# Final Report: photogrammetry

**Digital 3D - photogrammetry modelling of selected artefacts from the collection of the Museum of Byzantine Culture, Thessaloniki, Greece.**

*A project by:*

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*This final report aims to document the purpose, scope and goals of a low budget project that has been developed and undertaken to create digital 3D models of a selection of objects from the collection of the Museum of Byzantine Culture, Thessaloniki. The models were created using photogrammetry that has proven to be an efficient, user - friendly and low budget documentation technique, easily applicable to archaeology and cultural heritage. The project work has been divided into two main sections: a) data collection (taking photographs) in the museum environment) b) data processing and model building. At the end of the museum work section of the project, 35 artefacts have been photographed and will be digitally modelled in the upcoming months. The project has been made possible by the financial support of the Archaeological Institute of America and cooperation of the Museum of Byzantine Culture, Thessaloniki.*

## THE PROJECT

### Photogrammetry Technique

The Photogrammetry technique can be defined as the science, art and technology of obtaining accurate information about physical objects and the environment through the processes of recording, measuring and interpreting photography images. The basic principle of photogrammetry mimics the natural ability of human depth perception. The ability of three dimensional vision is a result of the offset in perspective centers between the left and right eyes. Digital images created to simulate this perspective shift are referred to as stereoscopic or stereo. The succession of stereoscopic images taken from consecutive positions with an overlap about 60% are subsequently processed through computer software to create 3D images. Compared to other techniques such as laser scanning, photogrammetry is affordable and relatively user-friendly and can be applied to many physical objects such as archaeological artefacts, buildings and topographical features of an area.

### Museum of Byzantine Culture, Thessaloniki, Greece:

Founded in 1994, the museum is currently one of the most important cultural entities of the city of Thessaloniki. The monastic architectural design of the museum is a homage to the city´s Byzantine past. The museum houses a remarkably diverse collection that can illustrate the religion, culture and daily life of the period.

## OBJECTIVES

The main aim of this project has been the construction of digital 3D models of the artefacts from the collection of the Museum of Byzantine Culture, Thessaloniki, Greece. Once complete and made available to the museum, these models can be shared online (the museum´s official website or a dedicated "sketchup" profile) with the public. Furthermore, photogrammetry has proven to be an effective tool for documenting archaeological objects and structures as well as museum collections. Therefore it is hoped that this (relatively) small collection of 3D models will be a valuable tool for the museum staff such as conservators and researchers who will be able to visually inspect the modelled objects through different angles and lighting conditions.

Through this internship my personal aims have been to:

– Develop and execute a research project independently,
– Gain practical and professional experience in a museum environment,
– Transform the theoretical training I received in photogrammetry into practice and develop skills for Ph.D. level studies.
– Establish professional contacts in the cultural heritage field in Greece.

## TIMEFRAME





- 6 August: *funds received,*
- 6 August - 22 August: *equipment purchases and preparation,*
- 22 August  - 20 September: *internship - data collection at the museum,*
- 20 September onwards - *data processing - model building,*

Notes:

Because of budget limitations, the time spent at the museum environment had to be limited to a duration of 4 weeks. One of the reasons for this has been the fact that this project was designed considering a larger budget (aproximately 3000 Eur) but eventually had to be scaled-down.

While the budget provided by AIA has run out at the end of the first month, my dedication to the project remains solid and I will continue to work on the models to bring this internship project to a completion. In compliance with the museum´s request, I will be giving the ready models to the museum management who will publish them on the official museum website. On the other hand, should the AIA community wishes to see the models before the museum´s publishing process is complete, I can provide access to the models.

## METHODOLOGY:





To create the models, the following work-flow has been created.

### Lighting:
Visible light. 3 units of 50 x 70 cm soft box for continuous lighting. Each unit holds 5 energy saving lightbulbs with a total output of 2850W. The light temperature was ~5500K to imitate day - light conditions.

### Photography:
The objects were systematically photographed using the rules / guidelines recommended by Agisoft Photoscan Pro. software user´s manual. The photographs overlapped by at least 60%. In the camera, the output format was selected as RAW that facilitated post processing of the images.

### File management:
Once the files (photos) were acquired, they were systematically transferred to an external drive. Each museum object was allocated a separate folder and the processed images were stacked in separate folders according to their purpose / properties.



colour / white balance...difications    high contrast    Jpeg    raw    Tiff

*Yigit Z. Helvaci final report*

Before the images fed into the photogrammetry processing software, they were edited in Adobe Photoshop. The process included:

• conversion of RAW files into JPEG,
• exposure and colour - balance corrections
• increasing the contrast and sharpness of the images

These corrections have been a somewhat necessary part of the modelling process for a variety of reasons. To elaborate, the photogrammetry software cannot handle RAW files. The exposure and colour balance corrections increase the texture quality of the models (accuracy and aesthetics) and increased contrast and sharpness contribute to the performance and output quality of the photogrammetry software.
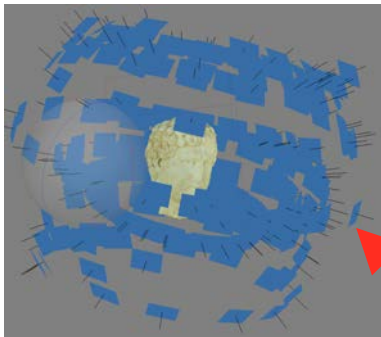
**Model Building**

The models have been created by using Agisoft - Photo-Scan Pro. version 1.2.6. for Mac.

In constructing the models, the general workflow imposed by the software was as follows:

Camera alignment
Dense point cloud
Build mesh
Build texture
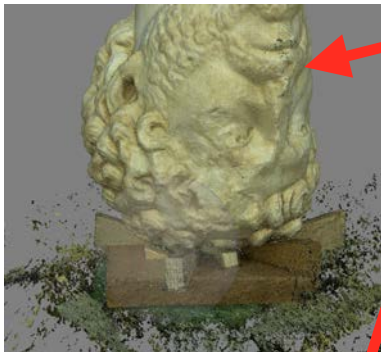
In general the following quality - detail settings have been used:

Camera alignment: medium or high depending on the amount of photographs.

Dense point cloud: medium or high

Build mesh: always highest possible setting in order to capture the surface topography of the objects as accurately as possible.

Build texture: standard

Note: Considering the average specifications of domestic or office computers, the models were not created in the highest available setting in order to facilitate handling.

**Computer specifications:**
Processor: 2 GHz Intel Core i7
Memory: 8 GB 1600 MHz DDR3
Graphics: Intel Iris Pro 1536 MB

**Model export:**
The created models were saved in the .psz format (photogammetry software) and as .obj files (a more universal file format for 3D objects). Furthermore, the constructed models were uploaded in the sketchup website. By the request of the museum, the uploaded models are password protected and currently not open for public viewing. The access information of some of the ready models have been provided in this report.

Some exported models can be viewed through the following links:

Gold bracelet: https://skfb.ly/SNIY
Marble head: https://skfb.ly/Trnn
Marble relief with Mother Mary: https://skfb.ly/SOCv
Sarcophagus with wall paintings: https://skfb.ly/TGPB

password for all the models: selanik

## RESULTS

During the museum internship period, I have been able to photograph thirty five objects from the museum collection. These objects were selected by the museum staff. The main criteria in selecting the objects were their size and significance for the museum collection. Overall, the artefacts that have been photographed represent a diverse set of objects including, marble architectural elements, floor mosaics, gold jewellery, wall paintings, sarcophagi and wooden panels. A complete list of the photographed objects is as follows:

| 1 | АГ - 3171 | marble column (left) |
|---|---|---|
| 2 | АГ - 3171 | marble column (right) |
| 3 | АГ - 3170 | marble arch |
| 4 | АГ - 3221 | marble pedestal |
| 5 | BT - 178 / 1 and BT - 178 / 2 | sarcophagus with wall paintings |
| 6 | BT - 165 | sarcophagus with wall paintings |
| 7 | АГ - 2491 | the good shepherd - table foot? |
| 8 | АГ - 1808 | marble slab - decoration element |
| 9 | BT - 156B -1 | sarcophagus with wall paintings - the end wall |

| 10 | BT - 156B | sarcophagus with wall paintings |
|---|---|---|
| 11 | BT - 156A -1 | sarcophagus with wall paintings - the end wall |
| 12 | BT - 156A | sarcophagus with wall paintings |
| 13 | BT - 200 | apse with wall paintings |
| 14 | АГ - 776 | marble slab - decoration element |
| 15 | АГ - 267 | marble slab - decoration element |
| 16 | АГ - 3130 | sandstone slab - decoration element |
| 17 | АГ - 3151 | marble slab - decoration element |
| 18 | АГ - 3152 | marble relief |
| 19 | АГ - 275 | marble slab - decoration element |
| 20 | ПΛ - 1 | marble slab |
| 21 | АГ - 775 | round marble decoration element |
| 22 | BT - 126 | arch piece with wall painting fragments |
| 23 | BEI - 339 | wooden icon panel |
| 24 | BEI - 97 | wooden icon panel |
| 25 | BEI - 162 a - kst | gilded church panel |
| 26 | АГ 3004 | marble head |
| 27 | АГ 774 | marble architectural element. stage. |
| 28 | АГ 913 | decorated marble door frame |
| 29 | АГ 4 | marble column head |
| 30 | АГ 772 | marble relief |
| 31 | АГ 275 | marble relief |
| 32 | | mosaic floor |
| 33 | | lead seal |
| 34 | BEI - 162 - detail | wooden icon panel |
| 35 | BKO 262 | gold bracelet with enamel decoration |

At this stage, I have been working on the processing of the raw data with very good results. The modelling of three objects have been complete and approximately ten other models are in the "build mesh" stage. Because the construction of the models (and the the manipulation of the software) requires a considerable level of trial and error, some models can take up to 3 days with my computer's specifications.

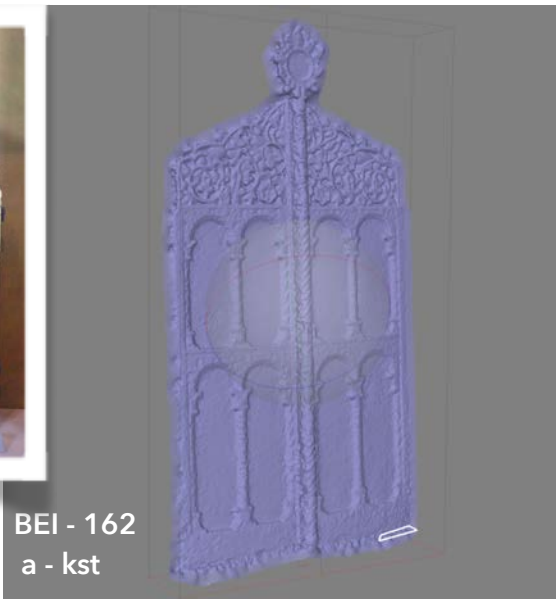Some illustrations to demonstrate the current stage of the modelling is as follows:
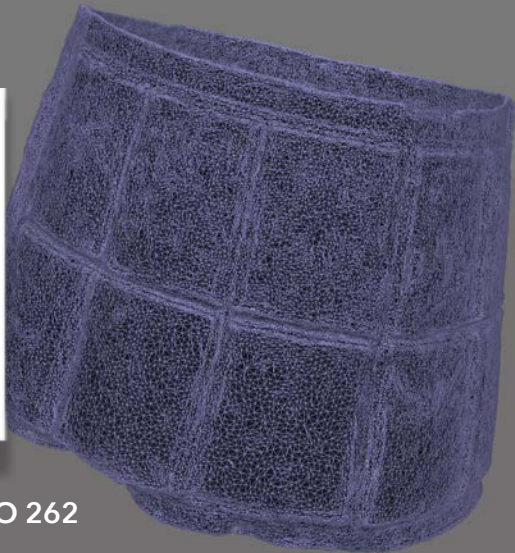
BEI - 162 a - kst
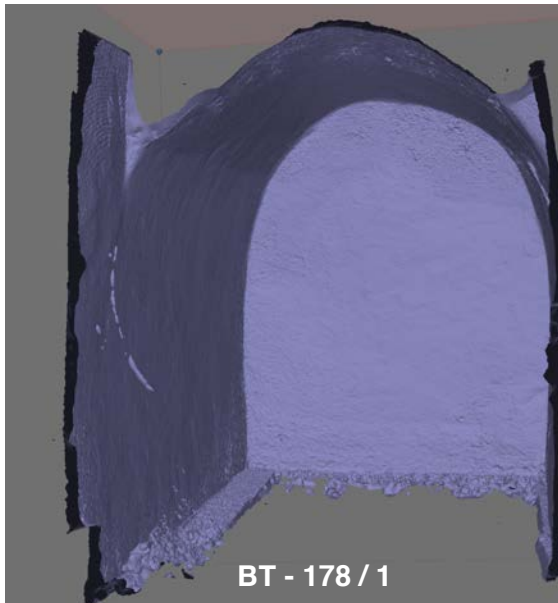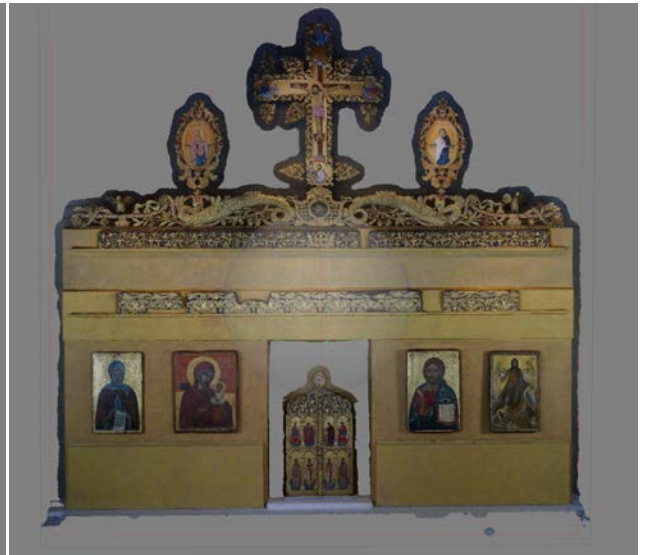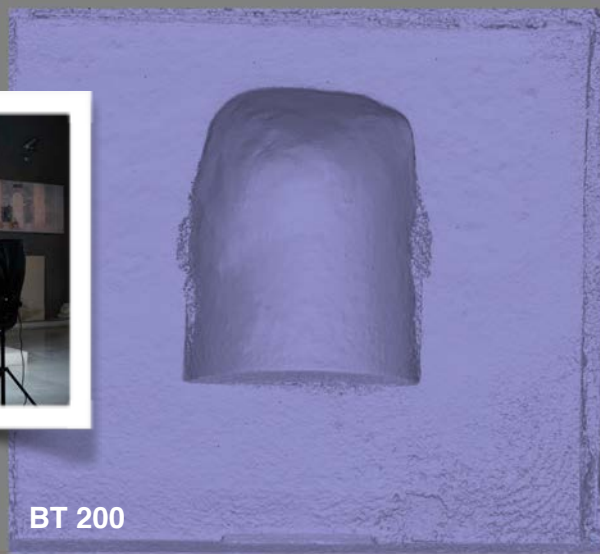
BT - 178 / 1

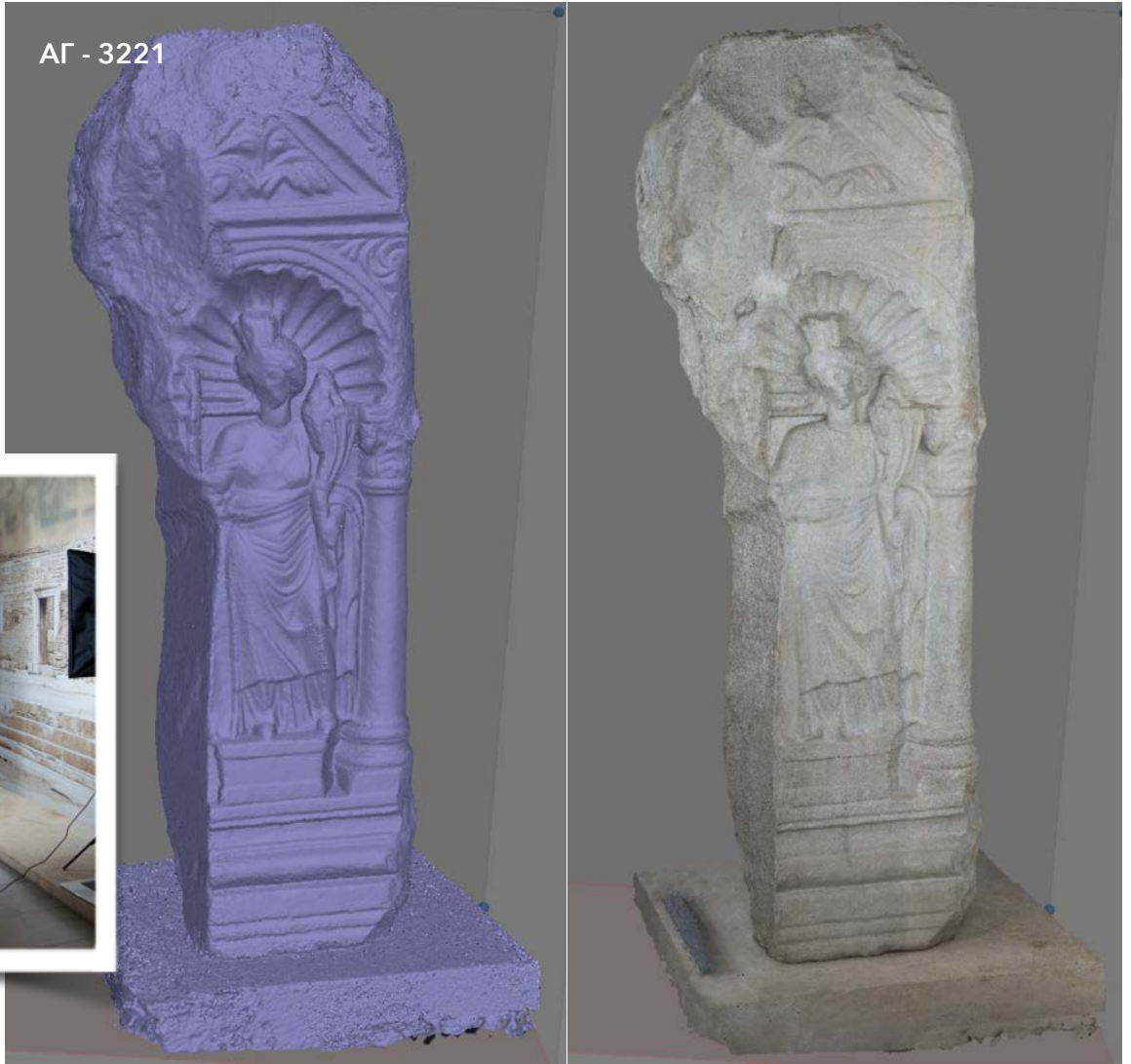BEI - 162
a - kst

АГ 3004
(finalised)

ВКО 262

BT 200

АГ - 3152

BEI 339

АГ - 3221

I am also hoping that the availability of these models will be a valuable tool for the museum conservators and other researchers. When the models are complete, the objects can be viewed from different angles and under different lighting conditions. Furthermore, by removing the surface image, the viewer can observe the surface topography which can contribute to a better understanding of the object´s conservation state. Furthermore the ability of manipulating the digitals models of the heavy objects in the digital platform should provide accessibility for the researchers.

# ACKNOWLEDGEMENTS