3D Models, Knowledge and Visualization: a prototype for 3D virtual models according to plausible criteria

Daniel Carvalho *based on peer reviews by* **Louise Tharandt** ⓘ *and* **Robert Bischoff** ⓘ

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The construction of 3D realities is deeply embedded in archaeological practices. From sites to artifacts, archaeology has dedicated itself to creating digital copies for the most varied purposes. The paper "Visual encoding of a 3D virtual reconstruction's 3 scientific justification: feedback from a proof-of-concept research" (Jean-Yves et al 2024) represents an advance, in the sense that it does not just deal with a three-dimensional theory for archaeological practice, but rather offers proposals regarding the epistemic component, how it is possible to represent knowledge through the workflow of 3D virtual reconstructions themselves. The authors aim to unite three main axes - knowledge modeling, visual encoding and 3D content reuse - (Jean-Yves et al 2024: 2), which, for all intents and purposes, form the basis of this article. With regard to the first aspect, this work questions how it is possible to transmit the knowledge we want to a 3D model and how we can optimize this epistemic component. A methodology based on plausibility criteria is offered, which, for the archaeological field, offers relevant space for reflection. Given our inability to fully understand the object or site that is the subject of the 3D representation, whether in space or time, building a method based on probabilistic categories is probably one of the most realistic approaches to the realities of the past.

Thus, establishing a plausibility criterion allows the user to question the knowledge that is transmitted through the representation, and can corroborate or refute it in future situations. This is because the role of reusing these models is of great interest to the authors, a perfectly justifiable sentiment, as it encourages a critical view of scientific practices. Visual encoding is, in terms of its conjunction with knowledge practices, a key element. The notion of simplicity under Maeda's (2006) design principles not only represents a way of

thinking that favors operability, but also a user-friendly design in the prototype that the authors have created. This is also visible when it comes to the reuse of parts of the models, in a chronological logic: adapting the models based on architectural elements that can be removed or molded is a testament to intelligent design, whereby instead of redoing models in their entirety, they are partially used for other purposes.

All these factors come together in the final prototype, a web application that combines relational databases (RDBMS) with a data mapper (MassiveJS), using the PHP programming language. The example used is the Marmoutier Abbey hostelry, a centuries-old building which, according to the sources presented, has evolved architecturally over several centuries ((Jean-Yves et al 2024: 8). These states of the building are represented visually through architectural elements based on their existence, location, shape and size, always in terms of what is presented as being plausible. This allows not only the creation of a matrix in which various categories are related to various architectural elements, but also a visual aid, through a chromatic spectrum, of the plausibility that the authors are aiming for.

In short, this is an article that seeks to rethink the degree of knowledge we can obtain through 3D visualizations and that does not take models as static, but rather realities that must be explored, recycled and reinterpreted in the light of different data, users and future research. For this reason, it is a work of great relevance to theoretical advances in 3D modeling adapted to archaeology.

References:

Blaise, J.-Y., Dudek, I., Bergerot, L. and Gaël, S. (2024). Visual encoding of a 3D virtual reconstruction's scientific justification: feedback from a proof-of-concept research, Zenodo, 7983163, ver. 3 peer-reviewed and recommended by Peer Community in Archaeology. https://doi.org/10.5281/zenodo.10496540

John Maeda. (2006). The Laws of Simplicity. MIT Press, Cambridge, MA, USA.

Reviews

Evaluation round #1

DOI or URL of the preprint: https://zenodo.org/record/7983164
Version of the preprint: 1

Authors' reply, 05 January 2024

Thanks for the time spent in finding reviewers for this paper, and thanks for the careful proofreading, all the changes suggested have been introduced in the new version I am about to submit.

Decision by **Daniel Carvalho**, posted 08 December 2023, validated 08 December 2023

Dear authors,

After the revision process, which was very positive, I would like to refer you to the minor revisions that were requested to improve your article. After this process, this work will become a solid contribution to the issue of 3D reconstruction and the methods inherent to it, and I will be happy to recommend it as such.

Reviewed by **Robert Bischoff** ⓘ , 27 November 2023

This paper, including its accompanying virtual product, is a description and proof-of-concept for the documentation and visual exploration of uncertainty or, as the authors term it, 'plausibility', of 3D architectural reconstruction. This paper tackles important goals: the reusability of data, the documentation of necessary metadata/paradata, and the sharing of data.

I found the paper to be well-organized and researched, and the online product was easy to use and functioned well. I believe the most important contribution of the paper is the justification matrix illustrated in Figure 2. As the authors' note, the details can surely be debated, but my review supports the authors' proposal without modification. There may be situations where modifications need to be made, but I believe the framework is specific enough to be useful while generally broad in scope. Too many criteria or possible values would make analysis more difficult. This paper is a valuable contribution to 3D methods in archaeology and should be recommended with only minor copy edits (a few suggestions are noted in the attached document).

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Reviewed by **Louise Tharandt** ⓘ , 14 November 2023

The paper was well written with a fitting title and abstract. Material and methods were explained in detail and the motives behind the features of the prototype were clearly demonstrated. The lack of visual encoding solutions of 3D models was highlighted and the rules displayed in the appendix were an interesting way to challenge the ongoing issue of using 3D models in cultural heritage. The tables and figures are well utilized. I have tested the prototype and the desktop version works well, with explanations of all features and easy to understand navigation. The mobile version is harder to navigate, while the model can be moved, the windows containing the information and matrices are hard to read and navigate.