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3D-IMP-ACT

VIRTUAL REALITY AND 3D EXPERIENCES TO IMPROVE TERRITORIAL ATTRACTIVENESS, CULTURAL HERITAGE, SMART MANAGEMENT AND TOURISTIC DEVELOPMENT

OUTPUT T.2.2

3D artefacts for enhanced and inclusive fruition of historic sites

Politecnico di Bari

MiBACT POLO MUSEALE DELLA PUGLIA

IKTK INSTITUTI KOMBËTAR I TRASHËGIMISË KULTURORE

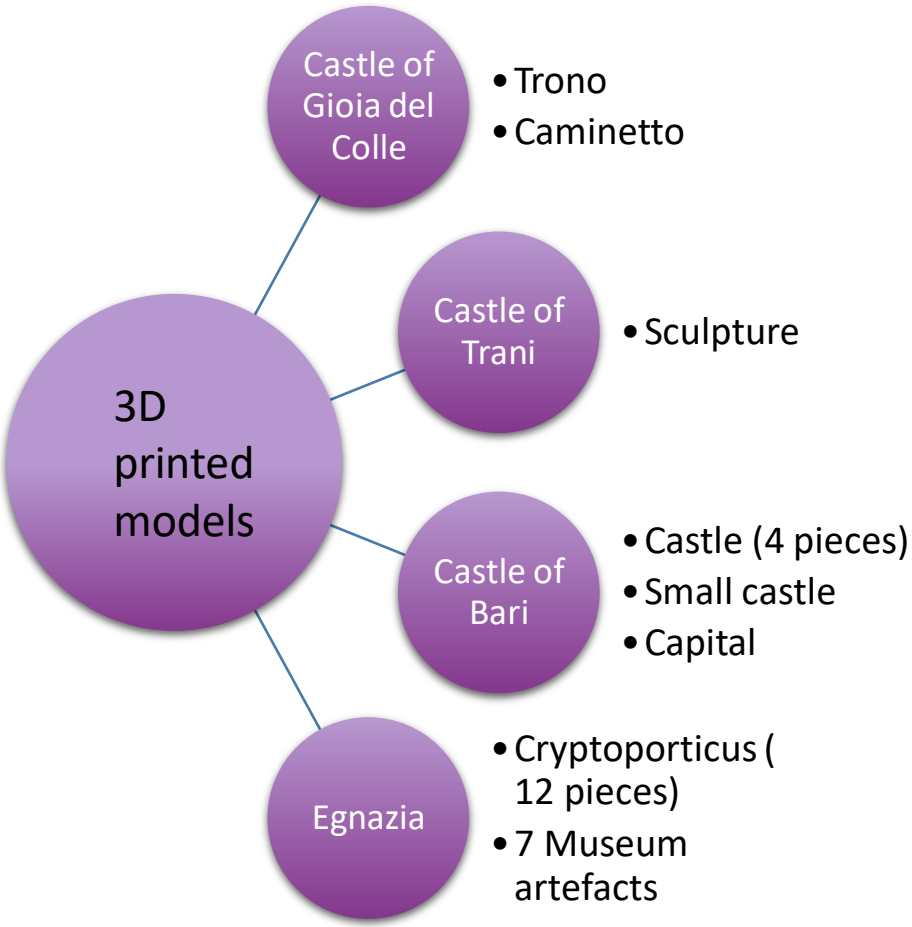
UPT 1951 1991

UCG Univerzitet Crne Gore

3D modelling and 3D printing of cultural heritages and museum artefacts

The combination of reverse engineering techniques and 3d printing technologies is a consolidated way of reproducing cultural heritage artefacts as solid 3d objects.

Photogrammetric acquisition → 3d model Reconstruction → Mesh repair and support generation → 3d Printing


3D printed models
Castle of Gioia del Colle
• Trono
• Caminetto
Castle of Trani
• Sculpture
Castle of Bari
• Castle (4 pieces)
• Small castle
• Capital
Egnazia
• Cryptoporticus (12 pieces)
• 7 Museum artefacts

SITE 1

Castle of Gioia del Colle

The Norman Swabian Castle of Gioia del Colle is one of the most interesting examples of fortified architecture in Puglia was built in the first half of the 13th century by Federico II.

Reverse Engineering through Photogrammetry: *Sala del Trono, Throne and chimney*
3D printed models: *Throne and chimney*

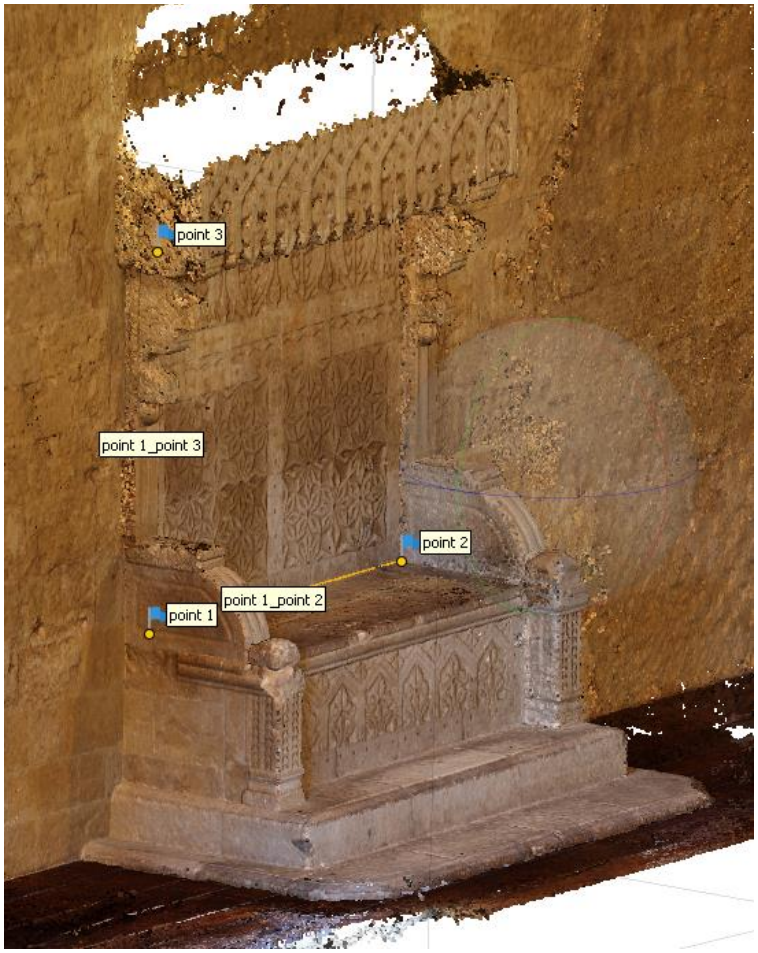
ACTIVITIES

Photogrammetric data elaboration

3D printing of photogrammetric models

Castle of Gioia del Colle - *Throne*

3D photorealistic model creation through pictures acquired by high definition camera (Sony-QX1) on telescopic bar and elaborated using Agisoft softwares (Photoscan and Metashape).



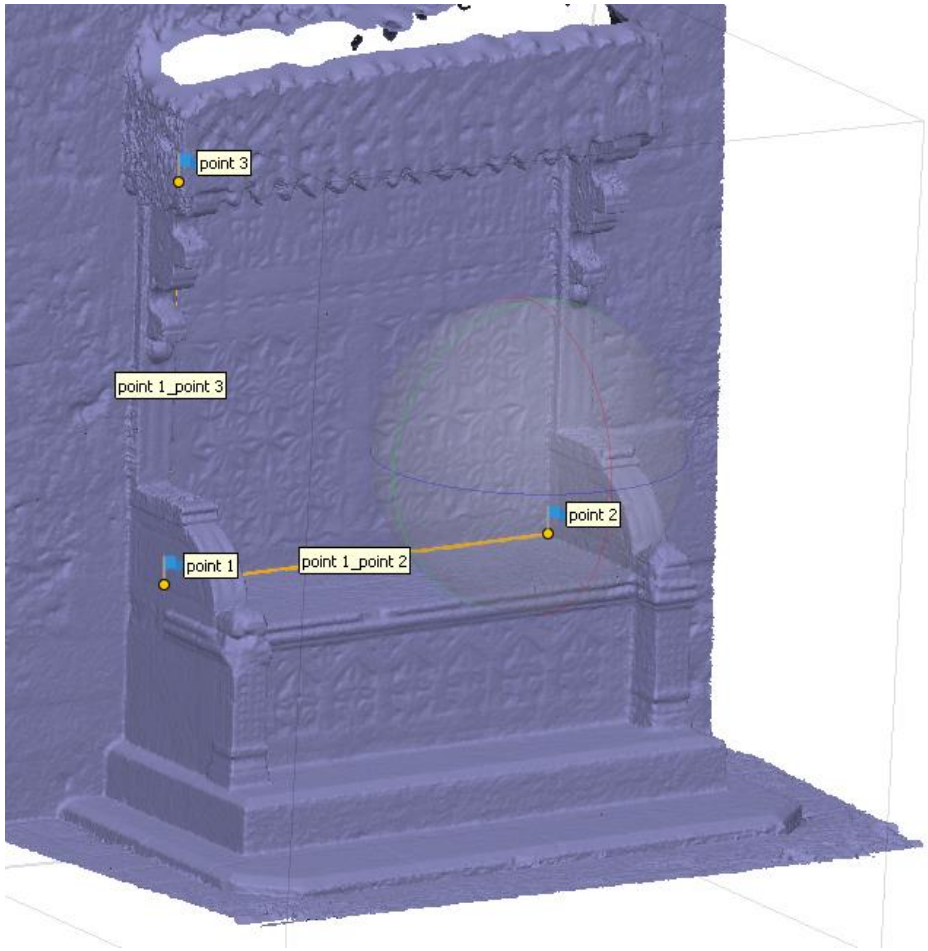
Dense point clouds construction

ACTIVITIES

Photogrammetric data elaboration

3D printing of photogrammetric models

Castle of Gioia del Colle - *Throne*



Meshes construction

ACTIVITIES

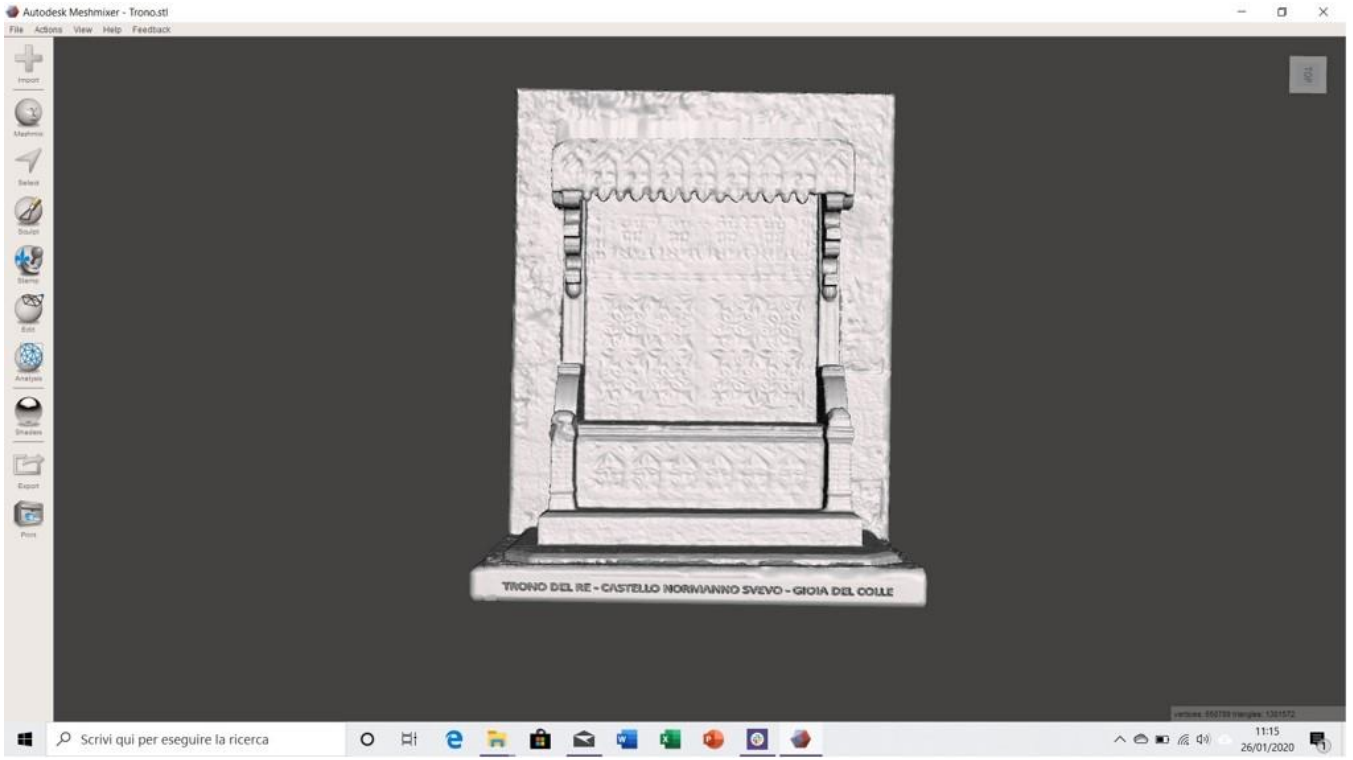
Photogrammetric data elaboration

3D printing of photogrammetric models

Castle of Gioia del Colle - *Trono*

3D printing of photogrammetric models:

3D meshes repair and Supports generation by Autodesk Meshmixer software, Toolpaths generation by Ultimaker Cura software and 3D printing using Wasp 4070.



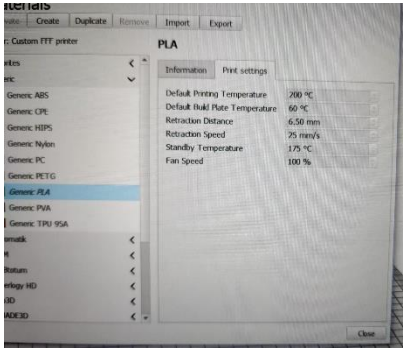
ACTIVITIES

Photogrammetric data elaboration

3D printing of photogrammetric models

Castle of Gioia del Colle - *Trono*

3D printing of photogrammetric models:
3D printing using Wasp 4070



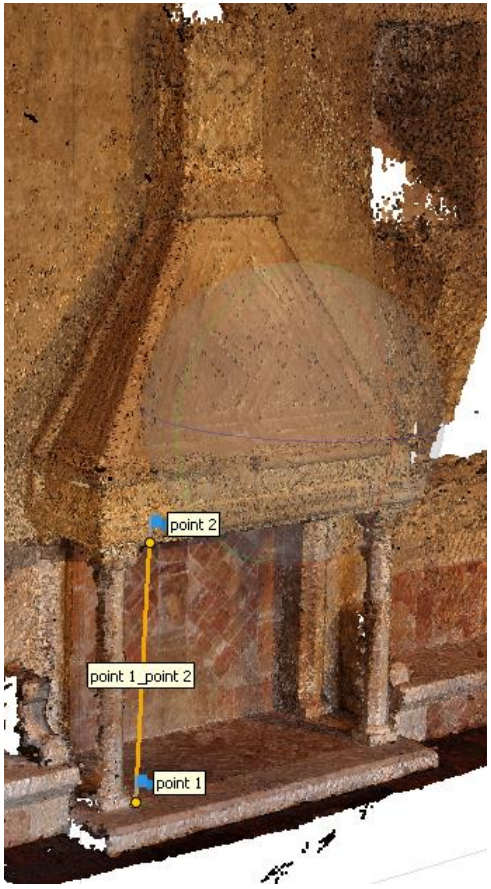
ACTIVITIES

Photogrammetric data elaboration

3D printing of photogrammetric models

Castle of Gioia del Colle - *Chimney*

3D photorealistic model creation through pictures acquired by high definition camera (Sony-QX1) on telescopic bar and elaborated using Agisoft softwares (Photoscan and Metashape).



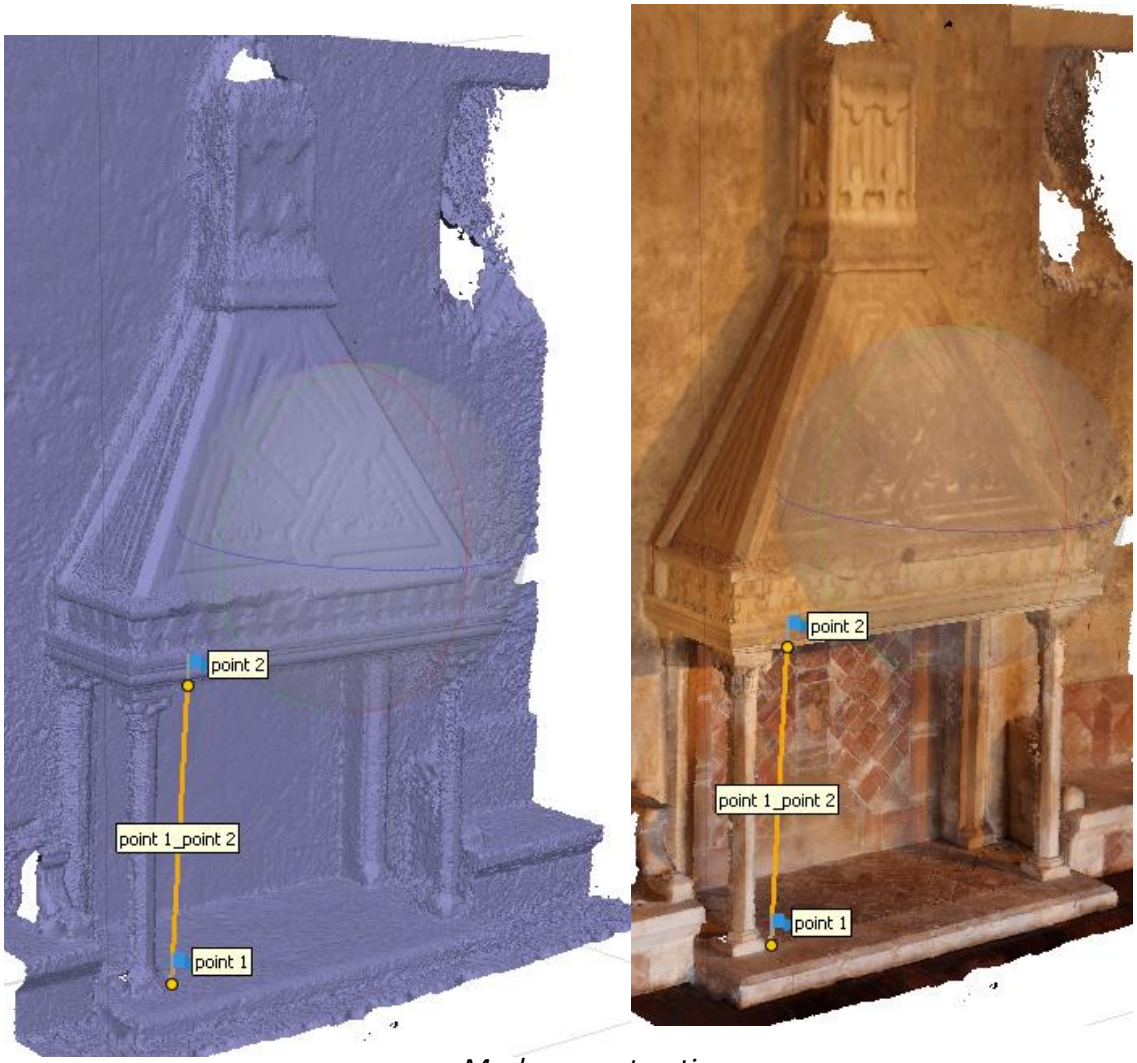
Dense point clouds reconstruction

ACTIVITIES

Photogrammetric data elaboration

3D printing of photogrammetric models

Castle of Gioia del Colle - *Chimney*



Meshes construction

ACTIVITIES

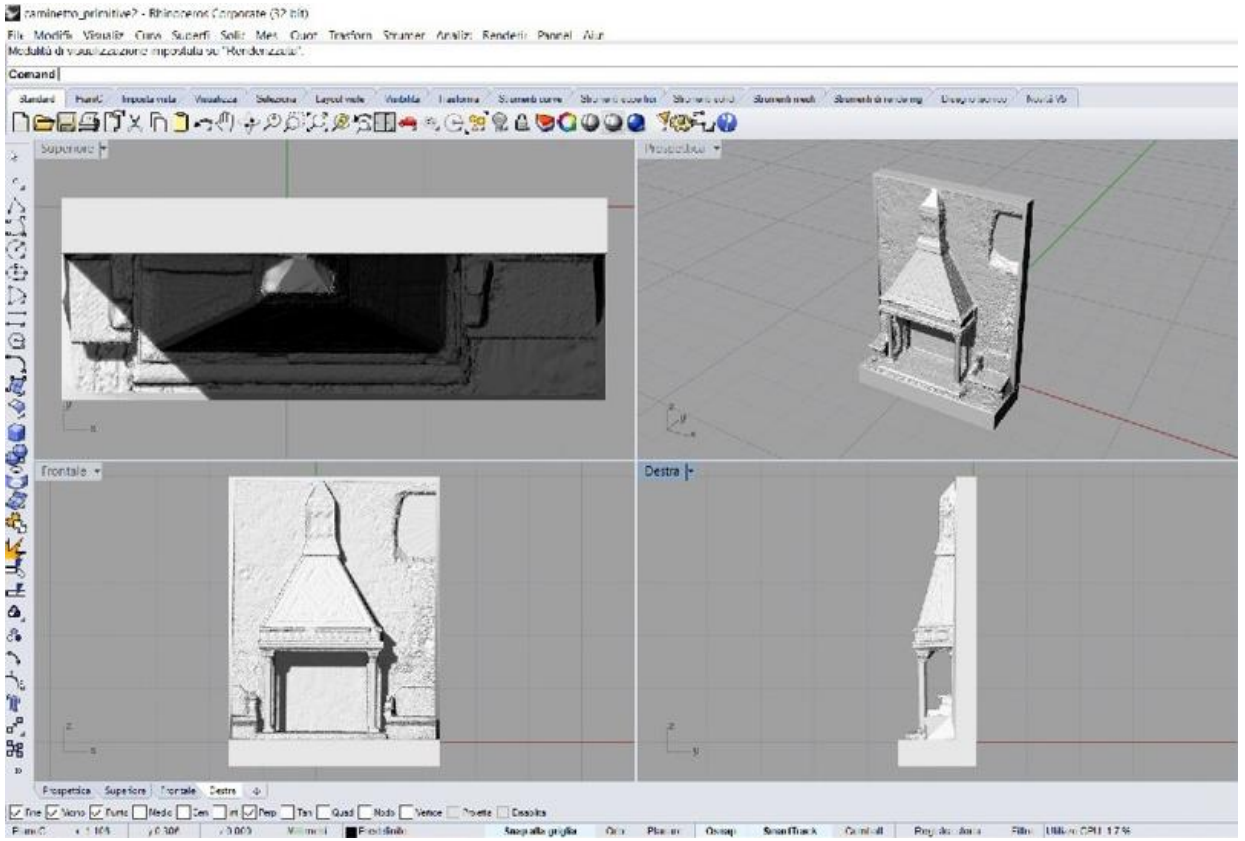
Photogrammetric data elaboration

3D printing of photogrammetric models

Castle of Gioia del Colle - *Chimney*

3D printing of photogrammetric models:

3D meshes repair by Rhinoceros software, Supports generation by Autodesk Meshmixer software, Toolpaths generation by Ultimaker Cura software and 3D printing using Wasp 4070.



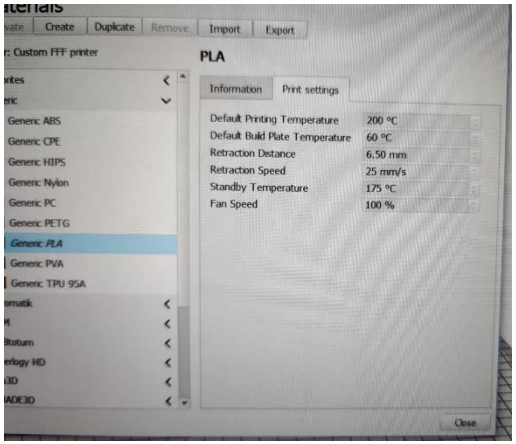
ACTIVITIES

Photogrammetric data elaboration

3D printing of photogrammetric models

Castle of Gioia del Colle - *Chimney*

3D printing of photogrammetric models:
3D printing using Wasp 4070.



SITE 2

Castle of Bari

ACTIVITIES

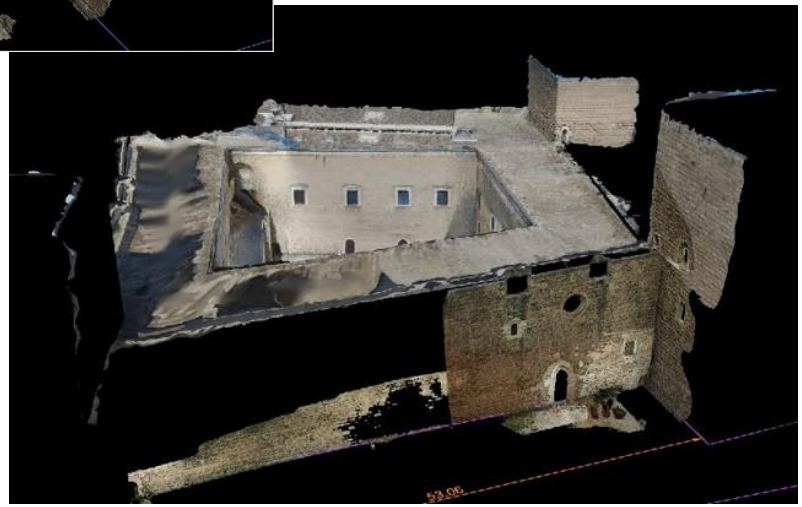
Photogrammetric data elaboration

3D printing of photogrammetric models

Castle of Bari - *central Courtyard*

3D printing of photogrammetric models:

3D meshes repair by Rhinoceros software, Supports generation by Autodesk Meshmixer software, Toolpaths generation by Ultimaker Cura software and 3D printing using Wasp 4070.



ACTIVITIES

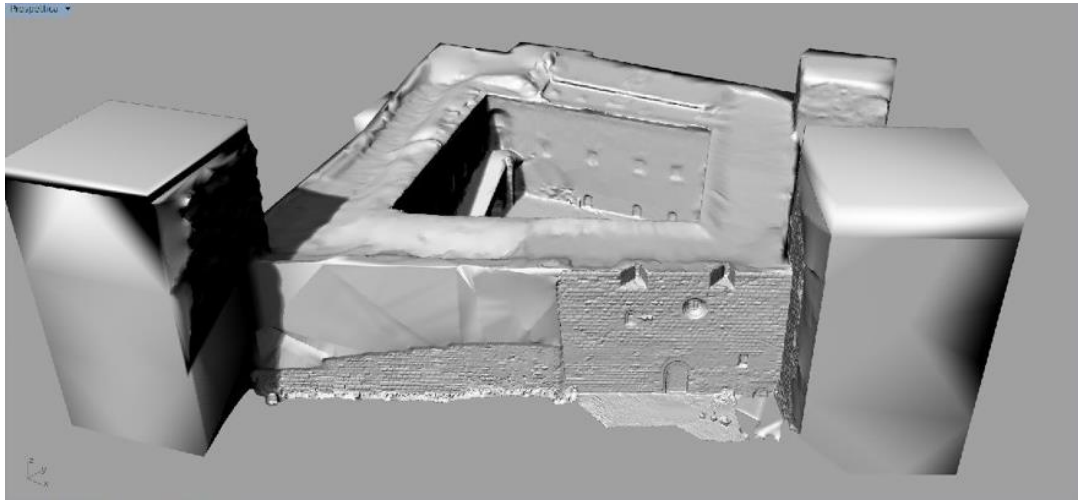
Photogrammetric data elaboration

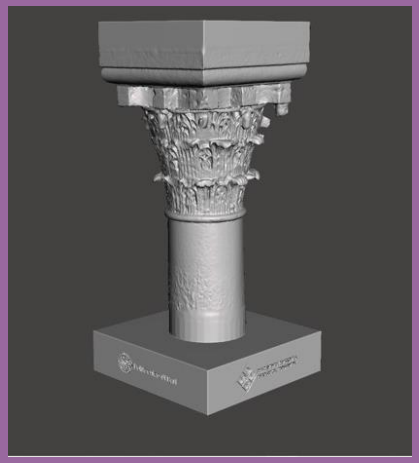
3D printing of photogrammetric models

Castle of Bari - *central Courtyard*

3D printing of photogrammetric models:

3D meshes repair by Rhinoceros software, Supports generation by Autodesk Meshmixer software, Toolpaths generation by Ultimaker Cura software and 3D printing using Wasp 4070.





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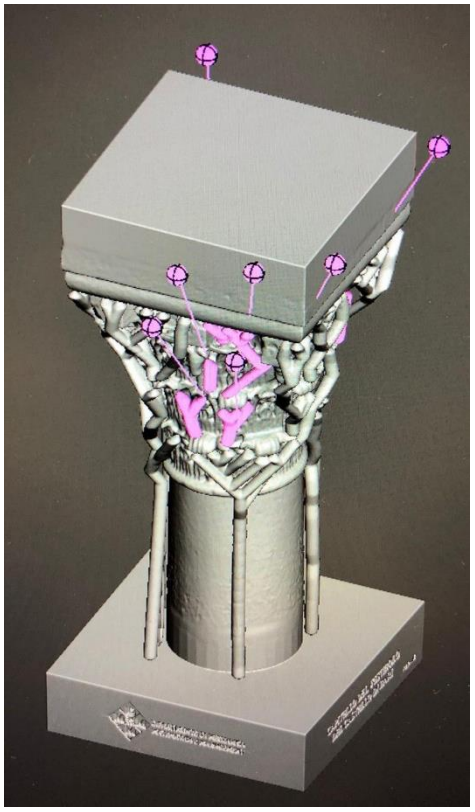
ACTIVITIES

Photogrammetric data elaboration

3D printing of photogrammetric models

Castle of Bari - *column capital*



ACTIVITIES

Photogrammetric data elaboration

3D printing of photogrammetric models

Castle of Trani - *architectural detail*

SITE 3

Archeological park of Egnazia

The Archaeological Park of Egnazia is a site of great importance and cultural interest inserted in a naturalistic landscape and environmental context of remarkable level. The site preserves the traces of all the dominations of Egnazia, from the fortified Bronze Age village to the medieval village of the 13th century AC.

Reverse Engineering through Photogrammetry:

Criptoportico (aerial photogrammetry and close range photogrammetry)

Museum artefacts (close range photogrammetry)

3D printed models:

a) Cryptoporticus (12 pieces),

b) Museum Artefacts:

1) *Attis head (2 pieces)*
2) *Big prayer*
3) *small prayer*
4) *seated figure 1*
5) *seated figure 2*
6) *pomegranate*
7) *quince*

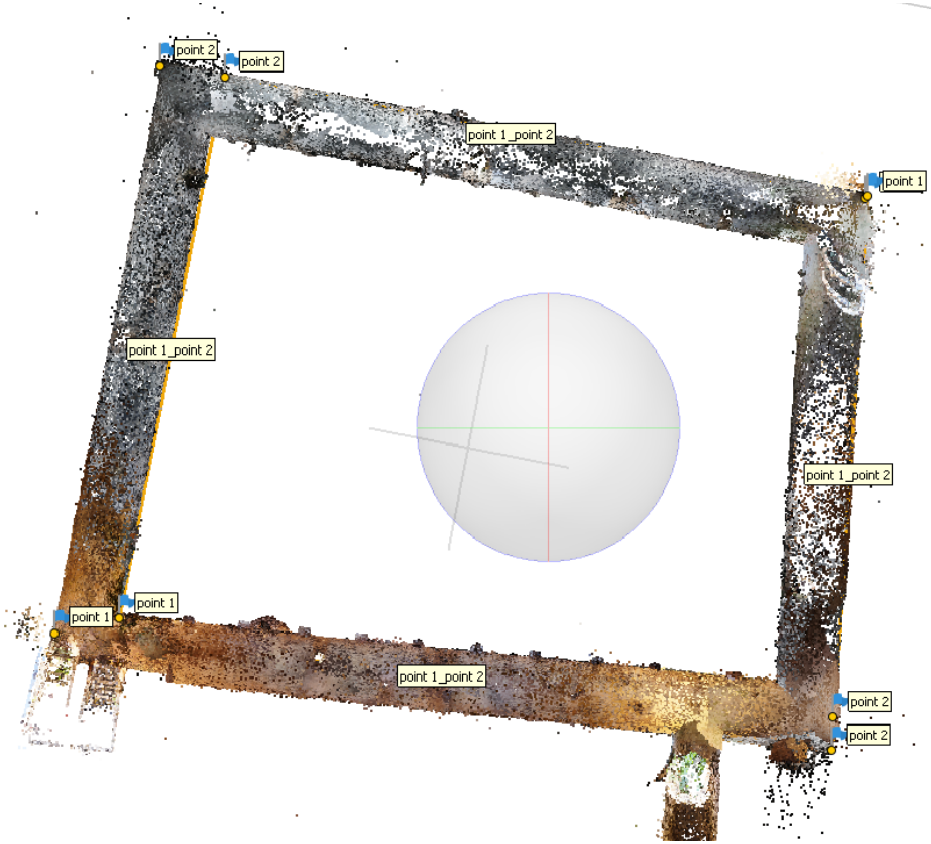
ACTIVITIES

Photogrammetric data elaboration

3D printing of photogrammetric models

Archaeological Park Of Egnazia – *Criptoportico* (inside)

3D photorealistic model creation through pictures acquired by high definition camera (Samsung-NX2000 and Sony-QX1) on telescopic bar and elaborated using Agisoft softwares (Photoscan and Metashape). The four sides have been processed separately and then they were registered.



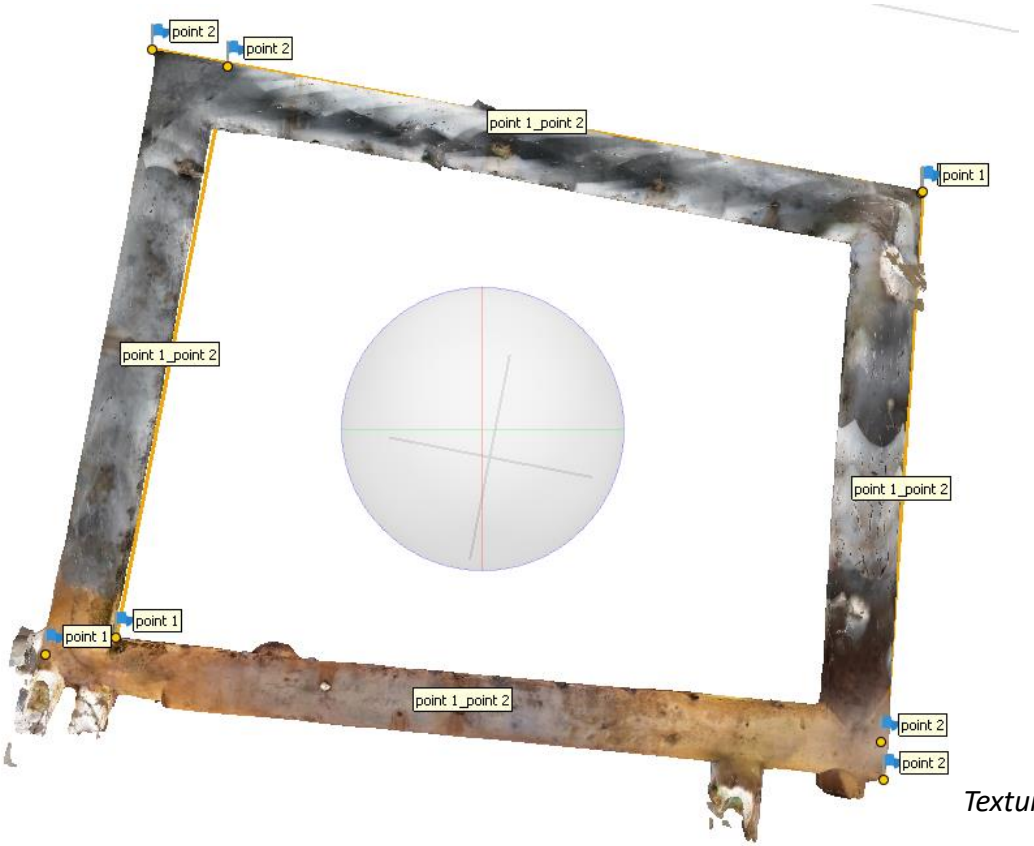
Photos alignment (736 cameras)

ACTIVITIES

Photogrammetric data elaboration

3D printing of photogrammetric models

Archaeological Park Of Egnazia – *Criptoportico* (inside)



Textured 3D model

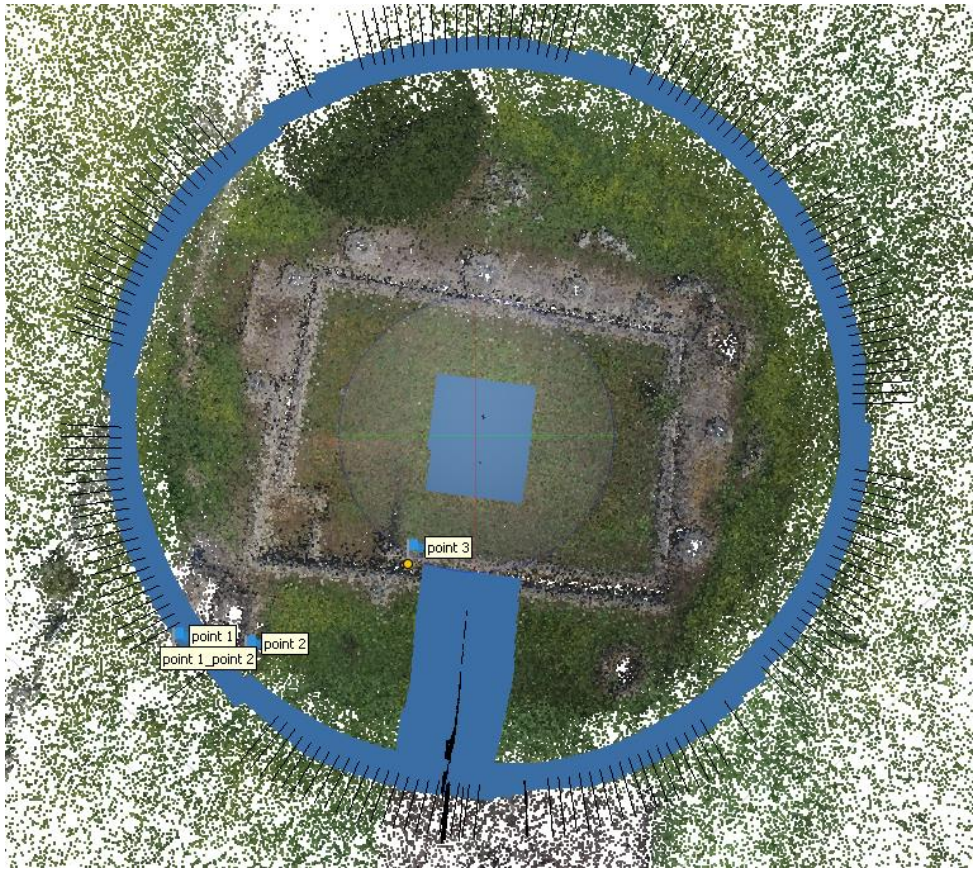
ACTIVITIES

Photogrammetric data elaboration

3D printing of photogrammetric models

Archaeological Park Of Egnazia – *Criptoportico* (outside)

3D photorealistic model creation through Agisoft softwares (Photoscan and Metashap). The frames were captured from video made using UAV (DJI Inspire).



Photos alignment (242 cameras)

ACTIVITIES

Photogrammetric data elaboration

3D printing of photogrammetric models

Archaeological Park Of Egnazia – *Criptoportico* (outside)

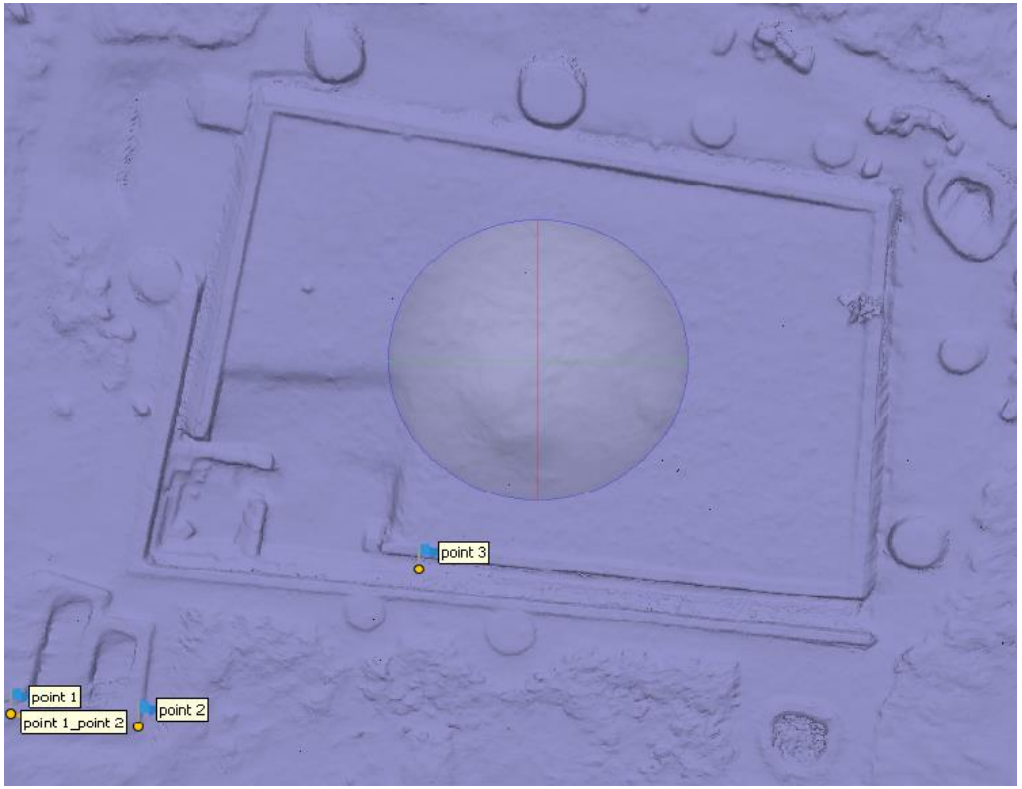
Dense point clouds construction

ACTIVITIES

Photogrammetric data elaboration

3D printing of photogrammetric models

Archaeological Park Of Egnazia – *Criptoportico* (outside)



Meshes construction

ACTIVITIES

Photogrammetric data elaboration

3D printing of photogrammetric models

Archaeological Park Of Egnazia – *Criptoportico* (outside)

Textured 3D model

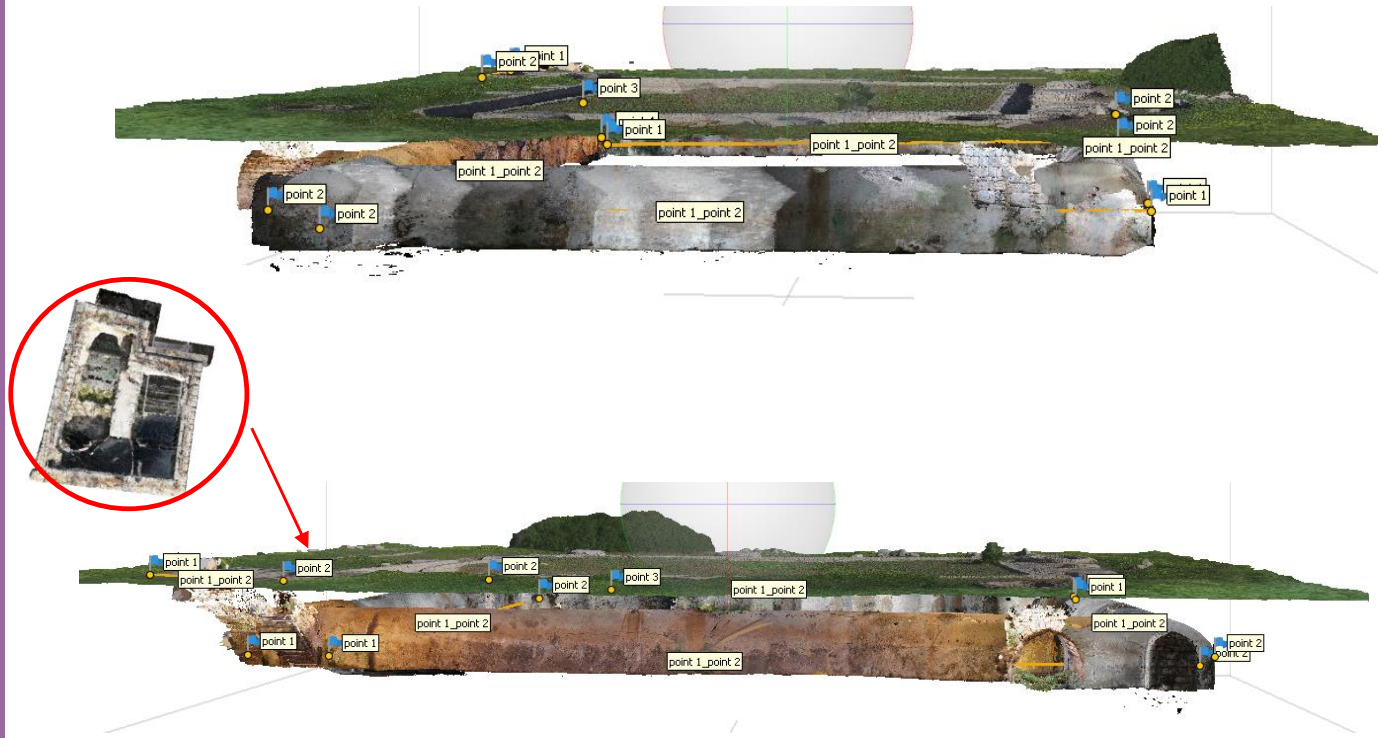
ACTIVITIES

Photogrammetric data elaboration

3D printing of photogrammetric models

Archaeological Park Of Egnazia – *Criptoportico* (inside and outside)

The inside and outside parts of Criptoportico have been aligned and merged.



ACTIVITIES

3D printing

3D printing of photogrammetric models

3d printed modular structure of the Criptoportico

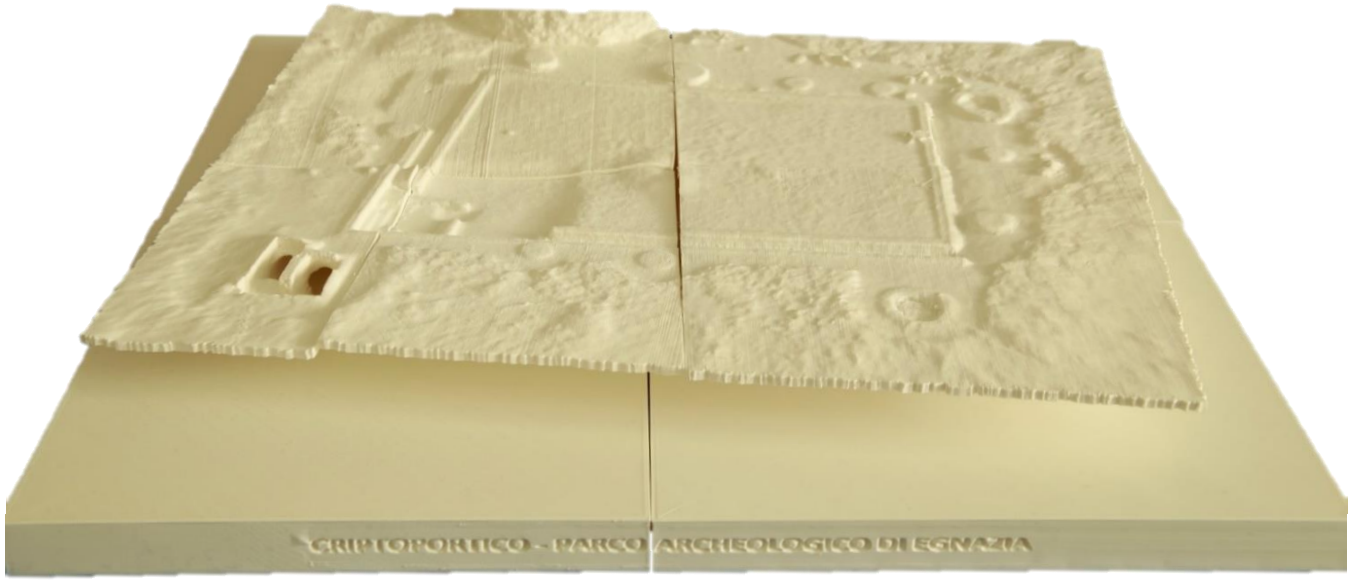
ACTIVITIES

3D printing

3D printing of photogrammetric models

3d printed modular structure of the Criptoportico (exterior+interior)

(12 pieces)



SITES

Archeological park of Egnazia

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3D printed models:

a) *Cryptoporticus (12 pieces),*

b) ***Museum Artefacts:***

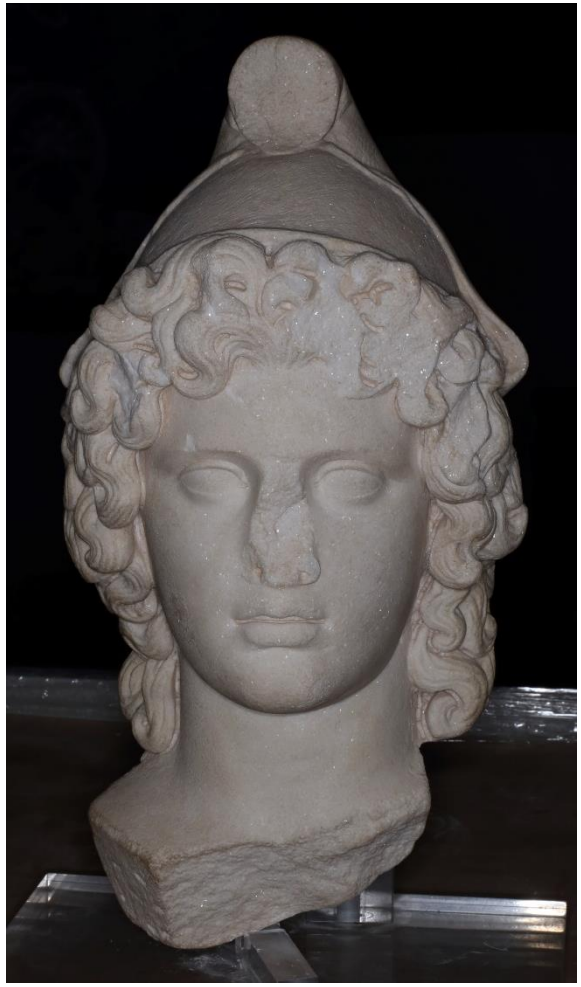
1) ***Attis head (2 pieces)***
2) ***Big prayer***
3) ***small prayer***
4) ***seated figure 1***
5) ***seated figure 2***
6) ***pomegranate***
7) ***quince***

ACTIVITIES

3D printing

3D printing of photogrammetric models

- **Photogrammetric acquisition**
  - Sensor: Full frame Canon EOS 6D (20.2 Megapixel)
  - Lens: 100 mm



ACTIVITIES

3D printing

3D printing of photogrammetric models

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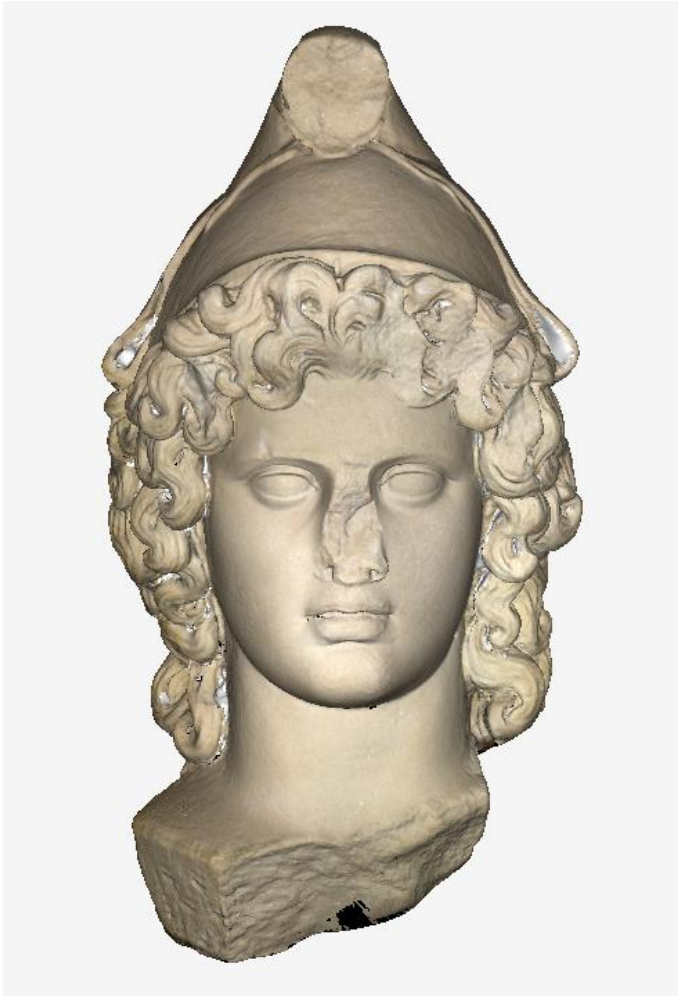
❖ **Digital model** processed with Agisoft Metashape

Parameter	Value
Number of processed images	80
Ground Sampling Distance (GSD)	0.0886 mm/pixel
Point Cloud [n points]	3,210,000
Mesh [n of faces]	975,000



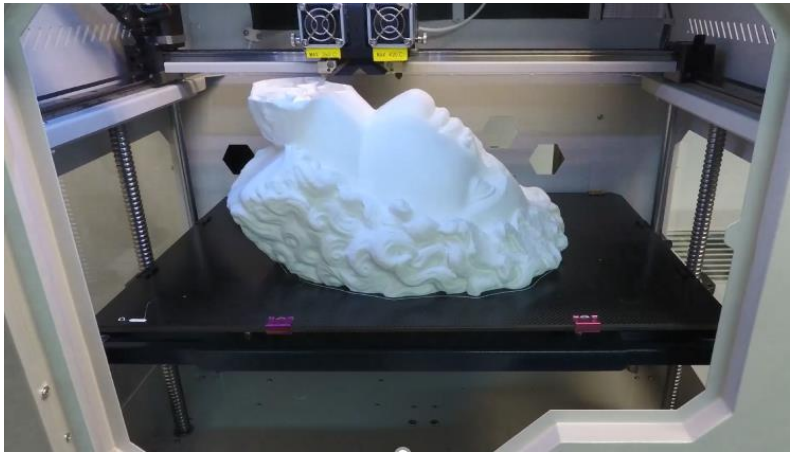
ACTIVITIES

3D printing

3D printing of photogrammetric models

❖3D printing of the digital model

- ❖ **Technology:** Fused Filament Fabrication (FFF) 3d printer
- ❖ **Material:** PLA



ACTIVITIES

3D printing

3D printing of photogrammetric models

❖3D printing of the digital model

- ❖ **Technology:** Fused Filament Fabrication (FFF) 3d printer
- ❖ **Material:** PLA

ACTIVITIES

3D printing

3D printing of photogrammetric models

- **Photogrammetric acquisition**
  - Sensor: APS-C Canon EOS 760D (24.2 Megapixel)
  - Lens: 50 mm

ACTIVITIES

3D printing

3D printing of photogrammetric models

❖Digital model

Parameter	Value
Number of processed images	79
Ground Sampling Distance (GSD)	0.0765 mm/pixel
Point cloud [n of points]	950,000
Mesh [number of faces]	800,000

ACTIVITIES

3D printing

3D printing of photogrammetric models

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3D printed model of
Big prayer

- **3D printed model**
  - **Technology:** Fused Filament Fabrication (FFF)
  - **Material:** PLA "terracotta"

3D printed model before support removal

«Orante»

ACTIVITIES

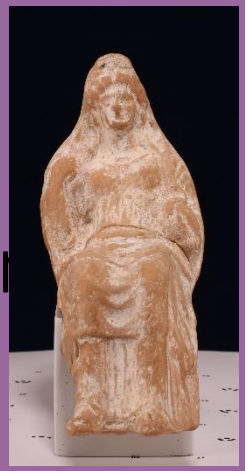
3D printing

3D printing of photogrammetric models

- **3D printed model**
  - **Technology:** Fused Filament Fabrication (FFF)
  - **Material:** PLA "terracotta"

3D printed model of *Small prayer*

Small prayer



ACTIVITIES

3D printing

3D printing of photogrammetric models

- **3D printed model**
  - **Technology:** Fused Filament Fabrication (FFF)
  - **Material:** PLA "terracotta"

3D printed model of *seated figure 1*

3D printed model of *seated figure 2*

ACTIVITIES

3D printing

3D printing of photogrammetric models

❖3D printed models

- ❖ **Technology:** Fused Filament Fabrication (FFF)
- ❖ **Material:** PLA "terracotta"

3D printed model of *quince*

3D printed model of *pomegranate*