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UNVEILING *DAMNATIO MEMORIAE*. THE USE OF 3D DIGITAL TECHNOLOGIES FOR THE VIRTUAL RECONSTRUCTION OF ARCHAEOLOGICAL FINDS AND ARTEFACTS

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Abstract:

The aim of this paper is to show how the possibility to acquire 3D reality-based data from archaeological finds allows to build 3D digital models that can be analysed and managed in a virtual environment and can be relocated, assembled or restored in order to suggest or graphically support archaeologists' interpretations and reconstructions. In particular, the paper shows how the use of 3D digital technologies is extremely helpful in contexts where iconographic sources are damaged or completely lost. In ancient Rome, for example, *damnatio memoriae* was a practice of erasing the memory of condemned persons from historical records after their death. This condemnation usually included practices such as the erasure of names sculpted on inscriptions and the destruction or reworking of statues and of any other image of the person. The paper shows the methodology developed for the virtual restoration of the statue of Nero that was found 500 years ago by the Roman theatre of Bologna, Italy, starting from the 3D digitization of the torso, to the reconstruction of its damaged and missing parts.

Key words: 3D reality-based survey, virtual archaeology, virtual reconstruction, 3D sculpturing, 3D modelling, Nero

1. Introduction and aims

In Archaeology, sculptures are considered an extremely interesting and rich field of investigations. Indeed, they are the tangible evidence of the specific cultural and historical context in which they were conceived.

Since the pionieristic project of the 3D digital survey of Michelangelo's David statue held 15 years ago (Levoy *et al.* 2000), the digitization of statues still represents an important body of knowledge that can support various kinds of investigations in different research fields (www.digitalsculpture.org, Grün *et al.* 2004, Frisher and Fillwalk 2012, Patay-Horvàth 2013).

In this context, the purpose of this paper is to show how the use of 3D digital technologies can help the reconstruction of the past through its iconographic repertoires. In particular, the paper shows the results of investigations held on a statue of Emperor Nero that was found in Bologna, Italy, five centuries ago and that was intentionally damaged after Nero was condammned to *damnatio memoriae* by the Roman Senate. This practice destroyed a wide iconographic repertoire that can actually be recovered thanks to the integrated use of 3D survey and modelling tools that facilitate the combination of fragments from different finds and that allow scholars to verify their interpretations, as well as to effectively communicate the results of their analisys.

This loricated torso attributed to Emperor Nero is one of the masterpieces conserved in the Archaeological Museum of Bologna.

Although its attribution now seems indisputable (Mansuelli 1956), the exact dating of the sculpture is more arduous. It could have been made between 53 B.C., when Nero advocated Bononia's case with the Senate, and 60 B.C., when an honorary inscription that was discovered near the theatre where the statue was found was dedicated to Nero.

The statue (Fig. 1a) represents a male figure wearing military garments and is preserved to the height of 117 centimetres. It was defaced, lacking the head and the neck, which were taken away in a violent manner. The arms and the legs are lost too; only the stumps of the forearms and the upper part of the legs remain.

The virtual reconstruction of the statue of Nero required a series of preliminary analysis aimed at detecting geometric details within other finds that share similar features with the supposed original look of Nero's statue.

The remainders of the arms do not allow an unequivocal interpretation of their original position: the left arm was

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reasonably raised to hold a spear, whereas the right one did not lean along the flank, as most scholars suggested. In view of the slight inclination of the right forearm stump, the arm must have been stretched out forward, possibly to hold a *patera* or *phiale* for libations.

In order to rebuild the statue's limbs, we selected the Augustus of Prima Porta statue, which represents the earliest example of Roman Imperial loricated sculptures. A twentieth-century copy of it is preserved at the Archaeological Museum of Bologna (Fig. 1b).

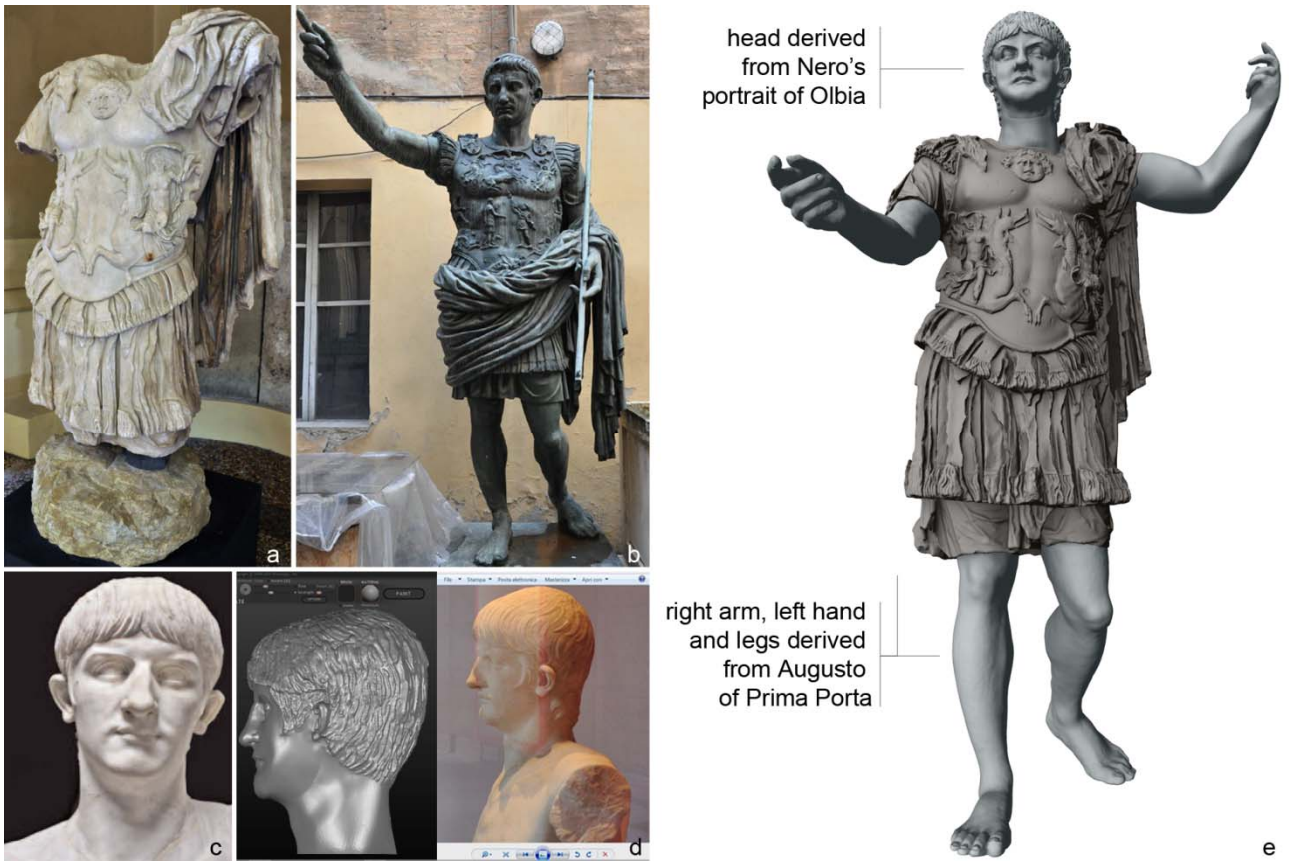

Figure 1: a) Picture of the torso of Nero (Archaeological Museum of Bologna); b) bronze copy of the Augustus of Prima Porta statue (Archaeological Museum of Bologna); c) Nero's portrait from Olbia (Cadario 2011); d) 3D sculpting of the head of Nero based on visual correspondences with the Olbia portrait; e) integrated digital 3D model of the statue of Nero.

Instead we encountered severer difficulties to find an appropriate head for the statue. If the statue's alleged date of creation is reliable, a head pertaining to the portrait of Nero Type 2 must be considered (Cadario 2011) juvenile and still related to the canons of Julio-Claudian portraiture in common use in A.D. 55. This portrait is from Olbia and is now preserved at the National Archaeological Museum in Cagliari (Fig. 1c). The Emperor still has a juvenile and yet non-idealised face, compared to his childlike portraits, with hollow features and the distinctive coiffure with longer hair and fringe combed clockwise over the right side of his forehead and counter clockwise over the left.

2. The adopted methodology

The 3D modeling process was basically organized within three main phases: *i.* the accurate and detailed 3D survey of the torso; *ii.* the 3D sculpting of missing parts starting from geometries derived by other finds; *iii.* the integration of data collected within the previous two steps.

As far as the first step is concerned, the selection of the most suitable methodology was driven by the purpose of collecting the most accurate and detailed geometric information of the torso, in order to document its conservation conditions and also to provide a digital replica of the find.

The second step consisted in the detection of the most suitable methodology to adopt in order to easily and quickly derive the main geometric information from other finds related, for example, to the position of the limbs, to gestures, to the shape of the face, to facial features and to the hairstyle. In this case, image-based technologies were privileged over range-based ones.

The third step consisted in the manipulation of data acquired from other finds in order to adapt geometry, scale, spatial orientation and level of detail of face and limbs both to archaeologists' reconstruction hypothesis and to the replica of the torso. 3D sculpting techniques were adopted to modify surface geometries and to add details.

2.1. The high resolution 3D survey of the torso

The torso was surveyed using a Konica Minolta Range 7 triangulation laser scanner. During survey campaign, the main difficulties arose due to to the geometric complexity of cloak and tunic, since they present deep convexities that required redundant scans and long post processing of data (i.e. in the manual closing of small lacks).

The survey of the whole torso required the capturing of 300 scans that were aligned, merged and topologically corrected in order to provide a high resolution 100 million polygonal mesh that was afterwards decimated in order to be easily manipulated.

2.2. The 3D survey of fragments from other finds

For the reconstruction of the shape and arrangement of legs and arms derived from the bronze statue of Augustus of Prima Porta, a Nikon D90 camera equipped with an AF-S DX Nikkor 18-105 mm lens was adopted. Images were processed using a well-known pipeline and the tools integrated in the Agisoft PhotoScan package.

The rebuilt mesh was afterwards manipulated in order to add missing details, such as, for example, wrinkles near articulations and nails. Furthermore, other 3D sculpting tools were adopted to scale and modify the arrangement and the overall shape of limbs and integrate them with the torso.

2.3. The sculpting of missing elements and the whole integrated 3D model

The 3D model of the head was entirely sculpted inside a 3D digital environment using the Pixologic Sculptris package. Nero's characteristic features were sculpted through the detection of visual references on pictures of its marble reference portrait from Olbia (Fig. 1d).

This visual matching allowed the intuitive detection of symmetries and evaluation of sizes.

Some details were afterwards modified in order to adapt features, build and hairstyle to the age of the torso, which is supposed to represent Nero at a more mature age with respect to the reference portrait (Fig. 1e).

3. Conclusions and future works

The present project shows how 3D digital technologies can provide effective graphic representations that can easily and intuitively communicate the results of deep and complex analysis and therefore support the work of archaeologists and historians involved in the interpretation and reconstruction of history.

From a scientific point of view, we are aware that no reconstruction will ever return the original statue, because no source is available to describe them precisely. This reconstruction of the monument can therefore be only one of many possible.

Nevertheless, from an archaeological point of view, being able to communicate a plausible reconstruction of the original look of the statue to a non-specialist audience represents a very important challenge and task.

In addition to this aspect, the model has an unquestionable documentary value and it also allows the combination of geometric 3D reality-based data with radiometric information captured through multispectral investigations that are actually being held in order to identify traces of pigments on the torso and restore the original colors of the statue (Baraldi *et al.* 2014).

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