

FROM THE RELIEF TO THE 3D RECONSTRUCTION THE METHODOLOGY

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ABSTRACT:

Through the plan in issue, carried out at the Virtual Heritage Lab of the Itabc at the CNR that looks at the “reconstruction of the archaeological landscape of the ancient Flaminia with virtual reality systems”, we would like to underline some steps for the reconstruction of the virtual environment and archaeological structures. It can be possible through different techniques and data sources, integrate in a coherent methodology of elaboration and communication: cartographic data, remote sensing, photo-interpretation, topographic survey, laser scanner data, photogrammetry, photomodelling, computer vision and so on. It is possible to build a digital ecosystem, oriented towards a real time desktop Direct X application that individualizes two levels of perception. The first one represents an holistic vision of the road from Rome to Rimini, based on technical cartography and aerial and satellite photos able to support the realization of a web gis; the second one, which dips into a micro-space vision that focuses the attention on four monographies, with the aim to represent and contextualize the local entities within the “ancient landscape” entity. Through the 3d reconstruction of the architectural heritage and its real time display, we obtained an accurate and communicative interpretation that both suits research purposes and can transmit the importance of conservation to the general public. It is perceived as an effective way to divulgate and publicise information that is often only accessed by the scientific community.

1. INTRODUCTION

The paper will review the building’s most important characteristics, its location, as well as the methodology used to propose a reconstruction plan.

For the restoration of a reliable and verifiable plan of reconstruction in all its parts it is necessary to begin from a first phase collection of high level data, both the cognitive aspect of the state of the places (“bottom up”) and the collection of texts, instances, archives etc. relative to actual places and on study cases morphologically and temporarily comparable (“top down”).

The first category of information about the cognition of the actual state of the sites is based on the possibility of using advanced technologies for the data acquisition that is intimately connected to the typology and the particularities of the entities to examine.

2. LASER SCANNER TECHNIQUE

The case of the Villa of Livia, for example, due to: 1) the complexity of the architectonic system, 2) the insufficient and partial credibility of the planimetry in public archives, 3) scarce information caused by incomplete excavations, has made use of advanced technology of the laser scanner to obtain 3d relieves with a resolution of 6mm. This technology represents an enormous potential of publishable, up-to-date, available and, above all, georeferenceable information, fundamental for an archaeological contextualized knowledge of the territory and in a position to transmit a strong evocative and communicative component.

The acquisition of 3D data with the laser scanner generates a high resolution model with questionable and exact data, with generated and interpolated faces. The same technique is used to detect both the architectonic compound of the Villa of Livia and the hill on which it exists.

The acquired and elaborate models are further optimized within other three and bidimensional graphic softwares (3D Studio Max, Photoshop CS2), used for texturing, decimation and the improvement of the graphical quality of the rendering (techniques of multires, normal maps, UVWrap, render to textures). The method can also generate low polygon resolution version of the meshes without modifying the perception of the model, keeping the frame rate of the application higher than 25 frame/sec. With this modelling approach we obtain a fluid navigation through the mesh.

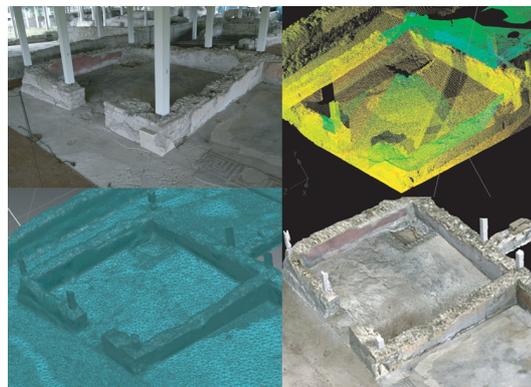


Figure 1 – From point cloud registered with Cyclon (by Cirax Technology) to the 3d mesh realized with Rapidform (by Inus Technology) to the 3D model textured and optimized with 3ds Max (Villa of Livia - Via Flaminia)

3. THE 3D RECONSTRUCTION

Only after a careful scientific study, the project places its aim in offering reliable and verifiable reconstructive hypotheses. For this reason, a methodology has been realized to use it like a historical-critical instrument suitable to communicate the architecture and the archaeology.

The application of virtual 3D modelling allows a spatial analysis and punctual verifications, both architectural and structural, that are very difficult to do in a traditional scientific ambit. To such aim, a methodology is very important in order to guarantee the scientificity of the final result. The realization of the models is obtained through complex algorithms that control not linear behaviours of the reality. The three-dimensional studied object becomes, through the calculations, a scientific model of one of the possible truths. The geometric-spatial simulation is introduced like the simpler and intuitive case: in fact, it is a construction realized in the virtual space with morphological and dimensional property, according to the real one, that concur to analyse the spatial and volumetric relations of the object. In addition to these mathematical-geometrical considerations, there are also formal evaluations that are not necessarily measurable (for example, the decorations). To such aim, for their reconstruction it has been carried out a stylistical-philological research based on typological and chronological parallels.

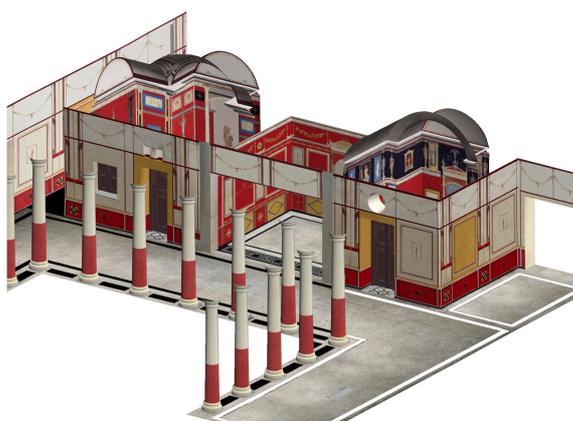


Figure 2. Partial 3D reconstruction (Villa of Livia - Via Flaminia)



Figure 3 : Particular of the parietal decoration from Auditorium Maecenatis (<http://www2.comune.roma.it/monumentitichi/pdf/Auditorium%20Mecenate.pdf>) and from villa of Livia.

Naturally, the architectonic aspect that derives is supported from the research that must be considered a point of departure for the deepening of the studies.



Figure 4. Example of typological parallelism
I sec. a.C - I sec. d.C.: Villa of Oplontis



Figure 5. Reconstruction of the republican garden of Villa of Livia with 3D Studio Max

A reconstructive process must be visible and transparent, supported by scientific data that determinates three different level of reliability (high, medium and low); through the formal and material analysis of the architecture, the original morphology, its operation and history can be understood, realizing reconstructive hypotheses that are based on constructive logic and cultural background. The structural verification through the graphical statics calculation is a fundamental instrument in order to ratify the reconstructive hypotheses. The study of materials supplies another important aspect: we may learn of its mechanical abilities which condition architectonic aspects such as the height of walls, cover systems, etc.

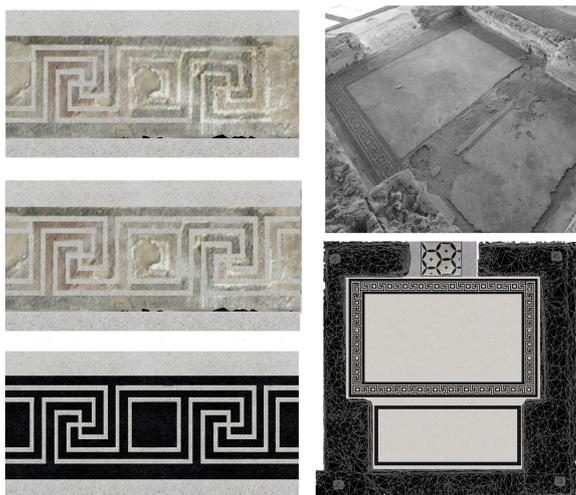


Figure 6. Particular of the reconstruction of one mosaic floor (Villa of Livia)

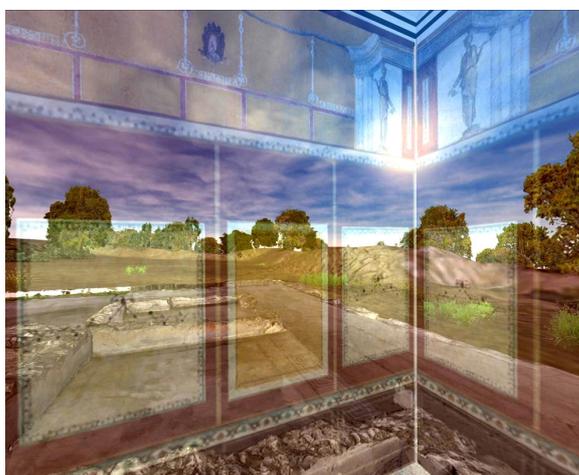


Figure 7. Flaminia project: Villa of Livia, VR application

4. THE DIGITAL ARCHIVES AND VIRTUAL RESTORATION

A completed digital 3D processing of acquisition and representation will be the best basis of knowledge according to an integrated approach in order to minimize the risk to lose scientific data (Forte, 2003). Once they are developed, digital models can provide substantial support. The recording and communication of the images through the digital archives has become a strategic instrument for the numerous activities which it can supervise. For the photographic agencies it is the instrument of main job, for the industry and scientific culture it is an excellent and modern vehicle of communication.

At the technical level of virtual heritage, they consolidate numerous disperse information and therefore facilitate any decision making prior to intervention. They facilitate the diagnosis of different structures and constructive techniques of the past. They complete and complement the graphic existent documentation with plotting of ruins and vestiges.

At the historic level, the models allow to represent the building through the ages, following the succession of interventions. Finally, from a methodological point of view,

models offer elements of analysis for the study, and preservation of the architectonic patrimony.

Scientific digital modelling of Cultural Heritage favours a conceptual surrounding defined by the perceptive restoration of architectonic space.

Digital models are also instruments for suggestive and accurate representation of reality or hypothesis that do not require interventions that could prove to be costly and irreversible. They also have the interest of being opened and interactive processes. The user can access the model as many times as necessary to generate new images or to modify and improve the design as soon as new information is made available or new hypothesis proposed.

Once the virtual reconstruction is finished, all information generated becomes part of the documentation regarding the building. The model output is a synthetic, accessible and suggestive document that contributes to progress in analysing the building and, beyond, in art history.

The choice and agreement on the scientific purpose eliminates sensational and non-professional interpretations that generally arise in the world of computing. (Currently, there is considerable lack of coordination on this matter and distinction is not made between scientific representations and those non-professionals).

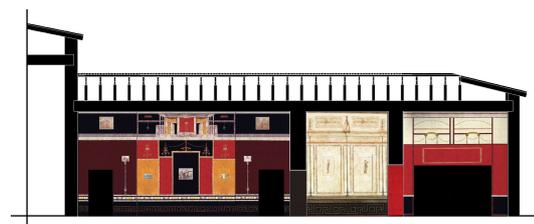


Figure 8. Example of the reconstruction of different walls decoration (Villa of Livia)

Because of these developments, on one side the resistance can be expressed towards innovations that appear to threaten the tradition; on the other side, there is the curiosity for the possible experimentation of new objects and new methods that, instead, represents the bases for progressing of the research.

Through the application of new technologies, with the realization of scientific graphical models, the cultural heritage does not modify structurally and is available also for not expert public.

In agreement with Cesare Brandi, we work on the aesthetic request of the cultural heritage on the base of the historical one. In this way an instrument is created and it doesn't physically modify the structure of the cultural heritage, neither takes part on its authenticity, one of the greatest problems of the physical restoration. In fact, while the traditional restoration has like objective to consolidate the present status of the cultural property, the virtual restoration exceeds this limit and is in a position to taking part exclusively on its digitized image and not physically on it.

Such operation turns out very important also in the elaboration of one methodology for the creation of the digital archives available to anyone. In this way, where the new technologies have entered to make part of a field of "ancient" study, the cultural property does not

represent more only its past, but it casts in the future. It is necessary, therefore, to keep also all the production of the digitized patrimony.

5. CONCLUSIONS

The relationship between the computer science technologies and the world of archaeology is not limited exclusively to the creative sphere; the new digital "media" are precious also in the field of the conservation, the study and the spreading of the artistic and cultural patrimony of the past. As Antinucci said in one of his interview, this technology has a big impact with the world of the art, because it is based on the visual abilities to simulation. Since the art is based substantially on the property of the image, on the visual perception of the objects, his value is contained exclusively in the visual perception.

Having a technology that offers the possibility to manipulate and to elaborate these images in any case, the contact with the art is immediate and multistage. Moreover, this technology concurs to move images to high resolution nearly those real ones and makes them available to all. In the past was difficult to have many books that were much expensive.

The simple fact to give wide access to the world of the images is a revolutionary fact. We can use the images scientifically, in order to make tests that could not be realized before. And these tests can be repeated infinitely times. This operation is also economically convenient, since today it is possible to recreate the models in real time. The more important possibility that these technologies can offer for the art it is not in these technical aspects of spread, but in the communication process. The art is the visual language that belongs to various cultures, ages and times, and it is not a comprehensible and immediately appreciable language. With the new technologies it is possible to realize instruments that make available to all the artistic works, because they succeed to explain them a very simple way, through the image.

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