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3D SURVEY AND MODELING OF MASKS AND CALYX CRATERS OF ARCHAEOLOGICAL MUSEUM OF LIPARI: INTEGRATION OF LASER AND PHOTO SCANNING SYSTEMS

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Study context

The poster shows the result of a 3D survey campaign carried out by **IPCF-CNR** of Messina at the Aeolian Archaeological Museum of Lipari. Within a wider study of characterization and diagnostic performed through non-destructive metohologies (see also poster n.16), many artifacts have been surveyed using a portable **laser scanner** in order to record their geometries as accurately as possible; in some specific cases the technique has been combined with **digital *sfm* photogrammetry**, based on photo-scanning, for a better photorealistic rendering of some painted surfaces.

Aims

The aim of the work is to show the potentialities of a combined use of range based and image-based survey techniques on archaeological artifacts in order to obtain useful tools for **analysis, diagnostic, digital restoration and virtual fruition within the Museums**.
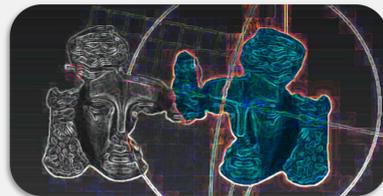
F.1- A screen of 3d data integration

Materials & Methods

Using non-destructive and non-contact methods we have analyzed: n. 9 terracotta comedy theatre masks (datable between the 5th and 4th centuries BC and discovered by L. Bernabò Brea and M. Cavalier in the second half of XX cent. in the Greek necropolis of Contrada Diana.), n. 2 figured calyx craters (mid 4th century BC), a stone inscription, a fragmentary clay head and a lekane lid.

F2.- Some of the finds surveyed

F.3- The Pittore di Adrasto crater (n.i.10648) and the arm laser-scanner
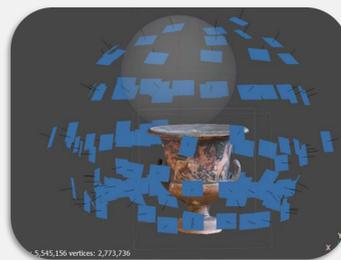
F.4- Position of the cameras around the object

The pieces were digitized with a **Faro® Cam2 laser arm** (model Quantum M FaroArm): with a point probe the digitizer has allowed to collect 3D data points with an accuracy ranging from 0.0007" to 0.004".
In addition, a scaled SfM model of some clay masks and of two figured craters was created using a **Canon Eos 7D** camera in order to integrate the model with photographic texture, not acquired by laser arm. In particular the vases were entirely photo-scanned following a 'converging axes' schema, taking care to get an overlap and sidelap between the frames ranging from 60% to 70% (F.3).

F.5- The Faro LaserArm and 3d data point
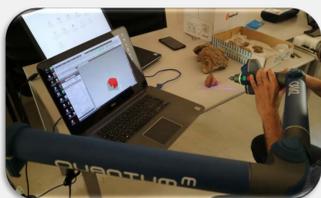

F.6- Acquisition with Faro Laser Arm

F.7- Acquisition and restitution of mask i.n. 14584

Data processing

1. Using "Geomagic Wrap®" the results of each laser scansion related to a specific find have been cleaned, repaired, merged and processed in order to create 3d meshed models.
2. The photo-scansion of craters has been processed in "Agisoft-Photoscan" following these steps:
- Correction of optical distortion of camera (by Agisoft-Lens)
- Alignment of the frames by tie points between adjacent frames;
- Building of of dense cloud;
- Generation of polygonal mesh (three-dimensional surface);
- Generation of texture (only for vases);
- Exporting of models;
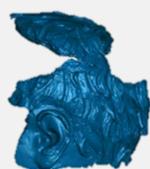
F.8- A restored fragmentary clay head

Post-processing of calyx craters: texturing and unwrapping

Finally, the high-resolution texture of vases made up by Photoscan was transferred to the vertices of the model using MeshLab, colouring the surfaces.
In addition, a **cylindrical projection** of the decorative apparatus of craters was also carried out using Agisoft Metashape ® (FF.7-8).

F.9 – Cylindric projection of Maron crater (i.n. 340bis) depicting the myth of *Hippolytus* and quadriga of horses

F.10 – Cylindric projection of Adrasto Painter crater (i.n. 10648) depicting the quarrel between *Tydeus* and *Polyneikes*

Results

These non-contact methods has allowed to obtain 3D models of all the finds listed above, useful for scopes of **research**, **preservation**, **monitoring** of conservation status, **restoration** activities (without intervening directly on the object), **promotion**, interactive **fruition** of unexposed pieces and **accessibility**.

Conclusions

Although the laser-scanner method is the most accurate way to define the geometry of objects (and the only one suitable for all that activities which requires maximum precision as digital restoration), it is very poor in photorealistic rendering in relation to the high cost of equipment and elaboration software, which require as long processing times and high modeling skills.
The technique of photo-scanning, thanks to the structure from motion algorithm, allows, once the acquisition scheme is accurately designed, to partially automate the processes using low cost and user-friendly tools, having a less geometrical accuracy but a more effective photorealistic rendering. The two methods are however absolutely complementary in order to finally get an 'integrated model', as well proved.

In the case of craters, in fact, the combined use of both tecniques offers an efficient and precise way for executing drawings of painted vases thanks to **stylistic analysis** of which it is possible to identify in some case painters and workshops: only a meticulous fine documentation of details may reveal the particularities and characteristics of a painter and can help to recognize these on other vessels.

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See more

F.11- Point cloud and 3d mesh of mask i.n. 11248

F.12- Mask i.n. 13558

F.13- Mask i.n. 11114E

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