, but this time a layer of pressure sensitive acrylic adhesive is added to the transfer with Papelgel® in the form of a dotted texture. This adhesive improves the stability and

quality of the transferred image, and its function is to enclose the ink drops in a layer and ensure that they remain on the surface. In this way, the fidelity of reproduction and aesthetic integration is significantly higher [3].

In order to guarantee that the dots pattern adhesive system meets the aesthetic and material stability and compatibility requirements, colorimetry, glossmetry and surface water behavior tests have been carried out together with accelerated aging tests under UV radiation.

### 3. RESULTS AND DISCUSSION

#### 3.1 Digital coloring process

Both to color the projected image of the apse and the transferred image of the vault, we have started from the black and white photograph. The process is very similar but with some specific differences, taking into account that in this case there are no original fragments from which to extract the color palette. First of all, to start the digital coloring process of the apse it is important to identify the existing characters, both the main and secondary figures, as well as the rest of the figurative and scenographic elements.

In the process of recreating the paintings digitally, the workflow must be taken into account from the outset. The different parts of the paintings are separated by layers and worked individually, on one hand the base color, on the other the shadows and finally the lights. This phase allows to have total control in a fractional way to be able to manipulate the elements individually. In addition, a palette with different digital brushes is created to simulate different types of brush strokes and finishes, modifying its texture, thickness, stroke pressure, transparency, and opacity.

It is also necessary to create a digital color palette, based on technical and analytical studies of real colors of the preserved fragments and contemporary works made by Palomino (fig.5). These colorimetric references transformed into digital space allow working according to the brightness, contrast and saturation of each color, evolving the digital pictorial technique to simulate Palomino pictorial technique [4].

### 3.2 Mapping technical aspects

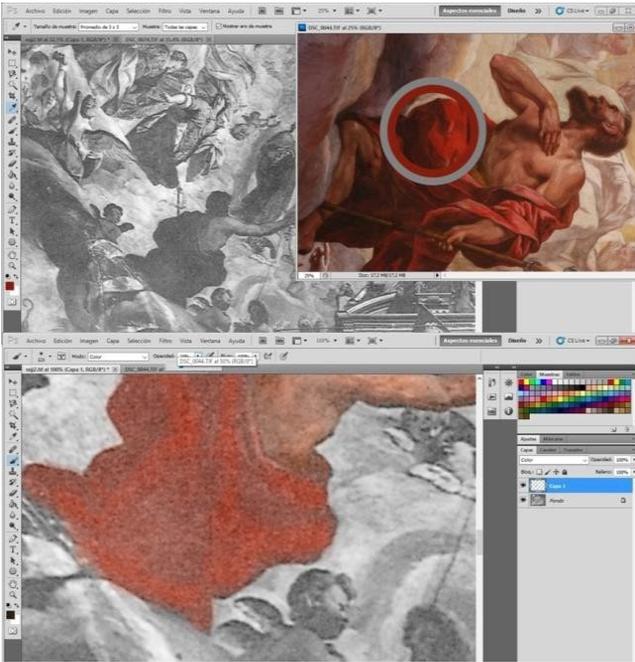


Figure 5 – Digital coloring taking as reference pictorial works from the same author.

Through the analysis of the photograph and together with the 3D model, the approximate point of view and orientation from where this photograph was taken is found, calculating the XYZ position. With these data it is possible to carry out a reprojection of the photograph on the geometry, thus obtaining a representation of the position of the photograph on the structure (fig.6).



Figure 6 – 3D simulation of the apse's pictorial texturing through video mapping.

Regarding the position of the projectors, the geometry of the surface must be considered, in order to project the entire concave surface, it would be necessary to have two projectors on the cornice to cover the sides and a third for the central area, this being a higher optics.

The total projection area covers a total of about 200m<sup>2</sup>. A light value between 75 and 100 Lumens/m<sup>2</sup> is established as acceptable, a range that would be achieved with projectors of 10,000 or 12,000 Lumens of power. Understanding that the perception of quality and brightness of a projection lies in the control of light pollution.

Another important aspect in this type of pictorial restitution is the resolution of the projection. 4K resolution little more than doubles FullHD, with 4K projectors you get four times as many pixels. Therefore, the higher the resolution, the higher the quality of the set<sup>4</sup> [5].

### 3.3 Image transfer method

To transfer the image, water is applied in a controlled manner to remove the temporary support Papelgel® and leave the ink on the surface. The original fresco paint is only slightly moistened at the perimeters of the gaps.

To check the stability of the new ink transfer method for the color retouching of the vault paintings, different tests have been carried out. After four cycles of 250 hours at a constant temperature of 40°C and 50% of relative humidity, the results obtained are positive. The  $\Delta E^*$  detected place the system according to the American Society of Testing and Materials (ASTM) at level 2 as "Very Good permanence". The stability of the acrylic polymers used as adhesives has also been verified since the transfer does not show any signs of loss of cohesion or adhesion [6].

The ink is removable with solvents of polarity fd 45-60. Image transfer is only carried out in the gaps coated for this purpose. This is a strict inpainting concept. As the ink is transferred to a non-original replacement stucco both structures can be removed mechanically without risk to the original fragments.

Image transfer by discontinuous dots of adhesive accredits the stability of the system, providing the reintegration with sufficient elasticity to adapt to the irregularities of a wall support and preventing future delamination.

#### 4. CONCLUSIONS

New technologies make possible to find a global solution to the entire pictorial set of the church of Santos Juanes in Valencia, although each area has different casuistry, it is possible to find a specific process that adapts to each one that, in addition, complement each other obtaining a joint solution. The difficulties found during the digital work have been mainly the lack of information and quality of the photographic material and the adaptation of the virtual model to the real geometry of the architectural space.

Moreover, mapping allows the viewer to return the aesthetic and functional values of the work, without using an invasive way, it favours a vision of its historical-artistic context. Without physically altering the heritage, the final audiovisual presentation can reach multiple information levels, helping the observer understand, for example, the technique and pictorial materiality of the frescos and, at the same time, discover the different iconographic representations.

The reconstruction of missing fragments through the transfer of the printed image allows the conserved fragments to be formally and iconographically contextualized, with a faithful approach to the lost originality provided by photograph.

The materials of the transfer system tested have been subjected to quite aggressive tests, so it is considered that in a controlled mural environment they should be capable of ensuring good physical and chemical stability, comparable to traditional techniques such as watercolors or other procedures commonly used in chromatic reintegration of these works.

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#### NOTES

<sup>1</sup> Transfer system one was implemented in an area of 150 m<sup>2</sup> in 2008. The results are shown in fig. 4 and it has not undergone any noticeable chromatic changes since then. Transfer system two is currently being applied after laboratory tests and actual experience on a fragment of San Nicolás wall decoration in 2016. The videomapping system has only been tested on virtual models.

<sup>2</sup> 25 years after the fire, 2/3 of the preserved painting was removed and replaced. The painting removed from the apse disappeared in the process.

<sup>3</sup> There are several photos with partial framing, but to generate the basic image of the vault, two photographs of large general shots and a third for the apse have been joined together to create the basic image of the vault.

<sup>4</sup> Pre-project on the technical study for digital restitution through video mapping on the central apse of the Church of Santos Juanes of València by Playmodes Studio S.L.