

Hertziana Studies
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Visualizing Complexities

Practices and Heuristics of Digital Models in Art History

Edited by Nicola Camerlenghi, Tanja Michalsky & Elisabetta Scirocco



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Tanja Michalsky & Tristan Weddigen

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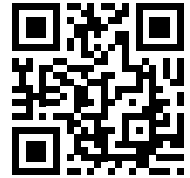
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Abstract

Giacomo Landeschi

What is a 3D Model and Why Do We Model? Some Reflections Built Upon Archaeological Case Studies

keywords – 3D modeling, Gis, Spatial Analysis, Virtual Reality, Pompeii



This article discusses the role of digital 3d models and spatial analysis for the study of ancient space. Drawing upon archaeological case studies, the aim is to reflect on theoretical and methodological issues that have long characterized the debate over the use of three-dimensionality in the study of ancient space. Nowadays 3d models are ubiquitous, with an increasing number of practitioners in the field of Cultural Heritage creating their own 3D contents and sharing them through online repositories with a diverse audience including researchers, students, and public. Still, whether data visualization and dissemination are important aspects to cover, to draw real advantage from the third dimension it is crucial to reflect on its heuristic value and the opportunities it can open for research. The proposed work pipeline combines 3d models and Geographical Information Systems (Gis) to analyze archaeological objects in their contextual space in order to address specific research questions that include the evaluation of any symbolic value connected to the architectural space of a Pompeian house.

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What is a 3D Model and Why Do We Model? Some Reflections Built Upon Archaeological Case Studies

Giacomo Landeschi

Following a commonly agreed definition, the term ‘model’ refers to a process of simplification of something more complex to enable understanding. Different techniques, including predictive modeling, least-cost path and viewshed analysis have long been used in archaeology to investigate the human past and to gain new knowledge about the (pre)historic landscape. In recent years, the development of more advanced hardware and software solutions allowed archaeologists, art historians and cultural heritage specialists to deal with complex forms of data representation, which include 3D boundary and volumetric models. Despite this form of data is now becoming ubiquitous, a real discussion of the theoretical and methodological implications connected to the use and misuse of 3D data in our discipline has yet to occur. One question is particularly urgent: what is the heuristic value of 3D modeling and how can we benefit from three-dimensionality for increasing our understanding of the past? How can we overcome the traditional picture of 3D technology as a mere tool for improving the user’s visualization experience and try to set new standards and best practices in order to take advantage of 3D models as additional exploratory tools? Drawing upon the experience matured at Lund University, we investigate the potential of 3D-based spatial analysis for addressing specific research questions: monitoring endangered heritage sites, re-enacting excavated stratigraphic sequences, assessing the multisensory engagement within a digitally reconstructed space of the past.

Material Culture and the Role of Affordances

The ancient space is not a static, immanent entity and it cannot be fully understood without considering the role played by its original inhabitants. Drawing upon this concept, it is the duty of an archaeologist to question current analytic methods and interrogate him/herself on what effective contribution can be brought by computational approaches to the study of the past as a lived space made by people, encounters, relationships, but also affections and emotions.

To cope with this issue, we should pay attention to three key elements: material culture, affordance, and modeling. As for material culture, intended as any material manifestation of (past) human activity, it is no surprise that it constitutes the main focus of archaeological investigation, being an essential source of information to connect ourselves with the mindsets of people from the past. Still, material culture does not tell us very much if we cannot grasp the intended meaning behind the object and possibilities of actions it can afford. That is why affordance plays an important role in this process of knowledge production: it is the way for us to ‘read’ a meaning of an object by interpreting its visual properties and so to infer about functions and actions that it could have ‘facilitated’.¹

Then the question that arises is about the strategy to put in place to deal with affordances and the relational space where past peoples lived. Modeling becomes a crucial element for this

¹ Gillings 2012; Gibson 1977.

purpose: according to Gary Lock,² a model is a simplification of more complex phenomena, made to enable the process of understanding. Modeling in its different forms, including surveying, drawing, has been widely used in archaeology (long before digital methods were introduced) as a standard practice to document and analyze the visual and material characteristics of an object, a monument or a landscape.³ Whether most of modeling processes have long been aimed at imitating the reality of the past,⁴ the real challenge nowadays is to simulate aspects of past realities⁵ (including the immaterial ones) and try to build scenarios where it is possible to adopt formal methods of analysis to better understand how that space was used by its original inhabitants.

GIS and 3D Spatial Analysis

In this respect, 3D data and Geographical Information Systems represent a viable solution as they provide users with an array of tools to visualize and, most remarkably, to analyze the archaeological landscape from a contextual/situated perspective.

Research conducted at Lund University has sought to demonstrate how three-dimensionality can be used as a heuristic tool to fulfill several research questions and to redefine archaeological practice. There are, in particular, a few research areas on which we have focused our attention. These include:

1. Risk assessment for endangered heritage sites;⁶
2. Re-interpretation of legacy data in an original way;⁷
3. Investigation of the symbolic dimension of ancient space;⁸
4. Analysis of marginalized aspects of past reality such as the 'emptyscape', or secludedness.

Through these projects we have sought to demonstrate how three-dimensionality can be employed as an effective analytic tool to

further our understanding of well-defined archaeological problems. Indeed, 3D data are nowadays ubiquitous in archaeology and are rapidly becoming a de-facto standard for site documentation in many different contexts spanning from research-led projects to cultural resource management enterprises. Still, the use of 3D models is often limited to improving the visualization experience of a user and communication of Cultural Heritage-related contents.¹⁰ There are obviously significant limitations that we must be aware of when it comes to data representation both in 3D modeling and GIS which span from the lack of transparency in model reconstruction, to the inadequacy of digital mapping to represent the reality of the past.¹¹ Nevertheless, the recent developments in 3D-informed GIS technology led to the possibility of managing 3D boundary models in a geodatabase management system (GDBMS) and to take advantage of GIS-based spatial analytic tools for a thorough and contextual investigation of the virtually reconstructed space of the past.

Towards a Heuristic Approach?

A case study in Pompeii was developed to test a novel method by which to investigate the social dimension of the ancient space through the analysis of the visual impact of a wall painting and by defining innovative workflows for the study and the analysis of the domestic household in Pompeii. This was achieved by taking a situated perspective of potential observers moving and interacting within the house. As thoroughly described in recent publications,¹² a wall painting describing an erotic scene was examined in a 3D GIS environment to better understand its visual impact within the space of the peristyle. Interestingly, by running a fully-3D Line-of-Sight (LOS) analysis, it was possible to determine both the number of hypothetical locations which provided a direct view to the fresco as well as the percentage of fresco's surface that was visible by the different standing points (fig. 1). Such an approach allowed us to raise new interpretations about the location

2 Lock 1995.

3 Dell'Unto/Landeschi 2022.

4 Gillings/Goodrick 1996.

5 Forte 2011.

6 Campanaro *et al.* 2015.

7 Landeschi *et al.* 2019.

8 Landeschi *et al.* 2016.

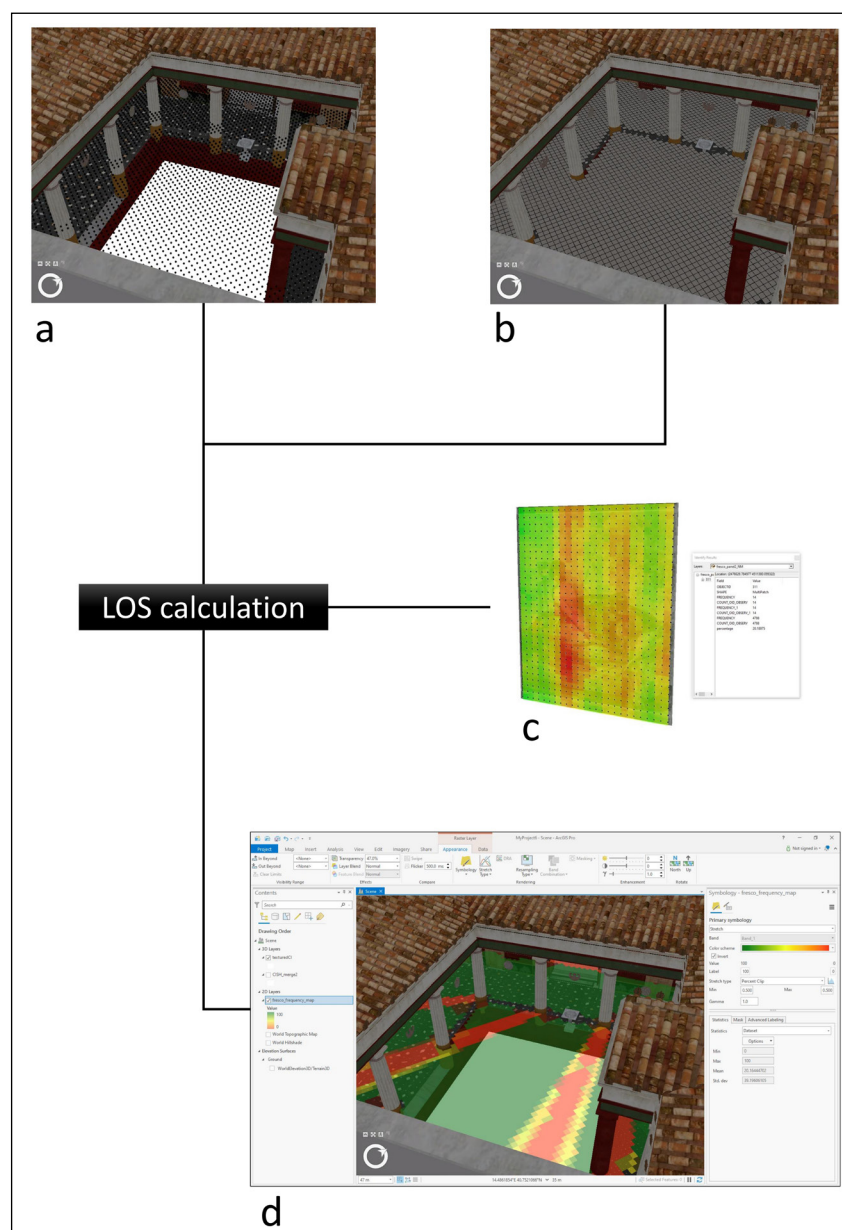
9 Landeschi 2019.

10 Frischer 2008.

11 Llobera 2012.

12 Landeschi 2019; Landeschi *et al.* 2016.

Figure 1
Workflow for Line-of-Sight (Los) analysis in
GIS (ArcGIS Desktop/Pro software release):
(a) setup of hypothetical observing points,
evenly distributed through the space of the
virtually reconstructed house of Caecilius
lucundus (height on the ground floor 1.65
m, space interval 0.2 m). (b) vector panels
defining the horizontal grid of analysis.
Los algorithm enabled us to generate (c)
a vertical map of visual exposure of the
fresco's surface and (d) a horizontal map of
cumulative visibility of the fresco from each
observing location.
From Landeschi *et al.* 2016.



and the symbolic significance of the examined artifact: its seemingly prominent position (it was originally located on the wall just next to the dining room entrance) was not so visible as we would have expected just by examining it on a traditional map plan. This was due to the presence of columns and other vertical visual obstacles that would have prevented a passerby from clearly recognizing figures and scenes represented in the wall painting. In addition, another problem was posed by the narrowness of the visual angle for those observing from locations situated too close to the peristyle wall where the fresco was placed.

In brief, this approach allowed us to redis-
cuss on a more general level, the problem of
visibility studies in archaeology and the use
of computational methods for simulating
sensory perception in a digitally reconstructed
space of the past. Interestingly, one of most
neglected aspect is that of visual acuity¹³ (and
the way it affects human sight and its capa-
bility of discerning details of objects. Natural
and artificial light, as illustrated recently by
Papadopoulos and Moyes¹⁴ is also an element
that is often dismissed from most visibility
studies conducted in archaeology and cultural
heritage.¹⁵ For these reasons, as a further stage

¹³ Ogburn 2006; Bernardini *et al.* 2013.

¹⁴ Papadopoulos/Moyes 2021.

¹⁵ Gillings/Wheatley 2020; Cassatella/
Carlone 2013.

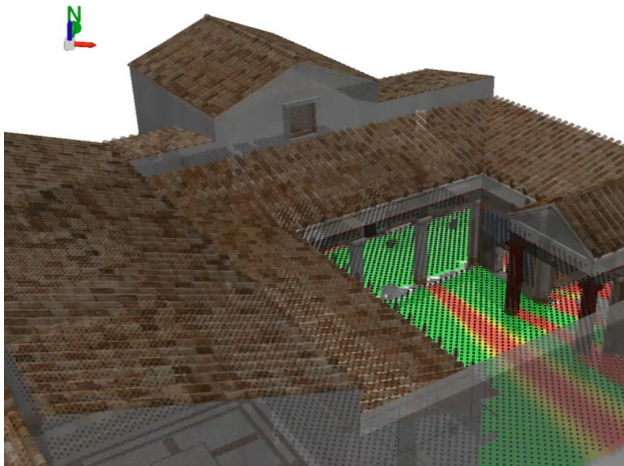


Figure 2

Workflow for Line-of-Sight (LoS) analysis in Gis (ArcGis Desktop/ PRO software release): the video <https://doi.org/10.17617/3.BxTD5K> shows the setup of hypothetical observing points, evenly distributed through the space of the virtually reconstructed house of Caecilius lucundus (height on the ground floor 1.65 m, space interval 0.2 m). LoS algorithm enabled us to generate a vertical map featuring the percentage of visual exposure of the fresco's surface and a horizontal map of cumulative visibility of the fresco from each observing location. From Landeschi *et al.* 2016.

of this research, we have been recently testing innovative methods for measuring visual attention in the attempt to deal with the issue of visual acuity and illumination effects. This was made possible by integrating Virtual Reality, Eye-Tracking technology, and 3D GIS. Although we are at a very preliminary phase of the research, a workflow (fig. 2) has been defined and a few measurements were performed on a very limited number of sample users, who were asked to walk through the virtual space of a Pompeian house (Casa degli Epigrammi Greci),¹⁶ and perform different tasks in order

to analyze their visual behavior in relation to architectural and iconographic details visible in the reconstructed space of the house.¹⁷

To sum up, this experiment allowed us to define new strategies for an experiential investigation of an ancient built space, where the use of modeling and three-dimensionality played a pivotal role and where combined methods allowed archaeologists to raise new interpretations and pose new questions about limitations and possibilities for future research around 3D-based spatial analysis applied to Cultural Heritage sites.

¹⁶ Staub Gierow 2008; Staub 2009.

¹⁷ Campanaro/Landeschi 2022.

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