

ReInHerit WEBINAR



“Creating 3D Models with Photogrammetry - Low-Threshold Technologies for Small to Medium Museums and their Application on Cultural Heritage Objects”

24 March 2023 | 3:00-4:00 pm (CET)





Creating 3D Models with Photogrammetry

Low-Threshold Technologies
and their Applications on Cultural Heritage Objects

Workshop Scedule

1 - Introduction

2 - Short History of Photogrammetry

3 - Relevance and Challenges of Using 3D Models

4 - Basics of Photogrammetry

5 - Practical Example

6 - Expanding the Basics

7 - Challenges and Limitations for Cultural Heritage Objects

8 - Q&A

Introduction

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Multimedia Professional with background in
Photography and Video production

Digital Museology at GrazMuseum, Austria

Work on ReInHerit Digital Exhibitions, Collection and
Travelling Exhibition multimedia installations

Workshop aims:

Introduce basics of photogrammetry, show hands-on
examples and tips, discuss limitations and challenges

What is Photogrammetry?

Photogrammetry is the art, science, and technology of obtaining reliable information about physical objects and the environment through processes of recording, measuring, and interpreting photographic images and patterns of recorded radiant electromagnetic energy and other phenomena

Wolf and Dewitt, 2000; McGlone, 2004

Short History of Photogrammetry

1490s Leonardo da Vinci developed principles of perspective and projective geometry - basis of photogrammetry

1849 Aimé Laussedat used terrestrial photographs to conduct perspective architectural survey in Paris.

1867 Albrecht Meydenbauer and Otto Kersten coin the term

New inventions like airplane, satellite and false color film further the technology

Short History of Photogrammetry

1963 Lawrence Roberts submits his PhD at MIT on
,Machine Perception Of Three-Dimensional Solids'
discusses extraction of 3D information from 2D photographs

Since 2008 it is possible to create high-resolution 3D model
from overlapping photo set

Recommended OER resource on
Photogrammetry by Dr. Costas Papadopoulos:
<https://teach.dariah.eu/mod/hvp/view.php?id=860>



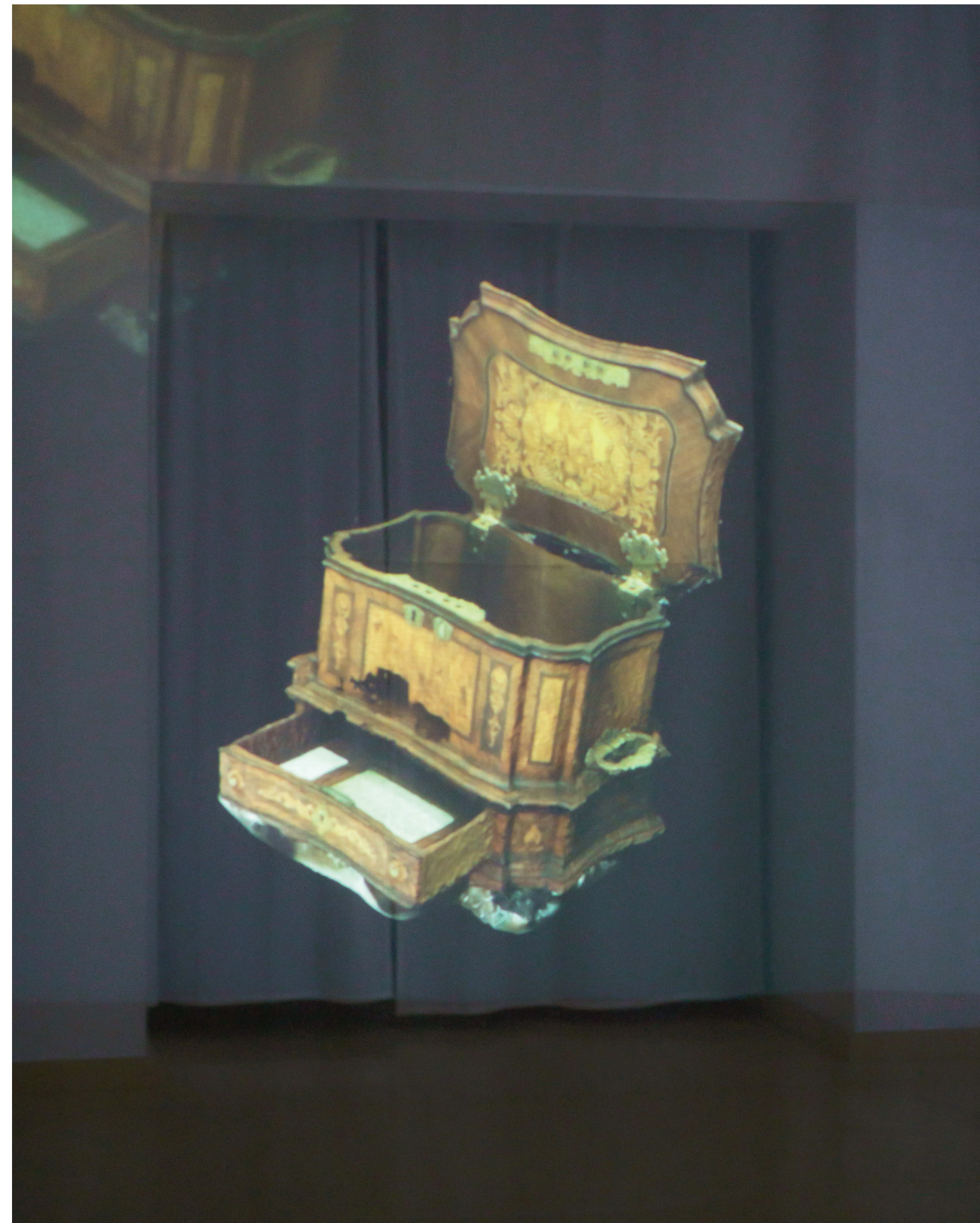
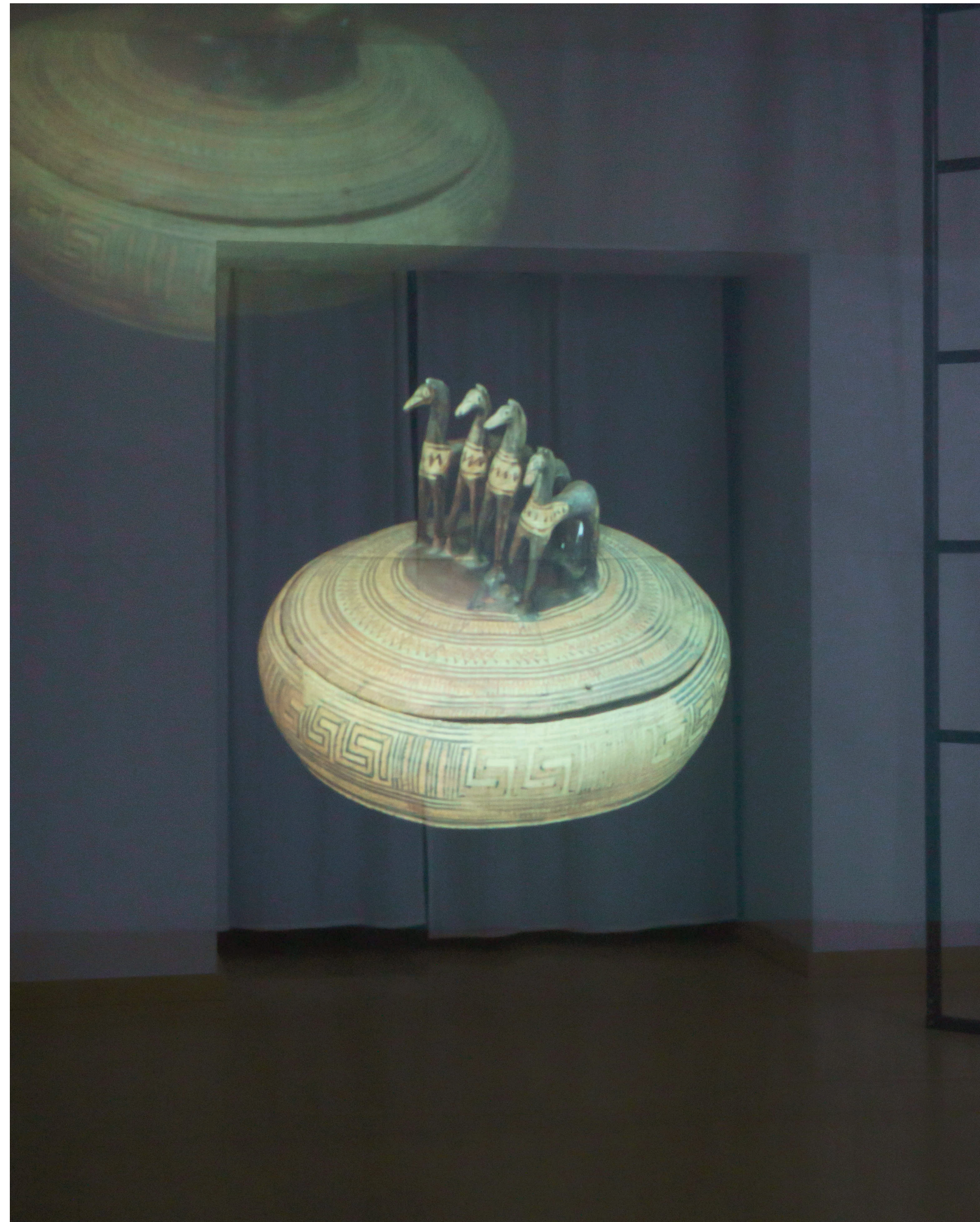
Relevance and Challenges of using 3D Models

3D models are relevant for efforts in digitization, preservation, presentation of Cultural Heritage objects

Offer new approaches to presenting objects in digital space

Enable easy exchange of digital objects between museums

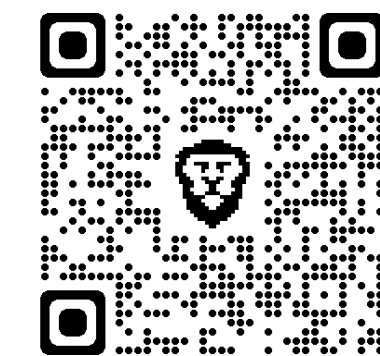
Enable inclusion of 3D objects in online formats



Case examples - 3D projection tests used in the ReInHerit travelling exhibitions



Explore the 3D model and learn more



Case example - 3D object embedded in ReInHerit Digital Exhibition

Relevance and Challenges of using 3D Models

Many external 3D scanning service providers are not specialized in working with CH objects

Especially small and medium size institutions lack resources needed to implement 3D models

Basic principles and tips by the Expert Group on Digital Cultural Heritage and Europeana:
<https://digital-strategy.ec.europa.eu/en/library/basic-principles-and-tips-3d-digitisation-cultural-heritage>



Basics of Photogrammetry

How does it work?

Photos of an object are taken from many different angles

The photos are loaded into a special software

The software generates a 3D model by calculating the geometry from reference points in the photos

Basics of Photogrammetry

What are the most important requirements for photos?

The object cannot be reflective or translucent
(not suitable for glass or reflective metal objects)

The photos must show overlapping parts of the object

The photos must not have harsh shadows on the object

The photos must not be blurry or out of focus

Basics of Photogrammetry

What basic equipment is needed?

A camera (higher quality smartphone or SLR with 50mm lens)

Diffuse light (daylight lamps or an overcast day to shoot outside)

A computer capable of running a photogrammetry software
(tip: computers marketed for gaming are mostly a good choice)

A photogrammetry software (various options, some free)

Basics of Photogrammetry

What is used in the demonstration?

Cameras: Sony A7III with 50mm lens and iPhone 12 pro

Software: Agisoft Metashape

Computer: MacBook Pro

Additional equipment shown: Adobe lightroom, darktable, tripod, daylight lamps, diffusors, a turntable, a glass plane, a polarization filter, Blender 3D modeling software

Basics of Photogrammetry

Some photogrammetry softwares:

Agisoft Metashape: not free but affordable, proprietary, intuitive UI, good quality output, Mac, Windows and Linux

RealityCapture: pay per export, intuitive UI, good quality models, only available for Windows

Meshroom: free, not as intuitive, quality not as reliable, only available for Windows

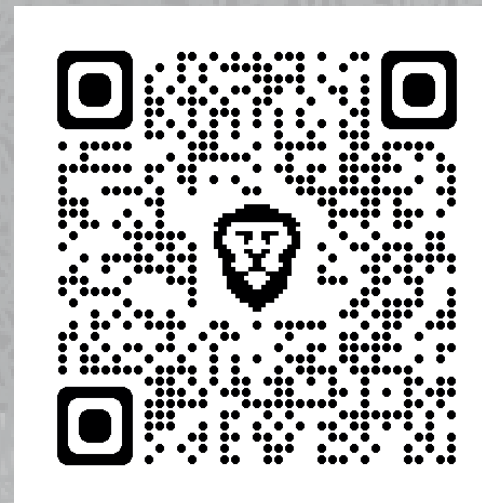
Other free options: Regard3D (for Mac), 3DS Zephyr - Free programs are generally less intuitive and less reliable

Basics Steps of Photogrammetry

- 1 - Prepare object
- 2 - Prepare equipment
- 3 - Prepare shooting location
- 4 - Set up object in shooting location
- 5 - Take photos
- 6 - Save photo in dedicated folder on computer
- 7 - Load photos into software and generate model
- 8 - Save project and export model

Practical Example

Video Demonstration



Expanding the Basics

Some options for expanding basic setup shown in video:

An electronic turntable and tripod for an alternative setup
(only works for objects with distinctive details!)

A diffuser for perfecting light (helps reduce shadows)

A polarization filter to eliminate/minimize reflections and glare

A photo editing software to perfect the photos for scanning

Expanding the Basics

Other potential expansions:

A color checker or grey card to help with white balancing

Scanning spray to digitize glass or reflective objects
(might not be suitable for working with delicate objects)

A scaling reference

(small reference object to help with correctly scaling the model)

Cloud Computing services to outsource computing
(e.g. Google Cloud Platform, renderro...)

...

Expanding the Basics

How much expansion of the basic setup is possible depends on time, resources and motivation

Perfecting photogrammetry methods is a matter of practice and willingness for self-study

Photogrammetry has expansive community online (game assets designers, 3D printing hobbyists etc.)

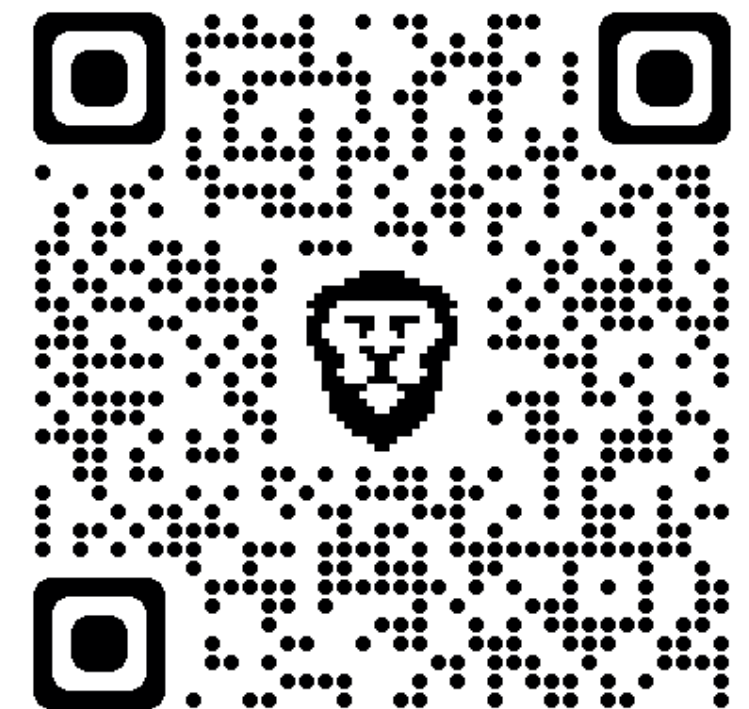
Many self-study resources available online (reddit forums, YouTube tutorials, blogs...)

Sharing 3D Models Online

Sharing starts with exporting your model - check your platform's data format requirements first and export accordingly

Sketchfab - Hosts 3D models online, models are embeddable and downloadable according to set user preferences

Free account has upload limits



Challenges and Limitations for Cultural Heritage Objects

Some objects are not suitable for photogrammetry
(glass, reflective materials...)

Objects might be too fragile to move to a shooting location

Institutions might not allow objects to be handled without the
assistance of qualified staff

Objects might be entirely unmovable and in
inaccessible locations (monuments, statues etc.)

Challenges and Limitations for Cultural Heritage Objects

Institutions might not have budget to invest in photography equipment, high performance computers, software...

Staff might not be qualified or able to invest time in training and learning about photogrammetry

Challenges and Limitations for Cultural Heritage Objects

Models produced with photogrammetry are not perfect reproductions

Limitations in accuracy can apply to texture, color, size
and proportions of objects

Limitations can be worked around by annotating models
and pointing out errors in reproduction

Inaccuracies occur especially when models are created
by inexperienced people

In Conclusion

Photogrammetry is a relatively accessible way of creating 3D models

It is possible to do with limited equipment and free programs

Despite limitations, photogrammetry can deliver usable results
for certain applications

The technique can be expanded and adapted at several levels

With some time investment in self-study,
photogrammetry is learnable for everyone

Thank You for your Attention!

Q&A

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