The virtual model in archaeology

Continuity of the 3D medium in documentation, reconstruction and publication.

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Zürcher Hochschule der Künste
Knowledge Visualization

Project developed for the MA graduation in Knowledge Visualization at Zurich University of the Arts (ZHdK), Switzerland. Mentor: Joe Rohrer.

ESAG
ÉCOLE SUISSE D'ARCHÉOLOGIE EN GRÈCE
SWISS SCHOOL OF ARCHAEOLOGY IN GREECE

The excavation in Amarynthos are under guidance by the Swiss School of Archaeology in Greece (ESAG) and the Ephorate of Antiquities of Euboea.
Partners: Tobias Krapf, Scientific secretary at the ESAG; Alexandra Tanner: Architect and building researcher at the University of Zurich.

Introduction

With methods ranging from "Structure from Motion" to "Virtual Reality", 3D models have become a familiar appearance in the field of archaeology. But despite many good examples of individual applications, the medium is far from being established as an integral part in the archaeological research. To that end a more holistic approach might be required, reflecting on the use and the benefits offered through the 3D media in all stages of the research work – starting with the field documentation over the analysis till the final communication at the end of the project.

This poster doesn't attempt to offer "one solution to fit all", but it aims to share one example of how a continuous application of the 3D medium could look like.

Method

This poster presents the conclusions of one specific project: the reconstruction of a 4th c. BCE stoa in the sanctuary of Artemis in Amarynthos, currently excavated by the Swiss School of Archaeology in Greece (ESAG) in collaboration with the Ephorate of Antiquities of Euboea. As part of a 3 semester Master degree at the Zurich University of the arts, the goal of the project was the visual documentation of all relevant findings, developing a 3D reconstruction model, and finally a proposal for its presentation in a digital environment.

The methodology was focussing on 3D-modelling, but included all the available methodologies from pencil drawing up to 3D printing.

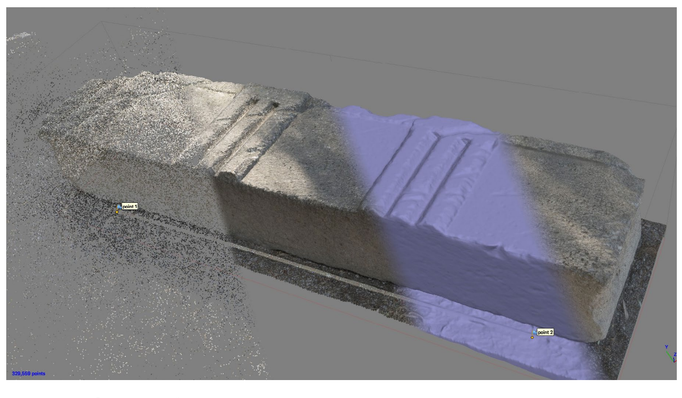
Conclusion

The project illustrated, that virtual models – and visualisations generally – come in many different shapes and are constantly evolving as the project progresses and brings different requirements. To use these fluid forms of visual information to ones benefit needs a thorough understanding of the different visualisations, their advantages and disadvantages, and how they can be transformed from one to another. After all it was mostly the transformation, which offered a different view on the subject and eventually generated new forms of knowledge.

The following sections present the different shapes of the 3D model during the three main stages of a research project and try to answer some of the most relevant questions.

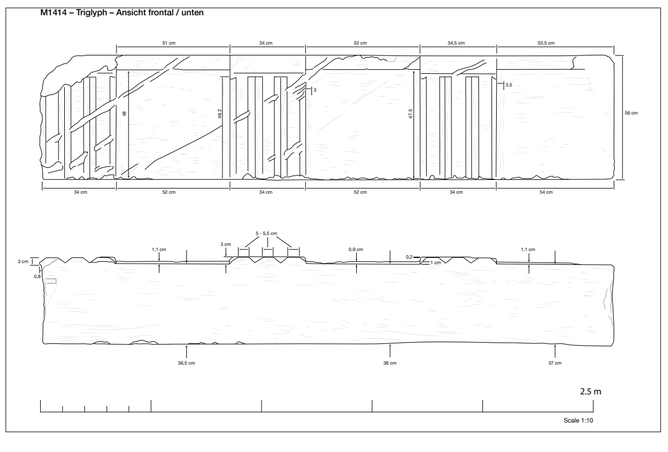
Documentation

The objects of research in archaeology are usually bound to a specific location, even more so when it comes to the remains of architecture. Quite often the context of excavation get also irrevocably altered or lost during the process. The basis of any further research and communication is thus the documentation, with its form and quality being crucial for any work beyond the site. An important part of the recorded information is of visual nature and requires visual methods.
Besides the long-established documentation drawings, spatial documentation methods like "Structure from Motion" (SfM) or Laserscanning make it possible to acquire complex 3D data of nearly every size. Whether as point clouds or as polygonal model, this data offer great opportunities not only to expand the documentation quality, but for all kind of further utilizations, be it analysis or communication.
To offer the best basis for further usage, certain standards must be achieved, e.g. true to scale or georeferenced, no strong shadows, colour correction, etc.



Structure from Motion
The image here shows the 4 steps the Software Agisoft Metashape takes to calculate a detailed and textured 3D model based on input photographs.

SfM models
The virtual models generated through structure from motion were ideal for further application – in virtual space as well as in the 3D printer.



3D to drawing template
These drawings were made with the use of templates based on SfM model to the left. The detailed drawing was created in front of the element, where all the details are best visible.

Drawing to model
Sometimes the precisest method for reconstruction modelling is achieved with the help of the 2D drawings rather than with the SfM models.

Do 3D models replace the drawings?

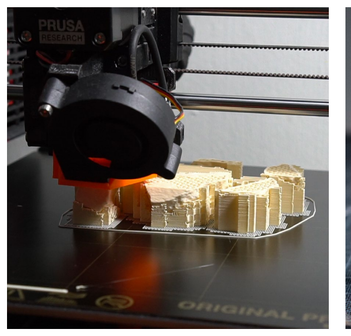
The drawing of the findings – being it stratigraphy, building structures or objects – remain an important part of the documentation, no matter how far 3D technology develops. Being two dimensional, scaled and produced through human observation rather than automation, drawings offer a completely different approach compared to the 3D documentation methods. The debate whether new 3D technologies replace the classical drawing thus is obsolete. The technological advances none the less have an impact on the nature of drawings and how they are made. For one, new tools have evolved for digital drawing, eventually skipping the pen and paper draft. At the same time spatial documentation can calculate proper templates for the drawings.
Though I believe there will always remain the situation where the pencil drawing is the fastest method to achieve a detailed up to scale drawing.

Reconstruction Modelling

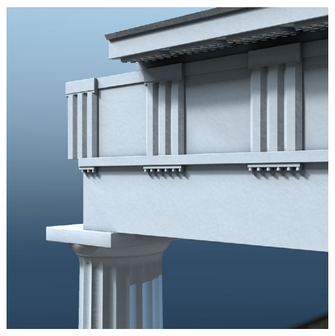
3D modelling allows the virtual manipulation and a visual-spatial examination of the findings. At this stage of active research, the modelling is not about a final product to be presented to an audience, but rather about the process of making: Like a virtual draft, the reconstruction model aims to develop ideas further and to generate a deeper understanding of the research subject. Changing between media (e.g. 3D model, 3D print, drawing) can support this.

A virtual reconstruction can pursue different goals, a variety of which gets discussed for example by Wittur (2012). For the stoa in Amarynthos, the aim was to evaluate the available find objects, how they might have been used in the building, as well as the general building construction itself.

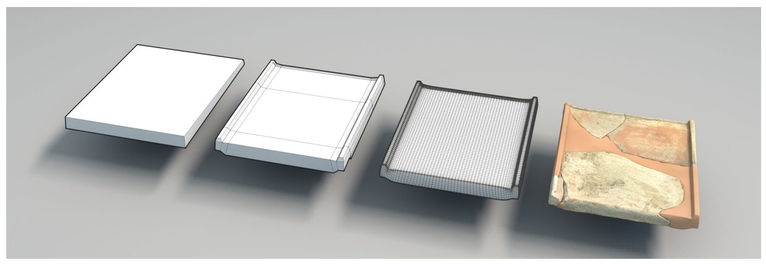
For the reconstruction model of the stoa of Amarynthos every step was discussed with the experts of the team: the archaeologist Tobias Krapf and the architect & building researcher Alexandra Tanner, who also drew the final CAD reconstruction plans of the stoa.

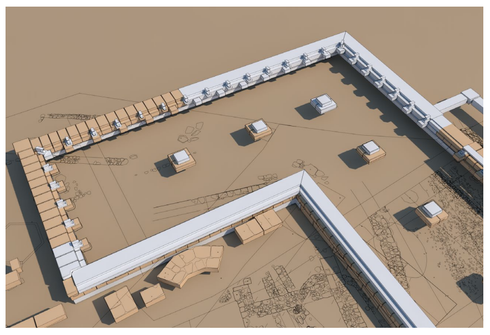


3D Print
The example here shows 3D printed fragments of a column drum, which could only be matched together thanks to these physical plastic copies in scale 1:10. The original fragments were stored in different locations.



Reconstruction process
This image shows the reconstruction process of a roof tile. The modelling was done on the SfM-Models, here on the very right.





CAD drawing to model
The ability to import CAD plans into 3D modelling software makes it easy to model the structures very precise. In brown here the in situ preserved foundations, the white blocks are not preserved anymore.

What makes reconstruction modelling a tool for research?

Surprisingly it is less about the reconstruction model or its appearance, but rather about the process involved. Besides a systematic approach, most crucial is a detailed documentation about the modelling process. It describes the used data, the decisions made whilst progressing, and the conclusions and insight gained.
This allows future researchers to understand the relation between the model as artificial construct and the findings as "evidence". It also helps the involved experts to understand the process – it might be future oneself.

A practical solution is suggested by Grellert & Pfarr-Harfst (2019) with their reconstruction-argumentation-method. This concept was essential when developing the interactive prototype described below.

Communication

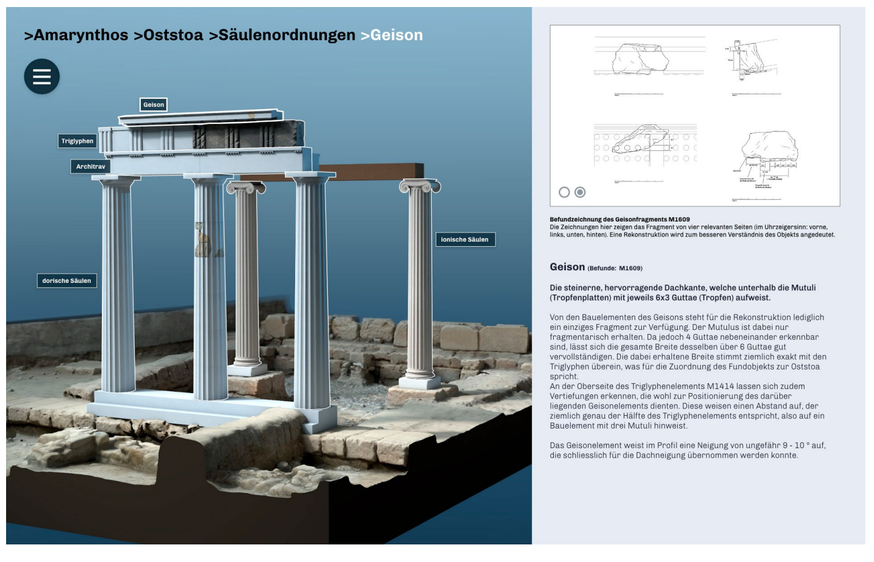
The final goal of every project is to communicate the research and findings to scientific peers and, quite frequently, also to a broader audience. The 3D models, previously generated and developed for research purposes, proofed to be great resources for any kind of communication, as their visual nature allows an easy access.
These models and visualisations need perhaps to be adjusted to suit the need of the audience, or to be extended with additional content.

When it comes to communication there is a wide range of media available for all kinds of channels. This reaches from the "simple" print products to animations, interactive applications till virtual reality.

In the project of the stoa it was not possible to offer a fully working, interactive solution in the short time available. Instead an interactive prototype was developed, to offer none the less an idea how interactivity could enhance the communication of a reconstruction model and show the multiple layers of information behind the model.

Interactive Application
An interactive application allows the visitor to disassemble the reconstruction model and see which findings and which information are actually behind the conclusions shown in the model.

Make sure to test out the prototype in the link below the image.



> visit the interactive prototype <

3D technology for long lasting solutions?

The academic publications in the discipline of archaeology are still mostly based on print. Even digital formats come usually as PDF and offer very little additional features compared to conventional print products.

For the publication of 3D content there are so far very few practicable solutions, even less so when it comes to interactive media. But it is exactly interactivity which would allow an experience similar to the one during the modelling process, that could communicate the model to its fullest.

Generally the "advanced" technologies as for example interactivity or real-time 3D see their application more often in public communication as in museums rather than in academic context.
To be considered a serious option for the publication they probably lack the guarantee of being accessible for the long terms.

References:

Wittur, J. (2012). Computer-generated 3D-Visualisation in Archaeology: Between added Value and Deception. Oxford: BAR Publishing.

Grellert, M. and Pfarr-Harfst, M. (2019). Die Rekonstruktion-Argument-Methode: Minimaler Dokumentationsstandard im Kontext digitaler Rekonstruktionen, in: Kuroczyński, P., Pfarr-Harfst, M. and Münster, S. (eds.) Der Modelle Tugend 2.0. Heidelberg: arthistoricum.net.
doi: https://doi.org/10.11588/arthistoricum.515

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