

# Representing a Roman Portrait

An investigation of archaeological digitisation

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## Abstract

This thesis aims to explore the uses for digitised information in the archaeological knowledge process, specifically on how it can be used when studying Roman portraits. By communicating the entire process from data acquisition and analysis to knowledge transmission and mediation, I hope to indicate strengths and weaknesses in the use of digital representations as a proxy for a physical artefact. The thesis also includes an intermedial analysis on how information has been transmitted in museum catalogues as a part of a reflexive approach to the information selection process. The dataset of selected and produced information will then be used to test different digital environments and lead to a discussion on different types of media's suitability for knowledge transmission and digital literacy in archaeology. The result of this thesis is to illuminate the ways that digitisation of artefacts in material collections is similar or differentiates from other types of archaeological digitisation.

Keywords: Roman portraits, Digital material studies, Visualisation, Knowledge Transmission

Relevant links: [3D model repository](#), [Digitised information repository](#), [3D model on Sketchfab](#), [3D model in Godot](#).

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# 1. Introduction

Jeremy Huggett in 2015<sup>1</sup> called for a “grand challenge” of introspection when using digital tools in archaeology, and that we should be aware of how new technologies affect the knowledge we create. Bernardou *et al.*<sup>2</sup> proposes that digital humanities should create “scholarly ecosystems” and that creating these is the only way to learn how digital environments influence our knowledge production. Both authors paint archaeologists as being in a unique position to explore new technology due to their engagement with both the soft and hard sciences.

Digital tools are used in different ways to create and work with digitised archaeological material. As I see it, this effort can be divided into four very broad genres or types. The documentation, where information is stored. The analysis, where knowledge is generated. Knowledge transmission where the information is relayed by at least one professional; this includes dissemination between researchers and teaching by the professional to students. And lastly mediation where the knowledge is transmitted towards the general public. Knowledge transmission and mediation can here perhaps be seen as the same, but I would argue that knowledge transmission requires some prior knowledge by the recipient or a more pedagogical and in depth approach by the transmitting agent. While in mediation the material needs to be able to stand on its own, or perhaps, as often as in museums, accompanied by narrative.

With the different aspects of archaeological digitisation clarified, now their use in different areas of archaeological practice needs to be emphasised. It has to be remembered that this is a very general view of archaeological practice and that the approach to digitisation can differ depending on the context of excavation, members of staff’s digital literacy and the ambition of a project, among other factors. But it is, in my view fair, to say that during archaeological excavations the digitisation focus is mainly on documentation. Text, georeferenced points, drawings and photographs are all generated in order to save as much information as possible from what is the inherently destructive process of archaeology in the field. For this purpose methodologies for reflexivity when using digital tools have been developed in order to further the interpretation

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<sup>1</sup> Hugget 2015, 89.

<sup>2</sup> Benardou *et al.* 2018, 1-14.

process both on and off site as well as to enhance the quality of the knowledge generation.<sup>3</sup> Recent articles have also shown how digitised archaeological material in academic research can be part of the knowledge generation and a distinct part of the theoretical framework.<sup>4</sup> In the contexts of excavation, interpretation and analysis, digitisation of material has come to be one of the major focuses in the archaeological debate during the last decade and the challenges proposed by Hugget and others have stimulated the theoretical and methodological discussions.

While the previously mentioned areas of archaeological practice mainly involve the use of digitised archaeological material for knowledge production and in some cases use 3D models as vessels for the more peer to peer oriented knowledge transmission, the focus of this thesis will be another, perhaps less explored, type of digitisable archaeological material: the collections. I find the collections of archaeological material to be in a very interesting position for the discussion on digitisation, since the material needs to be documented, and in many cases this documentation is now worked on to be transferred from analogue mediums to digital ones. The material is also generally made available for researchers, either by giving them access to the physical objects for visual or technical analysis, or for statistical analysis by accessing the stored documentation. The material is used by researchers for knowledge transmission, and by teachers for educational purposes. In museums the collections are also available for mediation to the public. We can see the ambition from museums and other institutions to create a digital environment with the purpose of using 3D visualisation as a replacement for the traditional use of 2D images in their mediation of the material.<sup>5</sup> While this effort is sufficient in order to show what artefacts that are available in museum collections, I am wondering if there is not a lot of untapped potential in multimedial digital visualisation. These collections are more oriented towards the mediation type of archaeological practice and can in some cases allow for additional metadata to be shared alongside them, which could make some analysis possible, but in most cases there is still a need to obtain access to the physical material in order to make any scientific inferences. From the more knowledge transmitting side of archaeological practice, we also have projects such as *Europeana*,<sup>6</sup> where all sorts of digitised material from the EU are collected and made available.

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<sup>3</sup> Berggren *et al.* 2015, 433-447; Derudas *et al.* 2021, 1-11.

<sup>4</sup> Campanaro 2021; Dolfini 2017, 36-49.

<sup>5</sup> Smithsonian 3D Digitization (2021); Sketchfab 2021, 2 April.

<sup>6</sup> Europeana (2021).

The Lund University Dynamic Collections is another example of digital knowledge transmission where the focus lies on the use of 3D models as a vessel for this purpose, both between researchers but also between teacher and student.<sup>7</sup>

With the 2020 and 2021 global pandemic I believe we have been shown how the lack of access to physical material can affect our archaeological research and knowledge transmission. With this in mind I want to explore in what ways a 3D model can stand as a proxy for a physical artefact. Both as an artefact to be analysed, but also as a vessel for the information used in knowledge transmission and mediation of archaeological information and thinking. In the same way as *Garstki* conduct an investigation on how photography evolved as a tool in archaeology in order to expand on how 3D models could be used, both for archaeological practice and mediation, I want to look at traditional ways to analyse and mediate artefacts and investigate how different types of digitised information can be used to transmit archaeological knowledge through digital media.<sup>8</sup> By choosing to work with an arbitrary artefact from a collection, I believe I can touch upon all the four types of archaeological digitisation practice and hopefully shed light on how to better a multimedial approach to archaeological visualisation in digital environments.

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<sup>7</sup> Dynamic Collections (2021).

<sup>8</sup> Garstki 2017, 726-747.



## 2. Aims and research questions

The aim of this thesis is to explore how the digitisation of archaeological collections can facilitate knowledge production and knowledge transmission of Roman portrait sculptures. This includes collection and analysis of data, and transmission of the results. The thesis is structured to walk the reader from documentation on to analysis and then lastly knowledge transmission and mediation, and my research questions are coupled to each one of these steps. The first step is to test what tangible and intangible information that can be gathered by using a 3D reconstruction as a proxy for the original artefact. In the second step I will be analysing traditional collection publications in order to anchor my choice of information that will accompany the 3D model. The third step is to test different digital environments suitability in order to transmit the gathered and selected information.

In order to fulfil the aims for the thesis I will strive to answer the following questions:

1. For what type of analysis can a digitised representation of a Roman portrait stand as a proxy for the real artefact?
2. In what ways has information about Roman portraits generally been transmitted through traditional and digital museum publications?
3. What type of digital media is best suited for multi-layered archaeological digital visualisation?

### 3. Background and research history

#### 3.1 Collections of Roman portraits

Prior to the 20th century Roman portraits had been collected, stored and presented by privileged groups such as the church, European monarchs, universities and private collectors who were in the economical position of acquiring these works of art and history.<sup>9</sup> These collections were usually, with few exceptions, limited to be observed by members of the same institution or groups that had been collecting the portraits. This practice would then have given the portraits an agency of power, extravagance or neoclassical “European nationalism” by their owners.

During the 19th century many museums started to view their collected artefacts as something that would benefit the entire community, and at the same time started to strive towards displaying artefacts with perceived authenticity. This authenticity was tied to the artefact’s role as an ancient piece of art, and many objects that had been restored in the prior centuries were taken apart into their ancient parts, in a change from a more romanticised view of antiquity into a more academic one.<sup>10</sup> The emergence of public museums were also tied to the formation of the nation states of Europe, and the exhibited material were used as political agents to transmit the grandeur of these separate nations by ownership of the canonical works that were perceived as the founding stones of western civilization. The fascination of these perceived masterworks led to the material getting isolated from their original context to be presented alongside other masterworks instead.<sup>11</sup>

A growing urge for more museums to exhibit and study these works, that the most prestigious museums kept the originals of, led to a rise in using plaster cast representations. The authenticity of an artwork was deemed to be kept in these representations and museums and other institutions displayed them both as a symbol for being cultured, but also as a means to bring these canonical works closer to the public. In the beginning of the 20th century the notion of authenticity in classical works changed from an art historical perspective, into a general historical and archaeological one, and the authenticity of the plaster casts as transmitters of this information

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<sup>9</sup> Bartman 2015, 13-24.

<sup>10</sup> Landgren & Östenberg 1996, 154.

<sup>11</sup> Barbanera 2008, 165-174; Siapkak & Sjögren 2013, 89-95.

changed, and led them to become more obsolete as objects in museum exhibitions. This notion of the original as the most authentic led to that only a few of the world's museums could present the most prestigious works. But as a medium for representation the invention of photography replaced plaster casts as non-static transmitters of information.<sup>12</sup> This dispersal of the canonic works led to another resurgence of copied material in plaster at the turn to the 20th century. This time around the sculptured copies in plaster became more of an archaeological tool for recording and transmitting information than a method for obtaining representation of the most highly profiled artworks for museum exhibitions.<sup>13</sup>

During the 20th century the placement of Roman portraits in museums seems to often have been spatially removed from other artefacts within the Roman contexts, and instead presented together with other stone portraits based on typology rather than any all-encompassing chronological era.<sup>14</sup> This is again an example of the Roman portraits being displayed as individual works rather than as a part in transmission of contextual archaeological information, and shows how agency in museum curation can influence how the exhibited material is understood by the observer. In just the last three decades these museological display practices, that seems to have been somewhat static throughout the 20th century, have been reevaluated and is now more focused on inclusive mediation and transmission of the professional knowledge process.<sup>15</sup> The general trends in how Roman portraits have been exhibited in museums seems to have moved from the closed rooms of the 19th century to contemporary openness and inclusion, and the use of representations have been changing depending on social and academic paradigms determining what authenticity is.

### 3.2 Digital visualisation in archaeology

In the 1970s and 80s digital visualisation of archaeological information consisted only of data entries used for formal modelling and statistics. This was an adaptation of new technologies into already set theoretical mindsets, where the data were considered objectively true, and therefore the results of these processes could tell a generalising story about historical agents. Coinciding with the technological progress, archaeologists during the 80s started to call out for and develop

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<sup>12</sup> Siapkak & Sjögren 2013, 95-101; Gleason 2015, 51-57.

<sup>13</sup> Payne 2020, 37.

<sup>14</sup> Siapkak & Sjögren 2013, 92.

<sup>15</sup> Barbanera 2008, 174-175; Powers 2015, 59-70.

new theoretical frameworks that would allow computing to produce information more adapted for a paradigm shift towards investigating individual agents and the uncertainty of the past.<sup>16</sup> But since this thesis is concerned mostly with data such as 3D models rather than visualisation of data in general, I will focus more on the former during this background presentation. During the 1990s and early 2000s the use of personal computers in archaeology and advances in the field of 3D graphics led to the creation of digitised archaeological artefacts. Both VR (virtual reality) and AR (augmented reality) applications started to be used within the cultural heritage field, for example in projects such as Rome reborn in 1996 and The digital Michelangelo Project in 1998, using laser scanners and digital modelling.<sup>17</sup> There was also an emerging discussion on how mediation of digital information could promote openness and distribution of information that could bridge the requirement of physical access, and on how digital environments could be adapted to fit both the researchers and the public's different needs when approaching collection material.<sup>18</sup>

But again the pace of technological innovation quickly outran the theoretical foundation of our work with 3D models, and there was again an outreach for less tech-fetishism and a more grounded approach to the use of this technology in archaeology and also the ways that the data was stored.<sup>19</sup> This has led to projects such as the London charter, which is an attempt to standardise the data collected from the data acquisitions made when creating a 3D model,<sup>20</sup> and also to studies in how to integrate archaeological theory into the practical workflow of 3D model generation.<sup>21</sup> Efforts to include archaeologists in the creation of the digital tools to a greater extent have also been made in order to remain transparent, open and interdisciplinary with the digital methodologies we use.<sup>22</sup>

There have in recent articles been discussions on digital material culture, something which was one of the keynotes of this thesis idea. In Molloy the author discusses the 3D models' role in

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<sup>16</sup> Lock 2003, 1-13.

<sup>17</sup> Guidi *et al.* 2007; The Digital Michelangelo Project 2021.

<sup>18</sup> Koshizuka & Sakamura, 2000, 85-92; Cameron 2003, 325-340.

<sup>19</sup> Lock 2003, 147-163; Hugget 2004, 81-89.

<sup>20</sup> Frisher 2015, 81

<sup>21</sup> Dolfini 2017, 36-49.

<sup>22</sup> Cobb *et al.* 2019, 137-154.

archaeology as a portable research tool.<sup>23</sup> Morris tests in what capacity 3D models can be used in practical experimental archaeology where they are printed and used as casts for clay figurines, which are then analysed and compared to original artefacts.<sup>24</sup> There is also now a discussion on the authenticity of digital artefacts, and how cultural heritage professionals should think about digital materiality and openness of data.<sup>25</sup> The trends in archaeology are turning towards the practical use of digital methods and material, as we have learned how these new tools and methods affect our knowledge production. But since much of the focus in methods and theory has been on archaeological knowledge production, I would also like to shed some light on the resulting knowledge transmission and how we should strive to apply the same principles for this purpose.

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<sup>23</sup> Molloy 2018, 97-113.

<sup>24</sup> Morris 2018, 50-61.

<sup>25</sup> Geismar 2018, 18-27.

## 4. Theoretical perspectives

As this thesis presents multiple methodologies from within archaeological practice, I found that there was no one theory that could be applied as a framework for the entire text. The following selected theories instead touch upon a more general attitude towards archaeological practice, and as many other theories within the digital research field they can be considered to be part of a postmodern philosophy. This choice was made because, rather than cementing what I know, I wanted this thesis to explore if the chosen methodologies were a good way of generating and transmitting knowledge. *Symmetrical archaeology*, as presented in 2007 by Witmore and Shanks, tries to urge archaeologists to consider themselves researchers in a mix between hard and soft sciences instead of choosing a place leaning towards one or the other.<sup>26</sup> In material studies this means treating both archaeological objects and their representations as agents within the archaeological process, where they affect both the tools we use to measure their material properties as well as our senses as humans. To reflect upon both the artefact and its representation's materiality also brings me to Ian Hodder's theory of *entanglement*.<sup>27</sup> The main purpose of entanglement is to take into consideration the relationships between humans and things, which the author describes as being either human - thing (HT), thing - human (TH) or thing - thing (TT) relations. The theory takes a stance against the notion that the past is a clear thing that can easily be explained, and rather tries to show how entangled every choice is, made by its surroundings and connected things or humans. And in this thesis I am working on relationships between the researcher and both the physical artefact and its representation, the artefact and the representation, the representation and observers and between the researcher and the observer.

In my material analysis I strive to explore how the artefact affects my thoughts and senses, as well as the instruments used in the digitisation process. This digitised material then will be affected by me in order to generate new knowledge that I am going to attempt to share in a digital environment. By also implementing *reflexivity* as a theoretical perspective, I hope to be able to separate my objective and subjective interpretations in the knowledge generation process

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<sup>26</sup> Shanks 2007; Witmore 2007.

<sup>27</sup> Hodder 2012; Hodder 2016.

in order to be clearer about my own biases in the presentation.<sup>28</sup> Going back to analyse older museum publications and compare contemporary digital ones is also a part that could be seen as both *symmetrical* and/or *reflexive* in that I by adapting or changing existing solutions to the transmission of archaeological information, are trying to generate a more objective best practice, while also keeping it open for change and reinterpretation.

While *openness* or *transparency* might not be considered theoretical frameworks, they are often buzzwords in publications on digital tools and methods in archaeology. Kansa & Kansa indicate in their article how different types of openness and data sharing affect how archaeological information is being used.<sup>29</sup> My aim for this thesis is to be as open and transparent as possible to promote reevaluation, reinterpretation and reanalysis of the digitised information I have gathered. I hope to have shown here how archaeological theory is part of all different methodologies applied in my work.

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<sup>28</sup> Hodder 2000.


<sup>29</sup> Kansa & Kansa 2013.

## 5. Methods and material

### 5.1 Material

The material chosen for this thesis is a Roman portrait in white marble. It is currently on loan from the Lund University art collection to the Department of archaeology and ancient history where it resides in the room of one of the lecturers. The artefact, which is catalogued as LUK S148 in the art collection, was donated to the university by the town's bailiff Charles Sandegren in 1949 and was delivered in 1967. The donation consisted of mostly Italian renaissance and baroque paintings but also other minor items privately collected such as this portrait. There is no known information of the portrait's provenance prior to this.

LUK	S148	Undernr	
IDnr	4745		
Namn	<b>Okänd, Konstnär</b>		
Artal		Kön	
Nation			
Mått	30	x	25 x 26 cm
<small>h x b x d</small>			
Dagermått		x	x cm
<small>h x b x d</small>			
Art	skulptur		
Material	<i>marmor</i>		
Teknik			
Plats/Sign			
Plats/Dat			
Tillkomstår			
Numrering			
Motiv / Titel	Huvud		



Upplysning Tidigare accessionerad som LUK M442.

Figure 1: Entry on the portrait from Lund University Art Collection



The only currently available information on the artefact is the entry in Lund University art collection's catalogue, which is available for research and teaching.<sup>30</sup> The portrait has also been used as material for a prior Bachelor's thesis in Classical Archaeology and Ancient History at Lund University.<sup>31</sup> This then makes my thesis the primary digital publication available for the mediation of this artefact and furthers my ambition on being as transparent I can about the fact that the analysis and interpretations is made based on digitised information, and that all of this is available for reinterpretation with open access.

## 5.2 Methods

The different methods used in this thesis can be divided into three separate areas. First of all I worked with the original artefact, where a photogrammetric methodology was followed in order to create a 3D model using photography and the photogrammetry software Agisoft Metashape. I will expand on this methodology in part 5.3. For the analysis of the digitised artefact I used two separate softwares called Blender and yED. Blender is a 3D modelling software and yED is a graph editor software, both of which are free to all users. Using these softwares I adapted the Extended matrix in order to visualise my archaeological interpretation of the different contexts that make up the original artefact.<sup>32</sup> In order to analyse different museum publications to search for ways they had chosen to transmit information I applied a method of intermediality which is an idiographic approach to discern different ways to transmit information in media and how these has evolved.

### 5.2.1 Extended matrix

Extended matrix (EM) is "A formal language with which you keep track of virtual reconstruction processes."<sup>33</sup> EM is mostly used for virtual reconstructions of architecture and was created to allow different interpretations of objects to be stored and part of a reconstructive study.<sup>34</sup> What draws me to use EM as a method in this thesis is the fact that it allows documentation to be linked to parts of a 3D model mesh. To use EM the creator has also developed add-ons for the

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<sup>30</sup> Figure 1; Appendix I.

<sup>31</sup> Liljeström 2009.

<sup>32</sup> See 5.2.1 Extended matrix

<sup>33</sup> Extended Matrix 2021, 16 March.

<sup>34</sup> Demetrescu 2018, 102-115.

graph editor yED and the 3D modelling software Blender which I plan to make use of in this project.

### 5.2.2 Intermediality

Intermediality is used as an interdisciplinary method of analysis where focus is set on relationships between different forms of information expressed through media. How it seems to be most widely used, and how I intend to use it in this thesis, is by looking at the relationship between images and words in different publications. This way of working with intermediality seems to fall under both typographical experiments and ekphrasis, which are methods used to analyse the relationship between images and text, as well as the information used to describe the images.<sup>35</sup>

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<sup>35</sup> Rippl 2015, 1-4.

### 5.3 Photogrammetry - methodology

Photogrammetry is a way to calculate a cloud of points in 3D space by using 2D images taken from different angles of an object. The pixels in the images and the angles relation between them are used by the software to make these calculations. The software used for my photogrammetric processing is Agisoft Metashape which is designed for 3D model creation with a structure from motion (SfM) process. This process is now one of the main ways for creating 3D models within the field of archaeology due to the absence of expensive tools needed. The only tool needed except from the software is some type of camera, and for this project I used a Canon EOS 6D Mark II. The process from photographing your object to creating a mesh, representing its geometry, and texture, representing the color of the surface, is described in depth by Rahaman *et al.*<sup>36</sup> While they are using different softwares for the separate steps of processing, all of these are built into the retail software Metashape. These are compiled under a tab named “Workflow” and let the user easily transform 2D representations of the object into a 3D one.

The photogrammetry session for this project spanned over four days from the 6th to the 9th of April 2021. Due to the weight and conservation status of the material I had to work with some restrictions regarding the techniques used to acquire photos. Firstly the artefact could not be moved far distances inside the university building. Due to which I had to work inside the closest unoccupied room and adapt to its lighting conditions. Secondly the artefact had to be placed in a way to ensure that it would not put any weighted pressure on any restorations. This made me unable to photograph certain angles of the artefact with the same quality of light as the other parts which resulted in insufficient information. The main obstacles then were to find camera settings that would give me a good enough result for proper alignment and to find a way to place the artefact that would allow me to take pictures that would capture a maximum amount of information possible of its surface. The end result of this was 15 sets of pictures taken with different settings and placement, until proper alignment was made possible in the photogrammetry software. All the images taken with the camera were saved as both jpeg and RAW images and the jpeg images were chosen as the file format used in the Agisoft metashape processing.

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<sup>36</sup> Rahaman *et al.* 2019, 1-11.

Table 1: Camera settings used for the initial alignment.

Focal Length	24mm
F-Stop	F/8
ISO	320
Shutter	1/25

Table 2: Camera settings used for the final alignment.

Focal Length	35mm
F-Stop	F/8
ISO	640
Shutter	1/40

This process was an ongoing balancing act where light, sharpness of the image and focus on the artefact vs background information had to be considered for every shot. As can be seen in [figure 2](#) the problem concerning the amount of missing information, quality of image sharpness and light could be overcome to at least a satisfying result. The missing information on the back of the head and the bottom of the neck was the only parts of the model that lacked sufficient information from the photographs in the end but is going to be saved as a separate context in my visualisation of the 3D model.

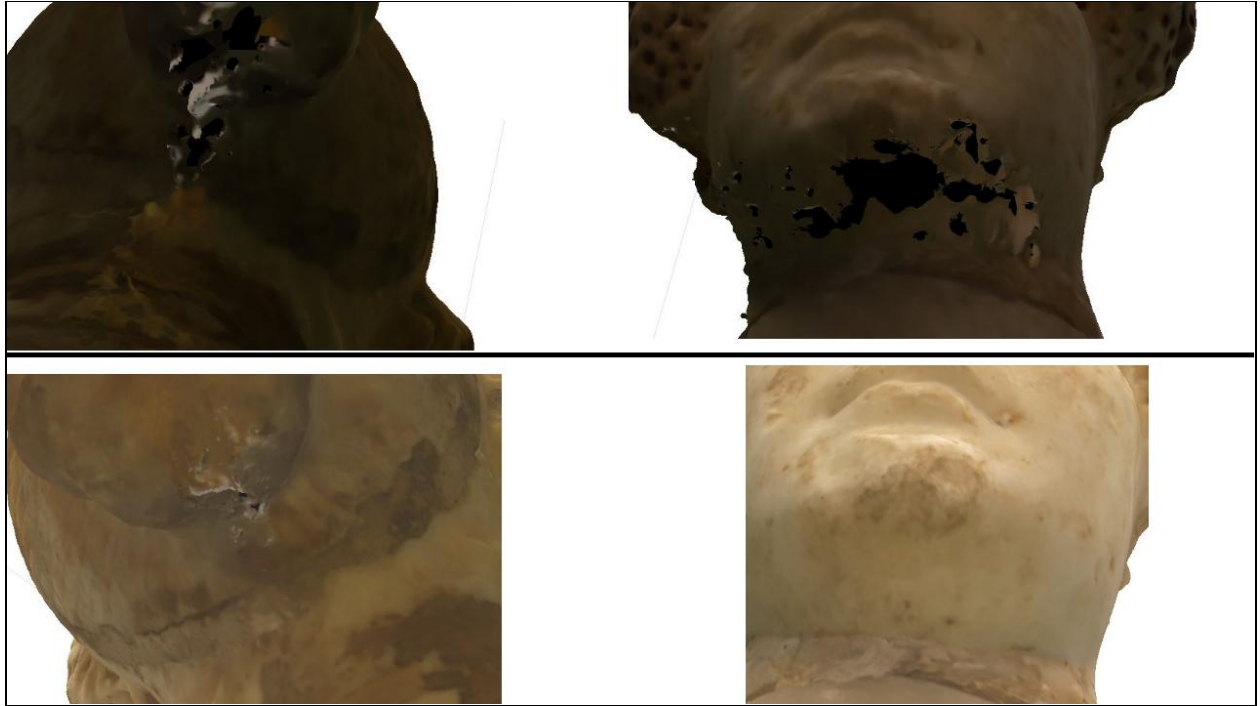


Figure 2: Mesh resulting from using different camera settings, Table 1 (top), Table 2 (bottom).

The final dataset was acquired by raising the artefact up and making three rotations around it with a handheld camera. One rotation with images taken from a below angle, one shooting straight on and the third one from an above angle, as can be seen in [figure 3](#). The major limitation for this specific artefact was the impossibility of shooting it while showing its bottom part clearly. Attempts to photograph the model while lying down were made, but due to the lighting conditions in the room the end result of this approach was far from satisfying. I instead made the decision of modelling and texturing these parts of the model myself in post-processing. This decision relied on the importance of the geometrical information for any analysis I was going to enable using the digital representation.

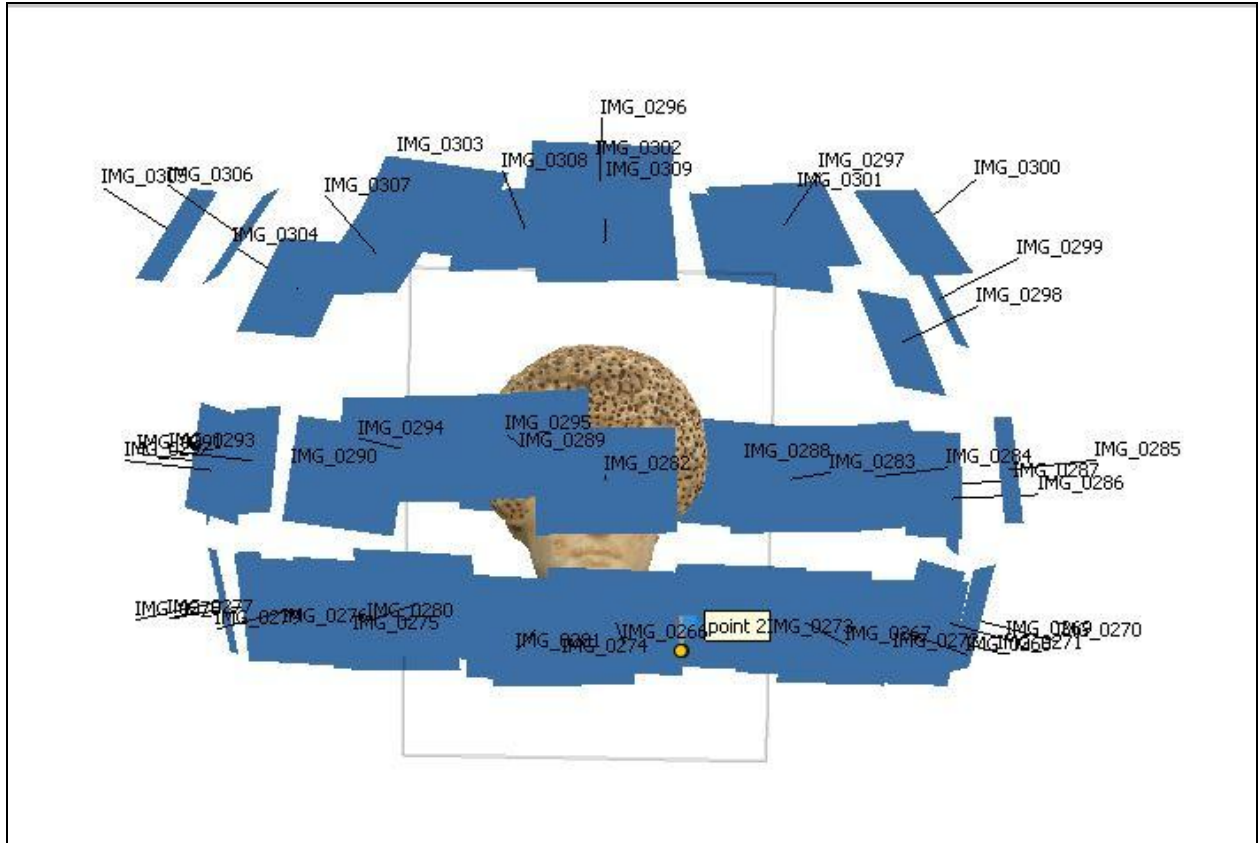


Figure 3: Cameras shown in position relative to the artefact.

## 5.4 Photogrammetry - results

The end result of the photogrammetry consists of multiple 3D meshes and textures. A mesh being the point cloud calculated by the software connected by digital faces to create a unitary digital geometry. The decision to save multiple resolution 3D models was made due to my limited time being able to use the university's agisoft metashape licenses for my project. And for different purposes a decimated model mesh might be easier to import into other software, and a lower resolution texture makes uploading the 3D model into digital repositories easier. The meshes were saved as .obj format and the textures as .jpg format.

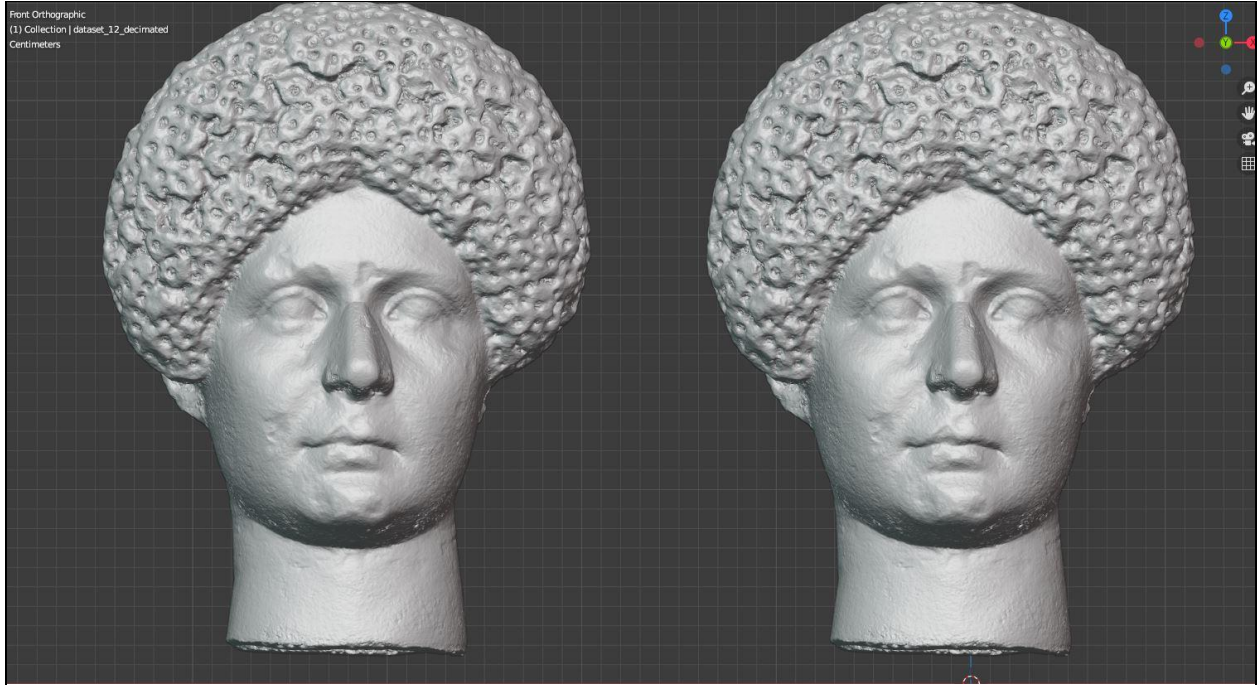


Figure 4: Decimated model (left) and full resolution one (right) side by side comparison.

Table 3: Resulting mesh information.

Model ID	dataset_12_high	dataset_12_high_4096	dataset_12_high_1024	dataset_12_decimated
Texture resolution(px)	8192x8192	4096x4096	1024x1024	4096x4096
Faces	1,499,999	1,499,999	1,499,999	599,999
Vertices	750,396	750,396	750,396	300,355

Beyond the geometrical mesh, perhaps the most recognisable form of 3D visualisation, I also chose to export both the sparse and densecloud from agisoft metashape. These are clusters of points that are calculated by the software from the identification of pixels on overlapping images, and calculations of the angle between the cameras to simulate its position in a matrix. I chose to export these points as .txt files which is the most universal file extension for tables and can easily be converted to other file formats.



Figure 5: Densecloud consisting of 10,801,149 points visualised in CloudCompare.

The complete dataset created for this thesis can be found in an online repository for as long as I as a private user can support it at:

<https://drive.google.com/drive/folders/1J4wht5NWNKsaPdCOHCjzqAo8tgtkfenf?usp=sharing>



## 6. Using representations for material analysis

The first ambition for my thesis is to test in what ways digital representations are suitable for any archaeological analysis. In traditional Roman portrait studies the main forms of analysis have been typology and relative dating based on the typological features. Because of ancient literary sources and a large pool of remaining iconographic material from ancient Rome, correctly identifying stylistic elements of a artefact can contextualise them and reveal relations that places the artefact in a historical context.<sup>37</sup>

### 6.1 Typology and dating

The main feature used to classify Roman portraits of females is the coiffure. In the social context of ancient Rome this was the only part of a portrait that did not need to be idealised and is therefore an important marker when it comes to different types of portrait.<sup>38</sup> The part of the 3D model dataset that is best suited for a typological classification is the textured mesh. Since the texture is more important than the geometry for this identification, the decimated mesh with 4096px resolution texture was chosen as the 3D model to analyse.



Figure 6: Coiffure shown from different angles.

<sup>37</sup> Fullerton 2015, 211-212.

<sup>38</sup> Fejfer 2008, 352; Zanker 2016, 189-190.

From these images two distinct features of the coiffure could be identified, the front coiffure with raised curls and back coiffure consisting of strict braids that ends up in a knot. A closer look on the front coiffure clearly shows that there are no distinct lines of rows with drilled curls, and some of the drilled holes seems to have collapsed or broke at some point since the creation of the portrait.



Figure 7: Front coiffure.



Figure 8: Back coiffure.

The type of braids in the back coiffure reminds me of other examples of Flavian portraits with a kind of imprint technique to make them appear braided.<sup>39</sup> While previously the so called melon coiffure seems to have been a stylistic focus in portraits of Roman women since the hellenistic time, and still is a popular choice of coiffure in to the first century CE in Rome,<sup>40</sup> the piece of this portrait that I would deem the main focus is the front coiffure. This type of coiffure is a distinctive feature on female portraits during the Flavian and early Trajanic period of ancient Rome, and would then date this portrait to somewhere between 70 - 120 CE.<sup>41</sup> And by studying other female portraits from this time I believe I can narrow down the dating even further. When we are looking for different types of coiffures the best starting point is to look for the empresses since they seemed to have been a driving force for the fashion styles by being portrayed in public spaces all over the empire.<sup>42</sup> Similar coiffures to this one have been identified as both Julia Titi and/or Domitia Longina.<sup>43</sup> It is my opinion that this coiffure looks more like the type II portraits of Domitia Longina identified by Varner, and this is also suspected in an addition to the source

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<sup>39</sup> Zankar 2016, 199-203.

<sup>40</sup> Vorster 2007, 120-121.

<sup>41</sup> Zankar 2016, 202-203.

<sup>42</sup> Fejfer 2008, 353

<sup>43</sup> *Ny Carlsberg Glyptotek: Billetaveler til kataloget over antike kunstværker* 1907, 665, 661; Varner 1996, 191-195; Fejfer 2008, 358.

that also identified some of them as Julia Titi.<sup>44</sup> Since Domitias husband Domitian was emperor between 81 and 96 CE and Domitia died in 130 CE this style of hair would probably have been popularised by the empress at some point in between these dates. Using typology and relative dating would then date the portrait to the late first century or the turn to the second century CE.

The use of a 3D model for this kind of analysis is not necessary, but when it comes to the task of comparing typological elements it at least gives you the advantage to be able to constantly change what angles you are viewing the artefact from, something that is only otherwise possible if you are in the same room as the original artefact. This is in my opinion the advantage to using 3D models for comparative analysis, compared to photographs or literal descriptions of featured elements.

## 6.2 Material analysis

The digitised model can only help you distinguish the most basic elements of the artefacts material, namely that it is made out of white marble. This is only considering the original parts of the artefacts and the restorations will be discussed later in the text. While a comparative visual analysis of the marble type could append some additional theory of the marbles provenance, the only way to be certain of this would be to use archaeometric analysis of oxygen, carbon and isotopic levels and compare these results to a database with samples from quarries around the mediterranean.<sup>45</sup> I have chosen not to make a comparative analysis of the type of marble for this thesis based on 1. The time comparing the marble of the artefact and the marble from all the ancient quarries around the mediterranean would take. 2. The fact that marble provenance does not correlate with the provenance of the artefact.<sup>46</sup> 3. My visual analysis would still not be able to be deemed correct without any archaeometric comparison. My hope is that any future analysis of the physical artefact is able to add to the stored information presented in this thesis and then perhaps provenance of the marble quarry could be added. But for now the specific type of marble cannot tell us too much about this artefact, but perhaps the question “Why marble?” can help us generate additional information that can be added to the dataset. and later used for digital knowledge transmission.

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<sup>44</sup> Poulsen 1940, 448.

<sup>45</sup> Gasparini & Pensabene 2015, 93-105.

<sup>46</sup> Gasparini & Pensabene 2015, 94.

Marble had been used as material for portraiture around the mediterranean during the first millennium BCE with perhaps its artistic culmination in the Greek classic period. But it was during the end of the republic and early Roman empire, when emperor Augustus is credited with leaving Rome a city of marble, that marble portraits became a mass medium for portraiture. Marble as a material by the end of the first century CE was both linked with the empire's strength, because of its ownership of marble quarries around the mediterranean, the imperial family, and to the gods due to the facts that marble and bronze were the preferred material for their images.<sup>47</sup> Even though marble from this time is the most common surviving archaeological material for portraits, it still was not obtainable for the common people of Rome. So the fact that this portrait is constructed out of marble is then an indicator that the commissioner was someone who could afford to have their likeness carved, and chose to use a material also used for portraits of the imperial family and the gods. The strong links to the empress Domitia Longina by the stylistic elements of choice then sparked an interest in me to explore if this portrait in fact could be one of the empress herself, which is what I am going to attempt to discern in the next part.

### 6.3 Profile analysis

Eric Varner uses a profile analysis to re-assess portraits previously rejected as being Domitia Longina.<sup>48</sup> For this analysis the author uses both a drawn profile of the portrait and the proportional relationship between the hair above the forehead and the face. From the authors text it is quite unclear exactly what consists of the hair/head and hair/face parts of the portraits, other than a mention of hair/head as the height of the hair above the forehead. Since it is unclear how to calculate these areas I can only attempt to compare the profile of the portrait analysed here with the author's results. To produce a profile from the digitised artefact is a pretty straightforward operation. The dense point cloud produced in the photogrammetric process can be used for this in a software called CloudCompare (CC). CC is a free open source point cloud processing software which easily allows me to import the point cloud from my dataset, toggle the visibility of points with a slider to expose the profile and then compute a polyline based on the location of the points. Based on the visual analysis, my artefact most closely resembles those of

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<sup>47</sup> Fejfer 2008, 157-163.

<sup>48</sup> Varner 1995.

Varners type II.<sup>49</sup> Due to the lack of scale in the article I have tried to scale and rotate to fit my profile based on features such as the chin, mouth and coiffure.<sup>50</sup>



Figure 9: My resulting profile (in red) on top of the profile analysis of Eric Varners type II. (adapted from Varner 1995, 197 Fig 8.)

This comparison can tell me that the profile of my portrait both has a smaller face and chin than those of Domitia type II as well as a higher frontal coiffure. Any similarity or dissimilarity of the nose can be discarded due to it being a later reconstruction. The pointcloud used to render the 2D profile could also be edited to remove the nose in order to only have a profile of the original portrait. Unfortunately at the time of writing I do not have access to the software used to generate the point cloud in order to edit it. And while it is possible to import the cloud into the free software Meshlab and edit it there is currently no way to export the resulting cloud again.

<sup>49</sup> Varner 1995, 194-197.

<sup>50</sup> Figure 9.

This profile analysis can be based on Varner's types and profiles tell me that while the coiffure is very similar to some of Domitia Longina type II portraits, it is with high probability not a portrait of the empress and would then rather be a private portrait which draws on her influence over the styles at the time.

#### 6.4 Extended Matrix and archaeological context

While EM was originally created as a tool to formalize virtual reconstruction hypotheses, I also see the potential of the tools created for this as a powerful way to link information to the digital representation, while at the same time visualising the researcher's knowledge process. My ambition with the EM tools is to visualise my interpretation of the different visible alterations to the artefact. The end result will hopefully serve a purpose much like the illustrations in Leander Touati's catalogue of the 18th century collection in the Royal Swedish Museum where the restoration is illustrated by dots on top of images of ancient sculptures.<sup>51</sup>

The first step in order to do so is to identify different phases in the artefact's biography. My dating of the artefact to the late first century CE would be the first phase, the antiquity phase. This is where the portrait was formed into shape from a block of marble. The second phase or "antiquity to contemporary" as I have decided to call it is a phase that contains all the restorations made to the artefact. This phase includes replicated areas of the lower neck and nose in marble and reparations of the back coiffure as well as neck with some kind of mortar. The restorations seem to co-relate to the 18th century idea of transforming an object back into a work of art.<sup>52</sup> The mortar used in the restoration does not seem to be of a uniform type used for both the head and neck area, and this information together with the lack of textual sources makes it hard for me to say if all restorations were made at one time or not. After the 1940s there is no evidence of any alterations up until the last phase, which consists of my digitalisation of the artefact. This phase will visualise and include information about areas of the mesh geometry that consists of false or bad information derived from the digitisation process. These contexts will then be collected into a table which will be organised into a Harris matrix.

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<sup>51</sup> Leander Touati 1998, 118-155.

<sup>52</sup> Leander Touati 1998, 87.

Table 4: LUK S148 contexts

ID	Phase	Material	Other
LUKS148:1001	I	Marble	
LUKS148:1002	II	Marble	Nose
LUKS148:1003	II	Marble	Lower neck
LUKS148:1004	II	Mortar	Coiffure repair
LUKS148:1005	II	Mortar	Neck repair
LUKS148:1006	III	Digital faces	Insufficient information for accurate digitisation
LUKS148:1007	III	Digital faces	Insufficient information for accurate digitisation

In addition to the contexts of the photogrammetric model the harris matrix will also include any digital reconstructions made by me as a fourth phase. After the context has been identified I will store the information about them in a document that is linked and visualised in the harris matrix as a document icon (D).<sup>53</sup>

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<sup>53</sup> Appendix II.



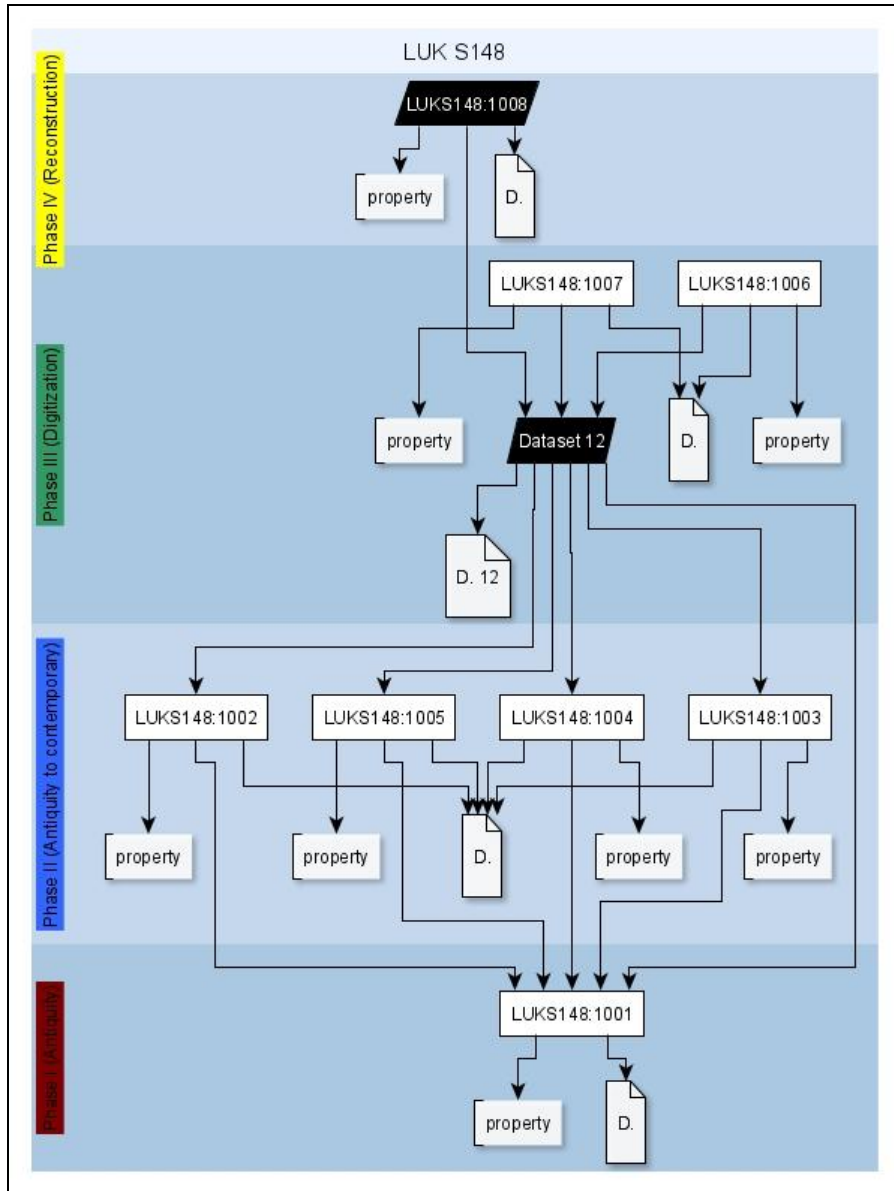


Figure 10: Harris Matrix of LUK S148s contexts.

In order to more easily work with the 3D mesh in blender I decimated the number of faces using the decimate modifier from 1,500,000 to 74,999 on the dataset\_12\_high 3Dmodel while still using the high resolution texture. The texture is the main feature that lets me identify the different contexts, while manipulation of the mesh is what allows me to visualise them inside of the software. The process of separating the different contexts in blender is pretty straightforward. You select all the edges around the feature, select all faces inside of those edges and separate them into another object. Doing this on a more high resolution mesh would of course result in

more accurate separations, but since the purpose of this method is for me to visualise and share my interpretation, a smaller dataset means higher accessibility and shareability. If I for example were to use the mesh for any analysis with removed features I would need to make more accurate separations. After the mesh is separated into different parts it is just a matter of loading the GraphML file visualised in figure 10 as a harris matrix into Blender and connect the parts of the mesh to its corresponding contexts.

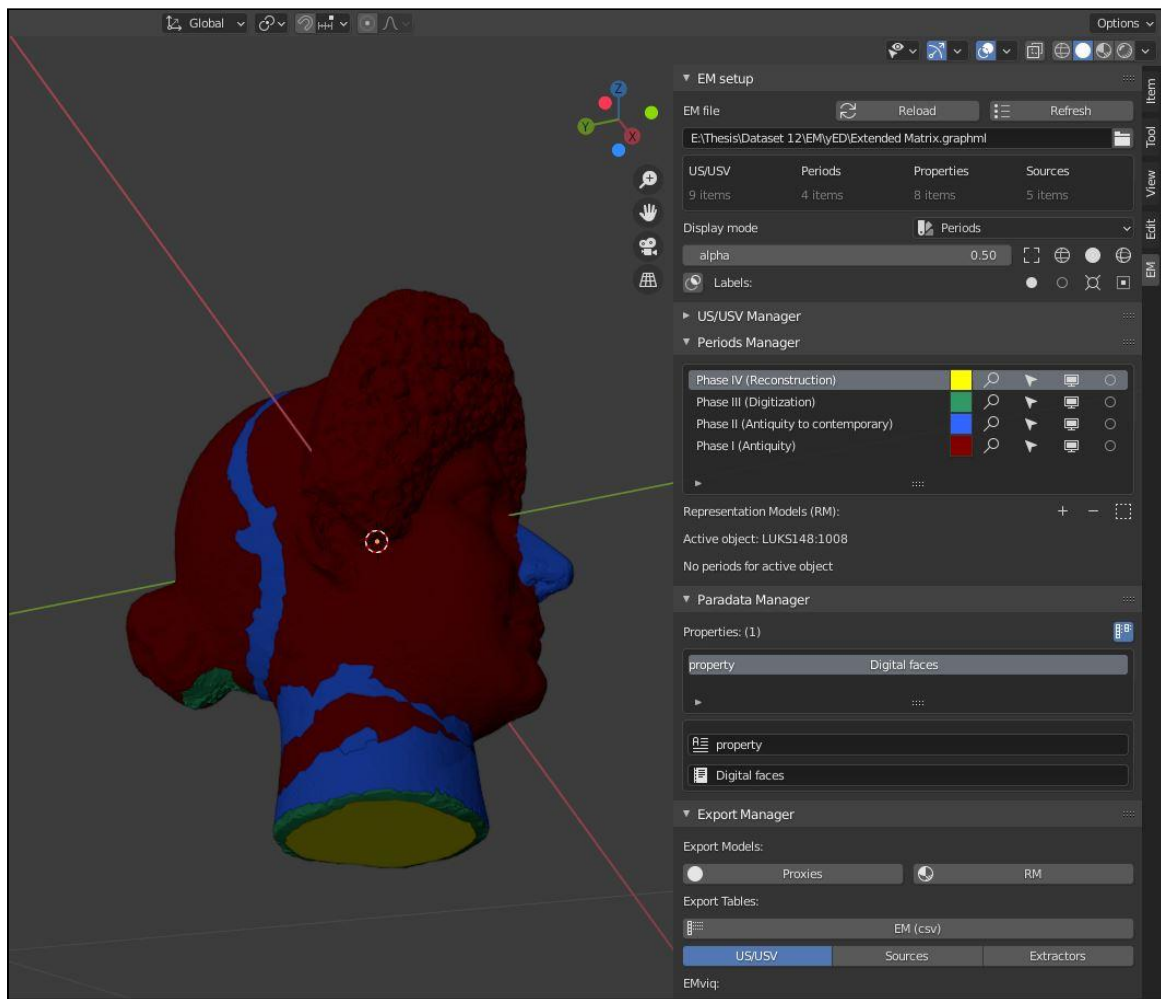


Figure 11: LUK S148 contexts visualised in Blender.

A 3D model with the mesh and materials constructed with the EM tools in blender were then exported and saved as a part of the dataset for this thesis. While this is not an analysis of the material it is part of my process of archaeological knowledge production. It is also an exploration

of the softwares capabilities to transmit information, rather than just following any established methodology for its use.

## 6.5 Discussion - Analysing digital representations

As shown above the most typical analyses done in material studies of Roman portraits can be conducted using a digitised reconstruction of an artefact. The comparative method for dating portraits based on stylistic elements can of course also be done using 2D images, so what does the third dimension add to this process? I would argue that the 3D model combines the accuracy of geometry and color that a photograph can mediate, along with the freedom of selective viewing you have when investigating a physical artefact. A photograph can only show the artefact from a predetermined angle set by whoever has had access to the physical material. By giving the observer the freedom of determining themselves on how to view the artefact, new nuances of interpretation is possible. I also believe that I have shown that the 3D model is perhaps a preferable vessel for visualising these interpretations made by researchers. While the EM tools is not specifically constructed for the purpose of visualising an artefacts biography in chronological contexts it is still viable for this purpose and perhaps even more importantly demonstrates how archaeologists and other cultural heritage professionals have adapted to a technological evolution that promotes free and transparent knowledge production to be shared over the internet.

Another way a 3D model representation could be used for analysis, that was not included in this thesis, would be to test hypotheses on color. Blender has free and powerful coloring tools which could be used for this purpose, and the 3D model is a good canvas for a multiple hypothesis approach due to the ability to copy digitised information. But since there is no polychromy analysis done to my material prior, and also because of my own lack of knowledge in the field, this analysis is something I will leave for future researchers.

As seen in the [material](#) section in this thesis the prior level of information regarding the marble portrait was quite low. By performing the analysis methods possible on the 3D model my interpretation is that this is a Roman female portrait in Flavian style that can be dated to the end of the 1st century CE. The choices in material and style strongly link this portrait to the higher

strata of Roman social life and economy. Unfortunately there is no analysis that could help me narrow down the geographical context of the portrait. The spread of marble throughout the Roman empire at this point would render even a classification of the marble quarry site useless towards this end. The fact that the portrait is of a female and the lack of any signs of religious attire on the head i.e. a veil would indicate a stronger tie towards private portraits rather than public ones.

At this point one could use a 3D hypothesis to move the portrait around in a virtual Roman private space such as the home and make estimations on where the portrait could have been viewed in the past. But as reconstructing a Roman home isn't a part of this thesis, and the fact that the information this would generate would be highly speculative, I will mention this only as a possible further analysis rather than any additional information about this specific artefact itself.

The artefact has also at one or more points, possibly during the 18th century CE, been mended and restored. By having visualised these different context and their relative chronology I hope to have formed a base for a narrative about the artefacts biography that takes off in the first century CE with how style was influenced by social norms, on to the thought process behind the choice to restore it at some point during the late second millennium CE, and lastly how it ended up in a collection in order for me to transfer information about it as a digital representation. In the next part of this thesis I will explore how information such as this has been presented in catalogue publications, both analogue and digital, in an effort to discern the best praxis for digital visualisation of archaeological knowledge.

## 7. Analysing images and text in museum publications

In this part of the thesis I want to analyse the relationship of images and texts transmitting information about Roman portraits in museum catalogues. I have chosen to analyse museum publications from the early 20th century and onward because I believe it encapsulates a time when classical archaeology branched out from art history and archaeological methods and theory became more apparent in the sources. By observing the different ways Roman portraits have been mediated both in printed and digital media, I hope to find different means of information transmission and adapt these to a digital environment in the last part of the thesis. Since an intermedial approach is a less formal way of analysing and more comparative, I first want to present some of the parameters I will be looking for in the different source materials.

1. Images and how they relate to information.
2. What tangible information that is presented.
3. What intangible information that is presented.

How images and text are related will help me focus my photogrammetry during the field acquisition to try to get a more highly detailed replication of parts on the physical artefact that are important for knowledge production. It will also be helpful in order for me to discern the most important kinds of information that has been used to accompany the imagery in order to convey a knowledge generation process by other researchers. By adopting this publishing practice, but at the same time taking into consideration the differing possibilities of the different digital solutions, I hope to perhaps challenge some practices that just have been transferred directly from old media to new media.

By tangible information I mean information that relates to the physical qualities of the artefact. This can be aspects that can be seen with the eye such as stylistic choices made, material but also information that can be gathered from some kind of analysis on the material such as measurements or C-14 dating. And by intangible information I mean information that is connected to the artefact either by archaeological research, how we have learned to interpret these types of artefact in a historical context, or information on how this artefact was connected to ancient agents in a social and cultural context. This analysis is part of my *reflexive* and

*symmetrical* approach to data acquisition, and will help me throughout the digitisation process discern what aspects of this portrait I should focus on.

## 7.1 Why museum publications?

The use of 3D models in archaeological research has been a widely discussed topic the last decade. Many of the proposed methodologies for this revolve around excavated materials or material still in context such as architectural remains. While new material and acquisitions is important for the archaeological knowledge production, another genre of material widely used by archaeologists is museum artefacts or other garnered materials. In museum catalogues images and information about these can be seen as substitutes or proxies for the material itself and are used to either show what material that is present in a collection, or as a spatial transference for information gathered by someone in close proximity to the material. This catalogued material spanning from lithic stone tools to Roman art are often used as references for typologizing and dating in archaeological practice based on their physical qualities, or as part of statistical datasets and as examples of a specific cultural context in different publications and teaching, based on their interpreted abstract qualities. I have so far performed different analysis methods that have resulted in stored digitised data for this kind of material, but I also want to try to find a best practice for conveying archaeological information by using 3D visualisation along with other types of information transmission through a multimedia environment. In order to do this I want to explore how museums and other educational or research oriented institutions are transmitting information now, and how museums have been transmitting information during the 20th century. I also believe analysing museum catalogues will serve the purpose of multi-layered knowledge transmission best, since their targeted demographic for information transfer consists of both the public and researchers. The traditional museum publications used and abbreviations for them I am going to use in the text are listed below.

- Ny Carlsberg Glyptotek: Billetaveler til kataloget over antike kunstværker, 1907 - CG07.
- Antik Konst i Nationalmuseum: Urval och beskrifning, 1911 - AKN.
- Catalogue of Greek and Roman Sculpture in the Museum of Fine Arts, 1925 - MFA.
- Ny Carlsberg Glyptotek: Katalog over antike skulpturer, 1940 - CG40.

- Antikens Ansikte: Grekiska och romerska porträtt från ny Carlsberg Glyptotek, 1986 - CG86.
- Roman portraits: sculptures in stone and bronze in the collection of the Metropolitan Museum of Art, 2016 - MMA.

## 7.2 Transmission of information

In the earliest publication (CG07) used in this analysis the amount of accompanying information is minimal. The information that accompanies the many of the images are (h.) which I would assume stands for height in the context of describing a portrait. There are also other abbreviations such as (f.), (H.), (t.) and (I). But there is no explanation as to what they stand for throughout the publication. Some of the portraits include additional information in the naming such as 670,<sup>54</sup> *Romersk Dame fra Trajans Tid* (Roman woman from the time of Trajan) which I would count as intangible information which demands a very high level of prerequisite knowledge. The tangible information transmitted throughout this publication in general is very low, the material of the different artefacts is not even mentioned, and the only thing I can learn are some of the portraits size (mostly in one dimension). In AKN which is the most contemporary publication to CG07 the most commonly added information is art historic, and highlights artistic elements in the portrait, with exception for any named portraits which are also accompanied with historical context. Both the tangible and intangible information for the artefacts at Ny *Carlsberg Glyptotek* presented in CG07 is later amended in CG40 where the author goes through every post in CG07 and adds information such as provenance, artistic elements, material, translation of texts and comparisons to other artefacts in the collection. The author of CG40 even explicitly expresses the change in how transmission of information now has the goal of being more accessible to a wider audience.<sup>55</sup> In CG86 the shift towards inclusion of a wider audience is even more visible. While CG07 assumed prerequisite knowledge on a high level, and CG40 added more tangible and intangible information to the collection that is better suited for researchers looking for further information, CG86 is a very stripped down version with both an overview of Greek and Roman time periods and gives the reader a short superficial

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<sup>54</sup> Antike kunsværker i ny carlsberg glyptotek 1907, 55.

<sup>55</sup> Poulsen 1940, 3-6.

historic overview of these before presenting the portraits accompanied by a mix of historical and art historic information but with very little metadata. This publication would seem as the total opposite of CG07 and could be seen as almost only mediation towards the public with a very weak transmission of any cultural historical knowledge production.

This supposed trend of having more accessible information is also apparent in a comparison between CG07, AKN and MFA. It was mentioned in the background on Roman portrait visualisation that museums during the start of the 20th century started to view their information as beneficial to the wider community. While CG07 and AKN uses no or very little textual information to accompany the images, a shift towards transmitting more information and a more developed use of imagery, I feel points to this new level of outreach from the cultural heritage field. The MFA publication have a focus on information about the art historical aspects of the portraits, something which I would deem as intangible information since they give the reader a sense of what Roman people might have thought rather than any information about the material itself, but they also provides a kind of formalised information about each entry such as material, height, length of face, a short description of its preservation, donor, inventory number and publications it is present in.<sup>56</sup> This kind of formalised information or metadata has since then been a standard way for accompanying information to images and can be seen in the catalogue entry of the material used in this thesis,<sup>57</sup> and digital repositories.<sup>58</sup> This metadata mostly consists of what I would classify as tangible information and includes data from visual analysis, typological analysis and context from the objects biography such as find site och provenance. While the specific types of data differ from publication, and types of artefacts, there at least seems to be a consensus that accompanying images with metadata in some form is a cultural heritage standard for visualisation of Roman portraits.

For museum collections today there are a wide variety of digital solutions for transmission and outreach of the stored information. The Ashmolean Museum has created a very interesting tool for navigation to their digitised artefacts, by creating a timeline which clearly divides the finds

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<sup>56</sup> Catalogue of Greek and Roman Sculpture in the Museum of Fine Arts, Boston 1925, 209.

<sup>57</sup> Appendix I.

<sup>58</sup> Europeana 2021, 5 April.



into groups depending on eight different types and what century they are dated to.<sup>59</sup> If you navigate to an artefact entry you can also tell if, and where in their physical museum it is on display. The accompanying metadata varies from different entries, and rather than leaving a field of information blank they seem to exclude them from the page entirely. Some of the entries are also accompanied by intangible information while others are not. By leaving out what information that is not there, I feel that they have missed a way to urge further research by someone that browses the collection and might be driven to investigate it further. Another example of a digital catalogue is the Museum of Mediterranean and Near Eastern Antiquities online database Carlotta.<sup>60</sup> In this catalogue you can find tangible information both as metadata and as a narrative inside of the metadata form.<sup>61</sup> They also accompany the post with references to any publications the artefact is present in, as well as to the national heritage board's entry on the artefact. In this environment they very clearly show major advantages in digital visualisation environments; the hyperlinks. Where you in traditional publications might get references to other pages in the same work, or to other people's work, there is the possibility in a digital environment to bring information closer together. By stringing digitised information together using keywords within a database you can easily navigate between information sharing the same period, material, style or any preset category that can be decided upon. This does not only bring information closer together spatially, but by using the internet to translate it to our screens, it also lessens the time it would take to physically transmit information.

Along the evolution of metadata there is now also an effort to standardise the implementation of paradata in digital environments, the London Charter.<sup>62</sup> This is a project that strives to act as guidelines and a standardised system for transparency and availability of the knowledge process behind, and information used and gained, in computer based visualisation. The result of using this as a guideline is called paradata, which is information about the digitised model that should be available in order to compare and analyse the accuracy of the digital replications.

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<sup>59</sup> Ashmolean Museum 2021, 22 May.

<sup>60</sup> Carlotta (2021).

<sup>61</sup> Carlotta 2021, 22 May.

<sup>62</sup> London Charter (2021).

When I have looked in these publications for entries on female Roman portraits, I have noticed that the same as in the methods for typological classification, there is a large focus on the coiffures. Coiffures are used to convey intangible information on the link between the portraits and the Roman imperial family.<sup>63</sup> This is the case both in CG07 (648) where the female portraits only have the name of an empress or a time period, and in CG40 (648) it is apparent that these classifications are made based on the coiffure as a major aspect of identification.<sup>64</sup> The coiffure seems to be an important part of information in most digital publications as well. This sculpture from the Swedish Mediterranean Museum, published on Europeana, indicates some other artistic features such as the brow and mouth as well as visible toolmarks as text information, but does not connect this to either dating or any intangible context.<sup>65</sup> The Metropolitan museum focuses only on the coiffure in their information on the post “Marble portrait of a young girl” where they connect it both to the archaeological method of dating, as well as its connection to the Roman empress.<sup>66</sup> These two examples of digitised information I believe highlights two different approaches on how to present information in digital publications. Where you in the first example cannot fit the text and pictures in the same view on your screen, the second one nicely orchestrates the layout for you to read and look at the same time. The meta and paradata of the artefacts are very similar in nature and give additional information on material, date, dimensions, provenance and references for further reading.

For my data visualisation I need to take all these different aspects on how to present information into account. As for the metadata I can follow the form made by the owners of the artefact shown in Appendix I, with the addition of important information I will gain from my material study of the artefact. For the paradata I will adapt the proposed guidelines from the London charter which will also be taken into account when it comes to storage of the intangible information such as “Documentation of Dependency Relationships” and “Documentation of Research Sources”.<sup>67</sup>

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<sup>63</sup> Kunze 1992, 208.

<sup>64</sup> *Ny Carlsberg Glyptotek: Billetaveler til kataloget over antike kunstværker* 1907, 65; Poulsen 1940, 465-466.

<sup>65</sup> Europeana 2021, 1 May.

<sup>66</sup> Metmuseum 2021, 1 May.

<sup>67</sup> London Charter (2021), 4.5 & 4.10.

### 7.3 Images and their relation to information

The practice of how to use images and information together can seem pretty straightforward, you show an image that relates to the information presented. But as we will see throughout this part we have assumptions about the intended reader when we put together our layouts which affects how our information can be used in the future, or by contemporaries whose understanding of the knowledge process does not meet our assumptions. This point I believe is clear when I have looked at older sources of Roman portrait information. In CG07 the images are the very focus of attention and every page is filled with six or more images of different artefacts, all taken with a front view. Interestingly a very similar view faces the observer when using some repositories of 3D models today, such as The British Museums collection of digital busts on the commercial webpage Sketchfab.<sup>68</sup> The main difference is that the images from the older catalogue either requires the viewer themselves to hold additional information to discern the images connection to information, or to spatially move to the physical museum to gain it, while the modern solutions only require you to be able to navigate the internet by using hyperlinks to make these same connections.

When I focus my analysis of the CG07 catalogue towards portraits of Roman women there is no difference on how they are depicted compared to any other portraits, the same front view is used for all images, but they are loosely clustered together based on either style or date.<sup>69</sup> This chronological or typological way of displaying, suggests to me at least one form of conscious information-transmission from the author(s) to the reader. In AKN there does not seem to be any standardised way for displaying images of portraits, almost all of them have their photographs taken from different angles, some with additional photographs, but most of them as one individual image. Most of these photographs are also not accompanied with text on the same page but rather one or two pages away. Another example from the catalogues that shows a shift in how images are used as a tool in themselves or an enhancement for the transmission of information are between GC07, MFA and CG86. Even though the MFA and CG86 are separated in time by 61 years they are both showing images of the portraits with one frontal and one side view. This shows an evolution of perhaps a more methodological standard for portraying images,

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<sup>68</sup> Sketchfab 2021, 2 April.

<sup>69</sup> *Ny Carlsberg Glyptotek: Billetaveler til kataloget over antike kunstværker* 1907, 54.

that is also visible in digital publications today. The Europeana entry mentioned before has three frontal pictures, two pictures from the side and one from the back.<sup>70</sup> The entries from Metropolitan museum and British museum also seem to cohere to this practice of front, back, and side views, but both have one image taken from an additional angle that might be either artistic or have a purpose of highlighting any specific artistic feature.<sup>71</sup> This same practice can also be seen in more contemporary publications such as in the more art historically oriented MMA.

This practice of additional viewpoints is still used today, and while the medium of a book might have limited the choices to a front and side view, due to lack of space or cost of printing, a digital medium provides an environment where every chosen angle can be displayed with 2D-images.<sup>72</sup> A further development of this idea is the 3D models where every angle of an artefact is provided, but this removes part of the agency from the author on what they want to present compared to the 2D solution with images. An issue that I have found with relations between images and information in traditional publications is when there is a spatial disconnect between the pages containing the information and the pages containing the images. For example in MMA the author references portraits from the catalogue at the end of the chapter recurrently, which have the reader pause the reading and flip through the pages back and forward.<sup>73</sup> This is of course a restriction of the traditional paper media we are quite used to by now, but nevertheless an aspect where different solutions are possible to test in digital environments.

In summary I believe images and their relation to information is one of the strongest tools we as archaeologists can use to indirectly transmit our knowledge through media. If we think about how we would relate this information to someone if we were in the same physical location together with the artefact, we wouldn't keep the artefact in a static position away from us and talk to the other person about the objects different aspects, we would either move the object with our hands and point to parts of interests, or have the other person move around it to show them the angles to view from we deem important for our understanding of the artefact. The notion of

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<sup>70</sup> Europeana 2021, 1 May.

<sup>71</sup> Metmuseum 2021, 1 May; The British Museum 2021, 1 May.

<sup>72</sup> Metmuseum 2021, 2 April.

<sup>73</sup> Zanker 2016, 189-239.

using imagery to show what is important to the author is something that is prevalent through all the sources I have analysed, whether it is to show off a collection in a museum or an important detail on the back of a coiffure that makes a point about the social context of a portrait. But once the images and text have been printed, exploration and alternate interpretations of the images are made difficult. By saving every step in the creation of my digital reconstruction and making it open and shareable my hope is that knowledge production and discourse can be enhanced by the use of digitised information.

#### 7.4 Discussion - Information and visualisation

So what understanding has this intermedial analysis of museums catalogues generated for my thesis ambition of bettering knowledge transmission for digitised Roman portraits? Starting with tangible information, the biggest shift seemed to have come early in the 20th century along with museums' growing ambition towards a broader knowledge transmission, which started to include mediation to the public as well. Traditional publications seem to devote little less space for this compared to the digital publications who in many cases now try to adhere to guidelines and standards set by projects such as the London charter. The amount of tangible information also seems to be less frequently used in mediation to the public and is perhaps more interesting for researchers. What this then tells me, is that the meta and paradata perhaps does not need to be part of the primary information presentation available in my test of digital environments, as long as it is clear that they are both available, and an easy way to navigate to them presented. Here I have to assume that anyone interested in these types of data will know how to look for them using an intuitive GUI (graphical user interface). And for initial understanding of the representation presented only the most superficial information such as material and size might be important.

The intangible information is then perhaps the type of information that has the greatest potential for being readapted for a new media. This information could consist of many different things depending on who the researcher writing it is, and the type of publication it is going to be a part of. In the museum catalogues we have seen mostly art historical and historical information used to accompany the representations of artefacts. Both of these categories fit into an archaeological narrative about the artefact. The visualised context biography is perhaps my addition to the

narrative as an archaeologist which is more specific to this one artefact, while the other types of information will produce a general narrative on Roman portraits rather than any story of this artefact. But since the archaeological interpretation created using EM can be visualised as a 3D model or a harris matrix, this is perhaps more suited for professional knowledge transmission. Much like the meta and paradata, some parts of the archaeological interpretation can be used in the primary presentation, as long as there is an intuitive way for anyone looking to further their knowledge to find it. The divide between primary and secondary information is not made for any other reason than to not overwhelm anyone looking at the representation, without prior knowledge, with information. My thought with this, is to at a first glance have the environments more resemble a display at a museum where you can look at an artefact and take in the visual information accompanied with information describing its general context. At the same time I want the digital environments to also contain all the other information as easily accessible as possible and act as a multi-layered multimedia repository.

When it comes to images, their relation to information and possibility to transmit knowledge, I believe my analysis has shown that many publications choose to visualise the frontal, back and side view of a portrait. In 2D media these views are selected by a cultural heritage expert, and with the only exception being the earliest museum catalogue, they are also accompanied with information that helps the viewer gain some understanding of what they are looking at. I feel that this approach would exclude someone with prerequisite knowledge to make their own interpretation of the artefact. And to implement only static images would remove the possibility for the observer to explore the representation and perhaps generate additional knowledge. This exploration which gets lost in the transition from a physical artefact to a two dimensional representation can, I believe, by using a 3D model in a digital space only enhance the possibilities of both transmitting information, and generating new knowledge using a representation as a proxy for the real artefact. In a multi-layered digital environment there should be the possibility for a professional to set absolute view points in order to explain their interpretation of the material, as well as the functions for someone else to fully, and on their own, explore the digitised geometric and textural information.

By using different examples of contemporary digital catalogues I hope to show that we do not yet share a standard for online knowledge transmission. For tangible information there has been a traditional way of sharing information that is adapted to digital collections, but what about the intangible? Just as the intent varies in older publications, from mediating that which is available in collections, to dissemination and reevaluation of knowledge, so it does today. But if in the past the artefacts chosen to be a part of the museums publication was selected with regard to their perceived authenticity, and this choice had to be made because of traditional printings limitations in size and cost, today we have the option to showcase every artefact, even those not on display for the public in physical museums. To share a greater dataset of information I believe will only promote further knowledge generation, but in order to easily access this, it has to be transmitted in an intuitive way. Adoption of digital environments also brings up the question of digital literacy. The amount of different tools and scripting languages available to create these environments will inevitably lead to a great range in their appearance and useability, and this is where going back to look at how professional knowledge transmission has evolved comes into play. Because a switch to digital collections is not a break from traditional or analogue ones, but rather an extension and evolution and we have to make sure that both researchers and the public will know how to access and use this information, otherwise we will just have more artefacts now collecting digital dust.

By using and reflecting on the ways knowledge transmission has been, and is used in museum publications, I now hope to have gained some insight into what information that will be the primary focus for my digital artefact visualisation. While transparency and openness has come to be the leading buzzwords for anyone involved in discussions on digital archaeology, I believe that a reflexive approach, where the ways this evolution of transmission has been adopted can bring both a insight into how information can best be transmitted now, and also highlight what is important to append to the project in order to prepare for future more developed techniques of transmission. In the last part of the thesis I will attempt to use the generated dataset of information to present a digital visualisation where all the beforehand mentioned parts of archaeological knowledge production can be visualised.

## 8. 3D visualisation and narrative - A Roman portrait

In the first parts of the thesis I have approached the types of archaeological practice, I called knowledge production in the introduction, which includes analysing the material and choosing what information that would be valuable to save. In this part I am going to move on from only using the 3D model as a proxy for the physical artefact and show how, by using technology, it can be used as a vessel for knowledge transmission. For this purpose I want to test different 3D visualisation solutions to see how professional knowledge transmission and mediation can best be combined in a multimedial narrative experience.

The first step is to gather and organise the information I have stored about the artefact in my dataset. This information will consist of any prior knowledge from the university art collection, information gathered through my analysis of the digital representation, the digital representations of the artefact in 3D and 2D and any intangible information with strong links to either the tangible or represented information. In the end of the intermedial analysis I wrote about primary and secondary information which I believe can be good terms to use when deciding what information to present on the screen. They also correlate with what Manovich calls elements in the *syntagmatic* and *paradigmatic* dimensions. In the book the author differentiates between information in new media, that we perceive as real in the world, and information that is only available in our thoughts.<sup>74</sup> The database here is the real information, which is composed of the digitised information we put in it, and the narrative we build in digital environments is imagined by the author. The purpose of the narrative is to pull information from the database and at the same time engage a response in the observer's own thoughts, somehow acting as an easily understandable vessel for knowledge transfer. My ambition in the visualisation of the digitised artefact is firstly to have it act as a mediator that is able to transmit information about what it is without any of my agency, much like if you were in a museum by yourself looking at artefacts. Second I want to be able to visualise my archaeological interpretation of the artefact, in order to bring more knowledge transmission into the project. And my third ambition is to make the digitised material available for reinterpretation and reanalysis by other cultural heritage professionals.

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<sup>74</sup> Manovich 2001, 229-233.



The primary information I want to be able to visualise for mediation is the following: The 3D mesh with original texture, information presenting what material it is, and the broadest narrative context in order to understand the artefact. I believe this information would be sufficient in order for the visualisation to stand on its own and does not include any of my interpretations.

The second step is where the archaeological interpretation will be the key feature for me to visualise. Both the prior knowledge from the university collection, as well as the results from my analysis will be presented. The primary information I want to transmit in this stage is material, typological style, date, provenance and dimensions. The primary information consists of much the same types as the tangible information I looked for in the intermedial analysis of museum publications. As the secondary information I also strive to transmit stylistic elements, biographical contexts and historical and art historical information tied to these. By choosing to visualise this I hope to emulate the interpretative and transmissional process that is possible while being in the same room and discussing the physical artefact.

In order to allow every part of my digitisation process to be reexamined and reinterpreted in the third step of this process all the data I have generated would have to be available. This data includes photographs, point clouds, 3D models and software save files. Visualising all these different forms of data would be an impossible task for any contemporary visualisation platform or software. Since this is the case I will instead have all the data stored in a cloud repository which can be linked to as part of the primary or secondary information and visualised as text. While this moves part of the intended knowledge generation process further away from any visualisation it still generates transparency into the digitisation process.<sup>75</sup>

Since text and images are the primary ways for me to transmit information I want to discuss the different ways I aim to visualise the text in the different digital environments. The 3D model will mainly be the visual information chosen for all different visualisations. The primary information is meant to make sense on its own, for example “Material: Marble”, and we are also used to absorb information in this way based on my study of museum publications. Short segments of

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<sup>75</sup> Link to cloud repository: [LUKS148\\_datasetfolder](#)

text or a kind of form/table would therefore be the most suitable way to transmit it. The secondary information I believe is better suited being presented in a narrative, which also could be made out from my intermedial analysis. For example the stylistic elements of the coiffure and the chosen material that connects the artefact to a higher strata of Roman society, and whereas this could also be presented on its own much as the primary information, “Social strata indicators: Coiffure, Material”, I believe that a narrative approach is far more suitable in order to engage any viewers.

## 8.1 3DHOP

3DHOP is a free 3D visualiser created by and for cultural heritage professionals. It has multiple powerful tools for in-browser analysis such as measurements, plane slicing and support for visualisation of multiple 3D models in one scene.<sup>76</sup> When 3DHOP is first downloaded it consists of an editable HTML file, and has support for immediate 3D model visualisation and in-environment manipulation of the visualised model. For the purposes of displaying both the model and the information I have gathered, there is no support for any text visualisation without HTML code editing. This delimits my plans for presenting the secondary information as a written narrative, and also for any hyperlinking to the files in my repository for reinterpretation purposes. My own digital illiteracy when it comes to HTML and CSS coding, as well as a lack of any GUI for the user, severely limited 3DHOP as a digital environment suitable for this project. There is also a problem with the shareability of the 3DHOP project. Since the project is presented as a .html file it would require me either to own a web server to upload it to, and visualise it from there, or for me to share the entire project folder to someone else, where upon they would have to present it as a local web server from their computer which also requires a heightened level of digital literacy.

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<sup>76</sup> 3DHOP (2021).



Figure 12: 3D model visualised in 3DHOP.

The out of the box digital environment of 3DHOP is then more suited for further analysis of the materials 3D representation, and perhaps not for mediation. There are examples of 3DHOP being adapted to include support for text information, such as the Lund University Dynamic Collections,<sup>77</sup> and another project from 3DHOPs own gallery,<sup>78</sup> and if I had more time to increase my digital literacy I believe 3DHOP could be adapted into an environment for the kind of knowledge transmission environment I am attempting to create.

## 8.2 Sketchfab

Sketchfab is a retail platform for 3D model online visualisation. It is being used by institutions such as The British Museum and some entries on the database Europeana are also uploaded and visualised using Sketchfab.<sup>79</sup> I believe that it is important to take into account that the free version of this platform only allows for one 3D model to be uploaded every month, and that it also restricts the amount of annotations available, a function I will be using in order to display narrative information. The site provides you with the possibility to upload a single 3D model accompanied by a title and a textbox with space for 1024 characters. This is a very suitable

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<sup>77</sup> Dynamic Collection (2021).

<sup>78</sup> 3DHOP 2021, 5 May.

<sup>79</sup> The British Museum. 2021, 2 April; Europeana (2021).

environment for transmitting the primary information about the artefact, it also leaves me with the possibility of using hyperlinks to guide the user toward another visual representation of the artefact, as well as to the dataset containing all the digitised information. As 1024 characters leaves little space for any narrative information about the representation to be displayed, I am going to take advantage of their built-in annotation system, where you can mark viewpoints of interest on the 3D geometry and accompany them with additional text information.

Sketchfab is a good option for visualising and presenting a digital representation of an artefact as a form of transmission for primary information and, even if limited by numbers of annotations possible, also secondary information as a narrative. The platform is built for 3D model visualisation and not cultural heritage visualisation which is made clear by the lack of tools for any analysis in the browser. This then makes it hard for the user to convey or promote any knowledge generation inside of the digital environment.

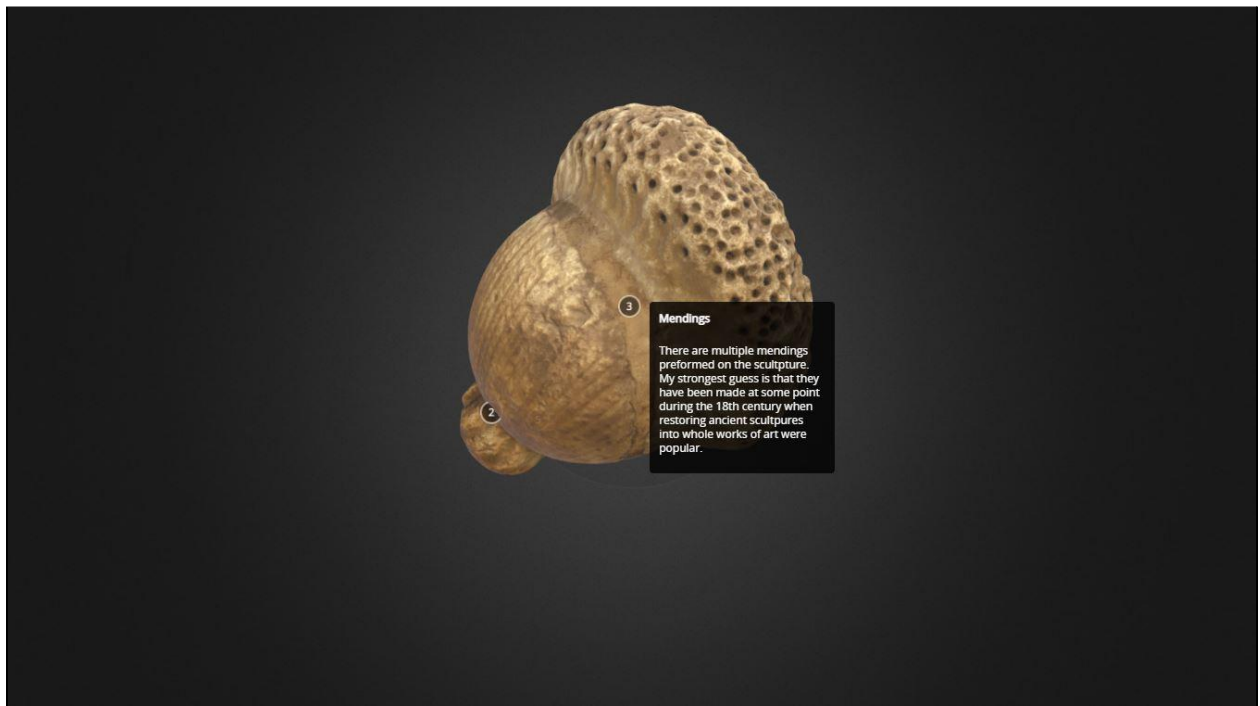


Image 13: Image from Sketchfab with annotation showing.

Link to 3D model in Sketchfab: <https://skfb.ly/onURO>

### 8.3 Godot (3D game engine)

Game engines are powerful softwares that can be used for visualising and manipulating a large variety of digital objects. In recent years there have been both archaeological and cultural heritage projects such as *A night in the forum* and *Nya Lödöse - staden under gamlestaden*.<sup>80</sup> In these projects the capabilities of the game engines have been used to present archaeological material. Godot is a free and open source 2D and 3D game engine that I have decided to use both because it gives the creator full ownership over that which you create,<sup>81</sup> and also because I have prior knowledge of its Python based coding language GDscript.

Using a game engine to visualise 3D model representations of an artefact can both allow the creator to choose what object that is in the scene at which time, and also allow the user to freely rotate the view around them. I could choose to present each 3D model in its own space, much like it would look like in a catalogue, but as the aim of the presentation is to transmit my archaeological knowledge process I decided to have all information shown in the same scene in order to keep all of it spatially close to each other. To display the primary information I have decided to use a textbox with information to show up when the project starts, which will include selected information in text in order to present the material.

To present the secondary information there will be multiple different solutions. A description of the different 3D models will be available in textboxes which will allow me to present the different interpretations I have deduced in my analysis of the digitised artefact. The meta and para data will also be presented underneath the description in order to relay both information about the artefact but also the representation. As a way of transmitting my own interpretation I have decided to emulate the annotation system available in Sketchfab, and a selection of buttons will both change the view in the scene, to ones predetermined by me, and also display narrative text information describing the different elements that the 3D model represent.

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<sup>80</sup> *A night in the forum* (2021); *Staden under gamlestaden* (2021).

<sup>81</sup> Godot (2021).

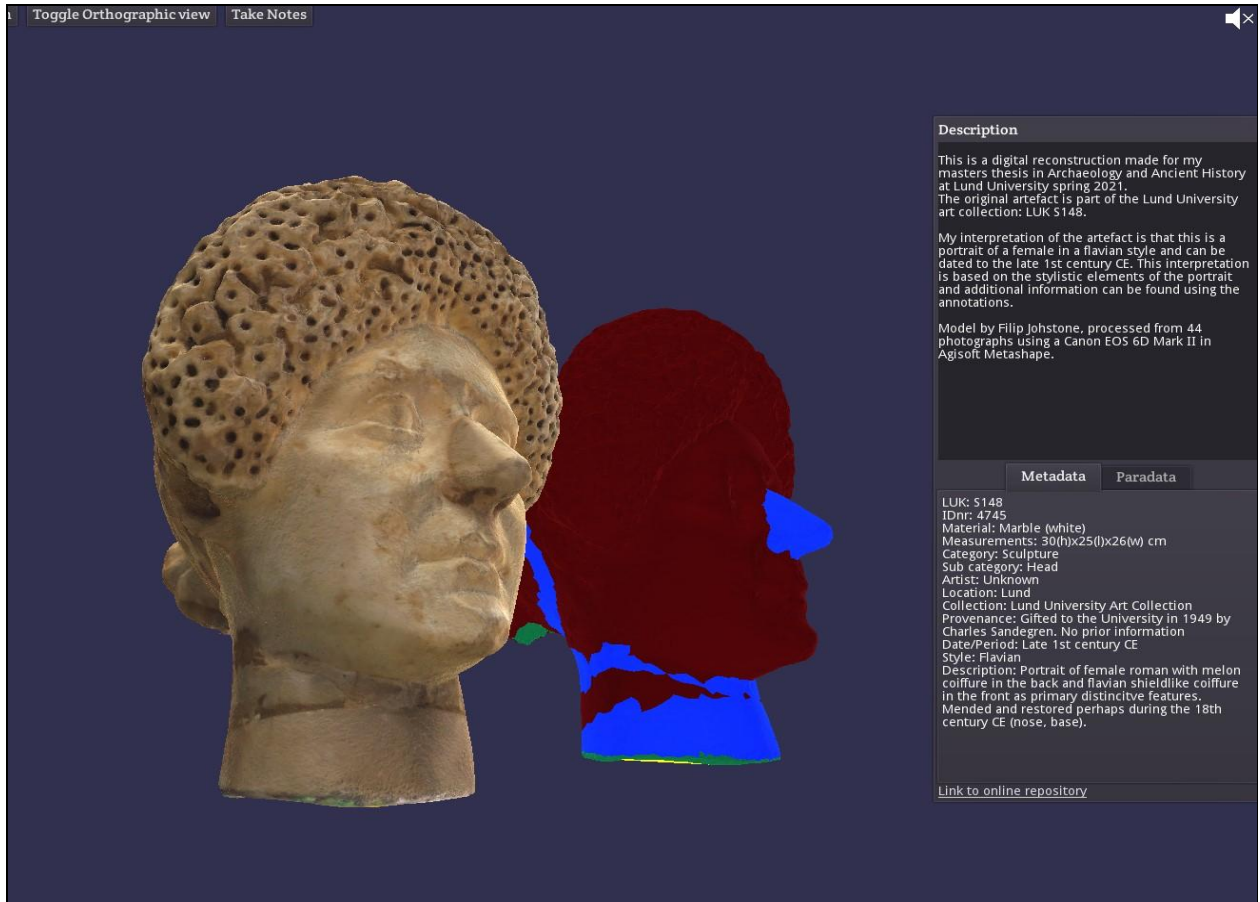


Figure 14: Image from Godot project showing visualising multiple 3D models and accompanying information.

I also made the choice to include background music in the project. This was done to test if additional sensory stimuli would make the digital environment more engaging for the user. Unfortunately there has not been a way for me to empirically test this in this thesis, but the option to mute the sound is also implemented. The information linking to the digitisation project will be visualised both as a hyperlink to the repository, as in the Sketchfab environment, but also as a text that very briefly describes the process of photogrammetry and different types of analysis made on the 3D representation. By using this narrative approach to explain the photogrammetry, I will hopefully bring observers that would not have the digital literacy in order to use the data repository some understanding of the digitisation process.

The visualisation of the 3D models seems to be a little less detailed in Godot compared to Sketchfab or 3DHOP. I believe this has mainly to do with lighting since the same meshes and textures are used in both projects, and then it comes down to my lack of proficiency in using lighting in 3D scenes. Godot presents good solutions for visualising the knowledge gained and the processes done to create this project as text, but would also allow for this information to be transmitted as audio and video. When it comes to shareability it does not allow for any 3D models or text information to be downloaded through the application, such as I have managed to construct it. This function is instead moved to the linked repository and therefore moves the user away from the digital environment in order to themselves make any reinterpretation of data. The project itself can be shared as either an executable (.exe) file, which is a standard file format used by games. Godot allows for exporting projects to multiple platforms such as Windows, HTML5, Mac OS, Android, Linux and IOS. To visualise a Godot project online you would either have to own a webserver to host the HTML5 project on, much like the 3DHOP project, but there is already infrastructure in place to share games online for free such as Itch.IO, which is where I have chosen to make my project available. There is also free infrastructure in place in order to share the source code created for the project at GitHub which allows anyone to examine the processes done to the digitised information in Godot and allows for transparency in the project.

Link to Godot project uploaded to Itch.io: <https://haust891.itch.io/3d-visualiser-test01>

Link to projects source code at Github: [https://github.com/Haust891/Camera\\_gimbal\\_3D\\_test](https://github.com/Haust891/Camera_gimbal_3D_test)

## 8.4 Discussion - Digital Environments

By testing these different solutions for digital knowledge transmission I hope to have shown both the strengths and weaknesses of different types of digitised information, and also highlighted some important aspects on the concept of digital literacy in archaeology. In this part I am going to discuss the tested digital solutions further as well as present projects that I believe demonstrate some strengths and weaknesses when using digital environments as transmission spaces for archaeological data.

3DHOP has powerful 3D rendering and tools that allow for analysis and interpretations of the 3D reconstruction inside of the digital environment, but due to lacking digital literacy on my part, the function of the environment as mediator fell short. It has been shown how environments created with 3DHOP can be used to this end as well, and the previously mentioned Dynamic Collections created by Lund University really focuses on using 3DHOP as a tool for both researchers and teachers to generate and share their interpretations of digitised artefacts.<sup>82</sup> They do this by storing the text and view data you can produce when interacting with the 3D models as .JSON files that easily can be shared and imported into the environment by other users. This approach allows the knowledge generation and transmission processes to take place entirely inside of the digital environment.

Sketchfab allows for beautiful visualisation and sharing of the 3D models, but has restrictions on the amount of information that can be shared in text, and since I have learned from my analysis of museum publications that intangible information is best presented as a longer narrative, this limits the amount of knowledge transmission that can take place inside of this digital environment. It is also a retail product and does not allow for any innovation of analysis tools by archaeologists or other cultural heritage professionals, who might have high digital literacy and would like to be part of an open-source approach to digital archaeological environments. Because of the constraints on the amount of text you can append to each entry many cultural historical institutions have chosen to use hyperlinks in order to present further information,

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<sup>82</sup> Dynamic Collection (2021).



thereby splitting any potential for knowledge transmission deeper than a presentation inside the environment the 3D model is presented in.<sup>83</sup>

Godot allowed me, with my current level of individual digital literacy, to construct a digital environment where both the 3D representations and text information could be used to not only display my results but also the information on the knowledge generation process. It does not allow for any analysis or reinterpretation inside of the environment, but as the code is sharable and free it would allow for these tools to be constructed and integrated by someone with higher digital literacy. Godot allows for code created in the engine to be shared inside of it between creators, and if an archaeological open-source community were to create analytic tools, they could easily be shared and implemented in new projects this way.

Towards my aim of mediating archaeological knowledge I do believe that the Godot project is the strongest of the different digital environments I created. And this raises an interesting question, do we want a one-solution software for visualisation of archaeological data? Digital literacy is such a wide field to explore, and there are many different tools that achieve the same results. Here I believe a similar trend such as one that was spotted in my analysis of museum publications can be discussed. The layout and type of information transmitted is different depending on the researcher, the project and societies expectations on what they want to see from an archaeological publication. But as stated in the beginning of this thesis, archaeological digitisation can be divided into broad types, and if the digital environments we create are constructed with this in mind I believe that we, by adopting user friendly interfaces, can create multi-layered environments that easily guides any user to the type of information they are looking for. In order for archaeologists to expand their digital literacy I also believe every solution is worth testing and discussing. We can start by creating our own frameworks from scratch, as has been done with 3DHOP but I believe the lack of GUI makes the amount of prerequisite knowledge needed very high. Using pre-existing and highly malleable frameworks such as Godot can make the transition from us archaeologists as users of digital environments to creators of them much easier.

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<sup>83</sup> Sketchfab. 2021, 2 April.

## 9. Conclusion

The aim of this thesis was to explore how the digitisation of archaeological collections can facilitate the knowledge production and knowledge transmission of Roman portraits sculptures. In two different parts I have shown how to use digitised information for both knowledge generation and transmission. As a reflexive and symmetrical approach to knowledge transmission I have also studied the evolution of museum publications during the 20th century, hopefully these analyses can help me answer my initial research questions.

1. For what type of analysis can a digitised representation of a Roman portrait stand as a proxy for the real artefact?

As shown in the material study the most general types of analysis in Roman portrait studies can be done using a 3D representation of the artefact as a proxy. This excludes any technological analysis that always would require access to the physical artefact in order to gain any results, but while this is the case the resulting data from any such analysis could easily be added to the dataset of digitised information in the future. While no new type of analysis was made possible because of digitisation, I believe the shareability and ability to reinterpret any result at different stages of the digitisation process can promote a broader academic discussion which is not based on proximity to physical artefacts. The digitised representation can therefore be said to be suitable as a proxy for any analysis that demands human interpretation of visual sensory input. It is also suitable as a proxy for the abstract connections to the varying contexts the artefact is entangled into.

2. In what ways has information about Roman portraits generally been transmitted through traditional and digital museum publications?

The information transmitted through museum publications during the last century has most often consisted of images presenting the artefact accompanied by tangible information. This tangible information is varied in different publications, but as its digital counterpart metadata, there has been a strive towards creating a general standard which would make any dataset readable by cultural heritage professionals all over the world. As for intangible information it is very

dependent on the researcher's own interpretation and field of research. These interpretations are also dependent on larger social contexts, such as what is considered authentic in society. I believe it is not always made clear what information or facts that are derived from use of a scientific method, and what is a researcher's own interpretation of the material. In publications that transmit information about Roman portraits I believe we can see an evolution towards being open and sharing more information about the artefacts, inside of one publication. This evolution can only strengthen knowledge generation, as well as providing mediation that is more transparent towards the fact that we as cultural heritage professionals can not uncover past truths, but rather make interpretations based on our knowledge of cultural contexts.

3. What type of digital media is best suited for multi-layered archaeological digital visualisation?

Digitised information can be manipulated and visualised in a multitude of different ways. This allows us as the transmitters of this information to adapt it in ways that suit our goals and ambitions. When it comes to all forms of knowledge transmission we do have to be conscious about what form the receivers are used to absorb information in, and by choosing to relay everything in text I believe to have adapted to an established standard for knowledge transmission. With this said the possibilities to manipulate the relation between the text and images is by far the greatest advantage I found when using digital solutions. In traditional publications every word and image is static once it is sent for printing, there is ofcourse multiple editions being printed with changes, and representing archaeological information in a digital environment allows for flexibility in these relations both for the transmitter and receiver. As I have shown, the digitised artefact geometry can also by manipulation, allow for knowledge transmission that is presented as visual information in these digital environments. It is my opinion that digital environments allow the archaeological knowledge process to be mediated in a more multi-layered and transparent fashion that grants both the senders and receivers a more free experience in exploring material, while also making the data available for reinterpretation.

Another benefit of digitisation that I did not get the chance to explore in my visualisation attempts is hyperlinking. As I stated in part 7.2 of this thesis, this method is a way to string

information together and it allows for fast access. Unfortunately my small dataset of one artefact did not require any hyperlinking, and so my ability to discuss this area of digital environments is limited. But I do believe that bringing information together faster and easier, perhaps is one of the main advantages of digitised datasets.

This thesis has been an attempt to show ways that digitisation of collection artefacts can impact the archaeological knowledge process from initial analysis, on to mediation and knowledge transmission. It is my belief that digital representations of artefacts are going to be used more in the future. And therefore it is important for us as archaeologists to test in what capacity they are suitable for our field. Digital environments can be manipulated in the same way as we manipulate physical objects when transmitting knowledge to a colleague, in a classroom or in a museum. The only exception is that we have to transmit the intangible information through a media instead of directly, and in so we have to think about how the ways we communicate gets interpreted into different functions inside of a computer. The main idea I hope to communicate with this thesis is to keep all these functions inside of one environment, and this could be functions for digital analysis, dissemination of knowledge, navigating through a database, mediation or pedagogy.

I understand that the idea I paint of time and effort spent when working on one artefact within the confines of this thesis is a realistic one, this drastically differs from the time and effort most people working within the cultural heritage field can put into a project for digitisation of items in a collection. But I do believe that these things are something important we as archaeologists and cultural heritage professionals need to reflect on if we want to make our shared heritage accessible and engaging in a rapidly growing technological society. And I am not proposing that everyone that are digitising an artefact should go about this entire process, but the way we save and store our data should enable someone later on to at least fill some of the knowledge gaps, about even the most seemingly mundane artefact.

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# Appendix I - University art collection catalogue entry

LUK S148                      Underrnr

IDnr 4745

Namn **Okänd, Konstnär**

Artal                                      Kön

Nation

Mått    30    x    25    x    26    cm  
h x b x d

Dagermått                      x                      x                      cm  
h x b x d

Art    skulptur

Material    *marmor*

Teknik

Plats/Sign

Plats/Dat

Tillkomstår

Numrering

Motiv / Titel    Huvud



Upplysning    Tidigare accessionerad som LUK M442.

## Appendix II - Context Descriptions for LUK S148

LUKS148:1001

Portrait of Roman female. Dated to the late 1st century CE during the Flavian period. White marble. 30cm high. Several medings at a later period.

LUKS148:1002

Reconstructed nose in marble.

LUKS148:1003

Reconstruction of neck in marble.

LUKS148:1004

Mortar mending in the back coiffure.

LUKS148:1005

Mortar mending on the neck.

LUKS148:1006

Insufficient information during photogrammetry due to lack of information on photographs. Some angles were hard to photograph because the portraits mending and weight would not allow maneuverability of the artefact.

LUKS148:1007

Insufficient information during photogrammetry due to lack of information on photographs. Some angles were hard to photograph because the portraits mending and weight would not allow maneuverability of the artefact.

LUKS148:1008

Reconstructed face based on existing geometry. Created in order to create a manifold mesh.

## Appendix III - Paradata

<b>Digitised information folder</b>	LUKS148_dataset12
<b>Acquisition method</b>	Photogrammetry
<b>Software used</b>	Agisoft Metashape
<b>Num of textures</b>	1
<b>Total polygons</b>	1,499,999
<b>Num of pictures</b>	44
<b>Total points</b>	750,396
<b>Author</b>	F. Johnstone
<b>Project filename</b>	dataset_12.psx
<b>Texture filename</b>	dataset_12_high
<b>Mesh filename</b>	dataset_12_high.obj
<b>Link to online repository</b>	<a href="https://drive.google.com/drive/folders/1J4wht5NWNKsaPdCOHCjzqAo8gtkfenf?usp=sharing">https://drive.google.com/drive/folders/1J4wht5NWNKsaPdCOHCjzqAo8gtkfenf?usp=sharing</a>

## Appendix IV - Metadata

<b>LUK</b>	S148
<b>IDnr</b>	4745
<b>Material</b>	Marble (white)
<b>Measurements</b>	30(h)x25(l)x26(w) cm
<b>Category</b>	Sculpture
<b>Sub category</b>	Head
<b>Artist</b>	Unknown
<b>Location</b>	Lund
<b>Collection</b>	Lund University Art Collection
<b>Provenance</b>	Gifted to the University in 1949 by Charles Sandegren. No prior information.
<b>Date/Period</b>	Late 1st century CE
<b>Style</b>	Flavian
<b>Description</b>	Portrait of female Roman with braided coiffure in the back and Flavian raised coiffure in the front as primary distinctive features. Mended and restored perhaps during the 18th century CE (nose, base).