METHODOLOGY FOR 3D ACQUISITION OF HIGHLY REFLECTIVE GOLDSMITHING ARTIFACTS

P. Hallot [1]*, M. Gil [2]

[1] DIVA – Art, Archaeology and Heritage Research Unit, University of Liège, Liège Belgium - p.hallot@uliege.be
[2] IRHiS, University of Lille, Lille, France – marc.gil@univ-lille.fr

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ABSTRACT:

The developed acquisition methodology is conducted in the framework of the e-thesaurus project which is initiated from a collaboration between the IRHiS UMR CNRS of the University of Lille and the University of Liège. The general goal of the project is to improve the accessibility of goldsmithing masterpieces - produced during the medieval period in the northern regions of France and today's Belgium - both for research and mediation purposes. One of the strengths of the approach stands on a large consortium gathering various fields: Goldsmithing specialists, art historians, curators, museums, geomaticians, religious arts experts and IT specialists. This broad panel helped to define precisely the requests for curators, researchers and museums mediation. The first phase of the project requests to develop a high-resolution 3D model that can be distributed over a web interface for researchers and a lighter version, which is the generalization of the first one, for mediation purposes. The interface should allow annotating the 3D model by adding semantic information or linking to existing references, images... Each semantic information will be classified in order if it is intended to research or mediation. Indeed, the technical description of goldsmiths elements can be rather obscure for non-experts. The geometric resolution of such models has also been discussed and the geometrical modeling primitives (point cloud or meshes) have been though to ensure the best representation and exploitation as possible. For this reason, we aim to produce both a mesh and a dense point cloud. The first one being lighter for mediation purposes and the latter one easier to integrate into a web interface for semantic annotation. Both models will be georeferenced in the same coordinate system.

To develop the acquisition methodology we selected three objects that are conserved in the Hotel Sandelin Museum in the city of Saint-Omer (North of France). This museum holds in its collection the foot-cross of Saint Bertin Abbey, the reliquary cross of Clairmarais Abbey and a pyx (box to keep the consecrated Host). These three objects have been produced between the end of 12th and the the first decades of 13th century. They were chosen upon their geometric complexity and the high number of different materials that they combine.

Figure 1. From left to right: Foot-Cross of St Bertin, Cross of Clairmarais (both sides), Pyx

The developed methodology is constraint by the rarity and the fragility of the three selected objects. We were not allowed to move them out of the museum and their manipulation of the objects is very limited. For instance, we were not able to lie the objects or reverse them. They were supposed to remain on their display structure. An acquisition protocol has to be defined and submitted to the curator. Several iterations have been necessary to define an acceptable setup for acquisition. These limitations, the highly reflective surfaces, the limited budget, and the limited accessility to acquisition material (such as structured light scanners) lead us to propose a photogrammetric acquisition process. Moreover the developed methodology is intended to be reproduced to several collections. This constraint reinforced our choice to work with accessible and affordable acquisition material.

* Corresponding author

Figure 2. From left to right: Natural Lightning condition and 3D models obtained from photogrammetric reconstruction.

The acquisition goes through three steps: a first acquisition through the protective glasses; an acquisition with natural light under a light tent, and a final acquisition with a cross-polarized light system. The first acquisition was only intended demonstrate the usefulness of the photogrammetric approach, propose a discussion basis during the project definition. However, the model resolution and quality are sufficient to present to each partner the limitation of 3D modeling, discuss the requested resolution, define the geometric primitives to use, and shows the complexity of modeling reflective objects. The model, once scaled, helped to build the acquisition support for the two next acquisition phases. During the second acquisition phase, we tried to light uniformly the artifacts using light deflection tents and flashes snods. Neutral distortion filters were used to limit the reflections.

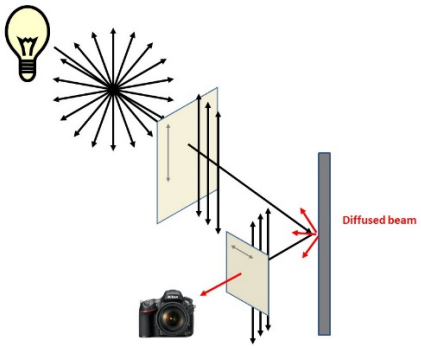

Figure 3. Principle of cross-polarized light filtering (https://chsopensource.org/polarized-light-photography-for-art-documentation/).

Finally, to avoid most of the reflectance we setup a cross-polarized light system in order to limit at maximum the reflective effects. This principle resides in the use of two linear polarizing filters. The first one is placed directly close to the light source in order to avoid a light diffusion in each direction but to select only the light vibration in a vertical direction. Once the object diffuses the light, a second filter is placed at 90 degrees from the first one on the lens. This ensures the acquisition of a minimum of diffused rays of lights (that causes the reflection). Several configurations of lightning were tested. We can say that there is a strong influence on the orientation of the polarized light source and the filtered lens of the camera. Moreover, the cross-polarized lightning modifies the color distribution.

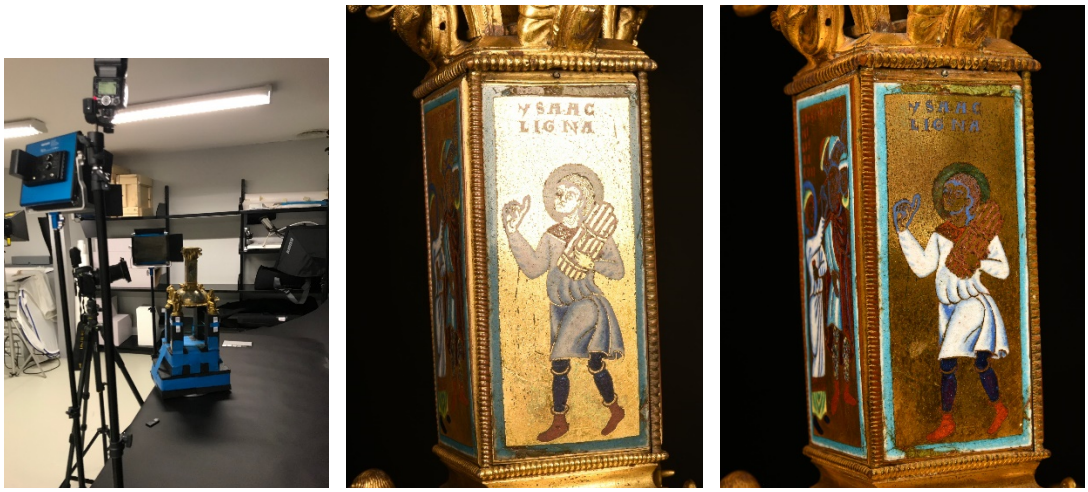

Figure 4. From left to right: Double cross-polarized light system, natural light picture, and polarized light picture.

The proposed research propounds a discussion on the color quality control and the geometric comparison between the two acquisition procedure. It appears that the color distribution is not affected uniformly by the polarized light. However, some “unseen” information appears in the model when using this lightning. This conduces us to proposes a geometric model calculated from the cross-polarized light pictures and a texture fusion with the natural light picture. This could provide a wider range of information for researchers.