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COMPARATIVE STUDY OF SLOWLY DAMAGE SURFACE

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ABSTRACT

High resolution 3D documentation technique may observe the degradation in time of the object. This paper presents a case study in two different locations, one in a highly visited church and another one, an isolated ensemble, with high values of relative humidity.

One of these kinds of application was made in an Orthodox Church - Sucevița, build in XVI century, monitoring the evolution in time of the surface of the iconostas.

On the left side of the wooden iconostas a cutting plane was observed and using 3D scanning the dimensions of the areas was inspected. Another 3D measuring, 15 months later, was made to inspect the evolution in time of the cutting areas.

Another provocative application was in a roman career dated between IX-XI centuries. The inscriptions on the walls give a high value of the ensemble and this was the main objective at this location, to digitize this incisions. The relative rise level of the humidity induces a low conservation state of the chalk walls, loosing the engraved details. Making two 3D scans, at different period in time, time between the scans being more than 1 year, the degradation of the surface may be observed.

The resolution of the used scanner permits to detect variation of the surface less that 0.2 mm, the result may be observed also in clouds of points and mesh representation. Because it is used laser technology, the result it is represented in grey scale. One of the applications of the software used to process the data is that a photo image may be loaded, and matched over the 3D model, obtaining a 3D colored model of the object.

Combing this 3D documentation method with microclimate monitoring of the location and thermal investigation of the object's surface a better understanding of the evolution in time may be made.

Time evolution urges us to develop new methods or to improve the existing ones. One of these methods is 3D laser scanning; the basics of recording the shapes of the objects begun in 1820's with the modern history of photography. In 1860's J. C. Maxwell made the first recording of a color photo image and with the developing of the CCD's cameras in the late '60-70 the recording of the objects make a further step (in this case the digital reproduction of the object was the novelty). Another step may be considered 3D reproducing of the object, instead of recording it in a 2D medium, a 3D method to digitize the object was developed.

Similar with the holography, where a monochromatic light and a photographic plate is used to record the reflected light form the surface of the object, 3D laser scanning use a laser beam to digitize the surface of the object.

Also 3D representation of objects may be produced using photogrammetry, but this passive method uses light coming from the sun, no need from artificial light, the ambient light should be enough, but the result is not that accurate and trustily.

3D laser scanning, an active method, uses the proprieties of stimulated radiation to produce high accurate digital models of the objects. No need for any light, only the radiation from the scanner. The power of the laser is 15 mW, its nondestructive comparing with the power of a usual bulb, with values from 45 up to 100 W. The distance between the scanner and the digitize surface (with this time of flight laser technique) must be between 1.5 and 22.5 m.

This work presents two kinds 3D monitoring examples.

The first one from Basarabi caved Churches, discovered in the late '50s, one of the most impressive archaeological sites from Europe. Habited between IX-XI centuries, the Ensemble consists in bower cult, grave vault, tomb. On the walls there are rich value inscriptions in Greek, proto-Glagolitic or Glagolitic, symbols – mostly crosses, or figurative representations.

The Ensemble is situating in a chalk hill and combined with the high values of the humidity gives a rapid degrading surface. Time for the first session scanning was 3 days, time in witch was made 3 medium resolution (starting with 0.8 mm) full scans of 3 Churches (Churches with 3 or 4 chambers, the smallest volume of the Churches was 16 m^3, at least one scan per room) and high resolution scans (the resolution starting with 180 μm) of the details engraved on the walls.

Besides the high values of relative humidity, also the dimensions of the Churches were a problematic factor. The minimum distance between the scanner and object is 1.5 m, and the size of some rooms is less than 2 m, also the attention to choose the scanning parameters (resolution, angular coordinates, applied filters, the applied gain of the reflected radiation) a special attention was accorded to assure the (minimal required) distance between the object and the scanner,

Because of this rapid degrading surface some of the incisions were lost, the only information about them is stored in digital form or in drawings.

Another interesting application is represented by Sucevita Monastery. Walled in the last decades of XVI century, one of the activities at this application was the digitization of the yew wood iconostas. Made at the end of XVIII - beginning of XIX century in baroque/ rococo style, the iconostas is one of the most well known details from Moldavian Monasteries.

One of the best visualization of this 3D digital models is the mesh one, even thou the scanner uses a time of flight method, by software tools may be obtained from the points representation a mesh one, when three near points generates a triangle, points that are base for another triangles. In this case the mesh resulting resolution is much better than the cloud of points resolution, mostly because this kind of representation uses interpolating data (that may not be true). Also this representation offers a better visualization of the data, exploring efficiently the surface and the details.

Scanning of this icon need no special attention, only at the post processing was more carefully made, if the hole model of the iconostas was made at a medium resolution of 0.8 mm (the information available could generate a model at a resolution starting with 0.4 mm, but because of the system requirements of the computers used to process the data, for a shorter upload time of the model and mostly because the details from the iconostas didn't need that kind of fidelity, the final resolution was near of 0.8 mm), the icon has a resolution between 0.4 and 0.6 mm. The distance is varying up to 1.6 mm (measurements made in July 2006).

a) *b)*

a) Gray scale cloud of points representation; b) Colored mesh representation. The distance between the slices varies from 0.3 up to 1.6 mm, image containing 1 millions of points (a)) and 3 millions of triangles (b)).

Scanning in two different moments in time the same details in the same conditions it may be observed the evolution of the object's surface. Once observed this evolution, some statement regarding the conservation of the monument may be concluded. Combining these results with thermal images and obtaining 3D thermal object representation the work/ method may be further on developed.

BIBLIOGRAPHY

1. Levoy, M. 3-D Digital Imaging and Modeling, 1999. Proceedings. Second International Conference on 3-D Digital Imaging and Modeling, Volume , Issue , 1999 Page(s):2 - 11
2. Walter Mărăcineanu, Monica Simileanu, Dragoş Ene, Cristian Deciu, Joakim Striber, Roxana Radvan, Roxana Savastru – "Trends of Photonics for Restoration and Conservation of Cultural Heritage. Romanian Experience", REVISTA MONUMENTELOR ISTORICE Nr. LXXV, 2006

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