Thinking beyond the Tool
Archaeological computing and the interpretive process

Edited by
Angeliki Chrysanthi
Patricia Murrieta Flores
Constantinos Papadopoulos

Commentary by
Jeremy Huggett

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About the Editors*

Angeliki Chrysanthi is a PhD candidate at the University of Southampton. Central to her research is the examination of methodologies for exploring visitor movement and the new potential for on-site presentation introduced by the ‘augmented space paradigm’. She has a background in Archaeology (BA), Preservation of Monuments and Sites (MSc) and has worked in several archaeological and heritage site preservation projects in Greece and, more recently, at the Akropolis Restoration Service. Her growing interest in studies such as mobile augmented reality, Human-Computer interaction and visual cognition has unfolded a series of new research directions and collaborations. She is part-time research assistant on PATINA research project (funded by RCUK Digital Economy programme) and senior member staff of D.E.P.A.S. Mycenae fieldwork project in Greece (The Archaeological Society at Athens in collaboration with the Archaeology Department of Dickinson College, Carlisle).

Patricia Murrieta Flores holds a PhD in Archaeology by the University of Southampton. She specialises in spatial technologies, GIS, High Performance Computing, and other applications of technologies to archaeological research. Her main interests include Landscape Archaeology, computational approaches to past human movement, the structuration of megalithic and symbolic landscapes of prehistoric Europe, and Zoque-Mayan Archaeology. She studied a BA in Archaeology at the National School of Anthropology and History of México and obtained an MSc in Archaeological Computing from the University of Southampton. She is field supervisor and scientific advisor of several archaeological projects in Spain and Méxi co. She has an extended record of publications and is co-director of projects in the Balearic Islands, Tarragona (Spain), and Chiapas (México). She is currently working to set in place a cross-institutional collaboration for the creation of a ‘Centre for the study of past human mobility through computational modelling’.

Constantinos Papadopoulos is a PhD candidate at the University of Southampton employing formal and informal analytical tools and computer graphics to critically evaluate the ways that modern methodological tools, and especially three-dimensional visualisations, can enhance archaeological interpretation. He has studied Archaeology and History of Art (BA) and Archaeological Computing (MSc), and he is interested in the theory of visualisation, perception and interpretation in prehistoric archaeology, the processes of recording in archaeological fieldwork, as well as the importance of light in the understanding of ancient built spaces. He has published his work in peer-reviewed journals, edited volumes, conference proceedings and a monograph and has produced archaeological documentaries which have been presented in internationally acclaimed festivals. He works as a supervising archaeologist, IT manager and 3D visualisation specialist in the Zominthos Project in Crete (The Archaeological Society at Athens), and in Koutroulou Magoula Archaeology and Archaeological Ethnography Project in Thessaly, Greece (Ephoreia of Palaeoanthropology and Speleology of Southern Greece in collaboration with the University of Southampton).

* Editors are listed in alphabetical order
Advisory Committee and Referees*

Vasko Démou - PhD candidate, University of Southampton, UK

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Christopher Witmore - Associate Professor, Department of Classical and Modern Languages and Literatures, Texas Tech University, USA

The editors of the volume also acted as referees for the papers related to their fields of interest and expertise.

* Names are listed in alphabetical order
Contributors*

Tom Brughmans
Archaeological Computing Research Group, University of Southampton

Paul Cripps
Wessex Archaeology

Rosa Cuesta
Universidad Rovira i Virgili (URV), Catalan Institute for Classical Archaeology (ICAC), Archaeological and Archaeometric Research Team, University of Barcelona (ERAUB)

Andrew Dufton
Joukowsky Institute for Archaeology and the Ancient World, Brown University

Corisande Fenwick
Department of Anthropology, Stanford University

Ignacio Fiz
Universidad Rovira i Virgili (URV), Catalan Institute for Classical Archaeology (ICAC), Archaeological and Archaeometric Research Team, University of Barcelona (ERAUB)

Tom Frankland
Archaeological Computing Research Group, University of Southampton,

César González-Pérez
Institute of Heritage Sciences (Incipit), Spanish National Research Council (CSIC), Spain

Jeremy Huggett
Department of Archaeology, University of Glasgow

Karen Jeneson
Thermenmuseum, Heerlen, The Netherlands

Markos Katsianis
Aristotle University Thessaloniki, Greece

Gary Lock
School of Archaeology, University of Oxford

Elaine Massung
University of Bristol

Hannah Pethen
School of Archaeology, Classics and Egyptology, University of Liverpool

Eva Subias
Universidad Rovira i Virgili (URV), Catalan Institute for Classical Archaeology (ICAC), Archaeological and Archaeometric Research Team, University of Barcelona (ERAUB)

Philip Verhagen
Research Institute for the heritage and history of the Cultural Landscape and Urban Environment (CLUE), Faculty of Arts, VU University, Amsterdam, The Netherlands

Alice E. Watterson
Glasgow School of Art, Digital Design Studio

Mu-Chun Wu
School of Archaeology, University of Oxford

* Names are listed in alphabetical order
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Introduction

Archaeological Computing: Towards Prosthesis or Amputation?

Angeliki Chrysanthi, Patricia Murrieta Flores, Constantinos Papadopoulos

Archaeological Computing Research Group, University of Southampton

Keywords: Archaeological Computing; Interpretation; Prosthesis; Amputation.

1. Origins and scope of the Book

The idea of putting together this book was inspired by the session ‘Thinking beyond the Tool: Archaeological Computing and the Interpretive Process’, which was held at the Theoretical Archaeology Group (TAG) conference in Bristol (17-19 December 2010). The session, as well as the regular format of paper presentations, included a round table discussion at the end of the session, to provide a debate forum for the participants, and encourage the development of the dialogue which emerged from the various presentations. This format not only facilitated the discussion on a better theorised approach to computer applications in archaeology, but also allowed delegates with diverse backgrounds to elaborate on common concerns from different perspectives. The overarching theme of the session, which revolved around how the various computational tools affect the ways we practice archaeology and interpret and disseminate aspects of the past, generated a series of stimulating debates, some of which we will attempt to highlight during the course of this introduction.

Although there are several fora that focus on computer applications in cultural heritage (to name a few, the Annual Conference on Computer Applications and Quantitative Methods in Archaeology; the Conference on Cultural Heritage and New Technologies; the International Congress of Archaeology, Computer Graphics, Heritage and Innovation; Arqueologica 2.0; and the International Symposium on Virtual Reality, Archaeology and Cultural Heritage), as well as several magazines and academic journals, (such as the Archeologia e Calcolatori, Internet Archaeology, Archaeomatica, Journal on Computing and Cultural Heritage, and the International Journal of Heritage in the Digital Era), most of them are driven by an increasing technological fetishism (Huggett 2004). The general trend has been to lay emphasis on the technological aspects of these approaches, and the significance of developing technical solutions to approach cultural heritage data. Several try to keep a balance between the theoretically informed papers and the applications of technologies. This is also true in the case of traditional archaeological research, where the usual point of departure, both in conferences and academic journals, has been the presentation of methodologies and case studies. Identifying and responding to a diachronic (and increasing) demand to support technological developments in our field with more rigorous theoretical grounding, led us to organise this session at TAG. It is worth noting that although TAG is not a typical archaeological computing venue, this was not the first time it successfully accommodated such a topic (e.g. Session <TAG 2.0/>, Southampton 2008, workshop on Cyber-archaeology, Stanford 2009 (Forte 2010), CASPAR Session, Bristol 2010). Furthermore, the publication of our book coincides with the celebration of the 40th year of the Annual Conference on Computer Applications and Quantitative Methods in Archaeology (CAA) where, for the first time in its history, there was a call for sessions on ‘Theoretical Approaches & Context of Archaeological Computing’.

The scope of the book aims to build on previous approaches to archaeological method and theory, and place emphasis on the fact that archaeological computing, with its wide range of applications and methodologies, has gradually become central to most archaeological practice. Yet archaeological computing is still seen as a set of tools, which provide a methodological exactitude to overcome problems and constraints. This mentality marginalises and separates it from the rest of archaeological practices. However, the diverse range of approaches presented in the book’s 12 chapters, make it apparent that computational approaches are not mere media, but processes of data recording, management, analysis and presentation and any attempt to distinguish archaeology and archaeological computing invalidates our efforts to make archaeology richer. The notion of interpretation as a process is the foundation stone of our book, as we postulate that computer applications in archaeology are not only related to end products, they are also integral elements in the process of cognition.
2. Interpretation in archaeological computing: are we on the same page?

The notions of interpretation and interpretive process are inextricably linked with archaeological practice. Interpretation, starting ‘at the trowel’s edge’ (Hodder 1997), came to the forefront in the late 70s with the post-processual school of thought, which emphasised the subjectivity in all stages of knowledge production, and gradually became synonymous with interpretive archaeologies (Shanks and Hodder 1995, 5). Accordingly, interpretation does not only mean a personal explanation or meaning, but also embraces agency, which contains cultural meaning, intentions and purposes (Hodder and Hutson 2003). These variables, since they are highly dependent on the social and cultural context of the present, make interpretations flexible, and therefore neither a single interpretation can be provided, nor could multiple interpreters give the same interpretation. In this context, post-processualism encouraged experimentation with multiple and alternative readings of the datasets, which may not necessarily lead to one acceptable truth (Shanks and Hodder 1995, 6-11). The gradual shift from the scientism and positivism of processual archaeology (quantification and statistics in archaeological computing) to the structuralism and human agency of post-processual thinking, influenced the way that the interpretive nature of archaeology was confronted. In both cases, it was the methodologies employed to transform data into theory, and reach a desirable outcome, that changed the nature of archaeological interpretation (Lock 2009, 76).

However, in the realm of archaeological computing, we came to realise that there is still a lack of consensus regarding the content of the term ‘interpretation’. This was not only derived from the round table discussion, but also from the content of the papers and the reviewing process. Is interpretation synonymous with theory? Does theory include the process of interpretation? When does interpretation take place in the workflow? And finally, is interpretation a process or a product? The word interpretation has been used in different contexts, with a slightly different meaning in each case, though always emphasising that interpretation involves a distinctive personal opinion and explanation. In archaeology, it has the same meaning, with the process for reaching an interpretation being emphasised, since it encompasses arguments, hypotheses and understandings. These distinctive elements flag interpretation as a process rather than a product. However, the meaning of the word interpretation is not always so profound. According to Ascher (1961), archaeologists have four main tasks: ‘First there is the formulation and refinement of concepts; second, data gathering and processing; third, the interpretation of the data, and finally, synthesis.’ Although this phrase defines interpretation as an essential step in archaeological practice, it takes place at the end, or near the end of a project. Considering the epistemological context of this saying, i.e. New Archaeology, it is reasonable that ‘objectivity’ and scientific authority precedes interpretation. However, in the 1980s onwards, archaeological research started widely adopting the notion of interpretation as a subjective process in archaeological practice, while trying to stay as detached as possible from the objective study of the past. Since then, however, the meaning of the word wavers between two different concepts; firstly, as an explanation and understanding, and secondly as a process that takes place throughout an archaeological research project. A Google Scholar search on ‘interpretation and archaeology’ yields about 340,000 results. These seem to be arranged around two large clusters: i) case studies examining how different approaches enhance the interpretive process, and ii) studies on the nature of archaeological interpretation and its links to archaeological theory. The former significantly outweighs the latter. It is also important, to make a clear distinction of the term, as it is used in the quintessential Ename Charter (Icomos 2007, 3), where interpretation ‘refers to the full range of potential activities intended to heighten public awareness and enhance understanding of cultural heritage sites’. In that sense, archaeological computing has always played a key role in the interpretive process by employing a range of rich media for public dissemination.

This book aspires to fit between these categories, as we believe that archaeological computing not only constitutes the tools that enhance archaeological interpretations, but also provides an active interpretive process, from the stage of conceptualising research questions through modelling and the end products. Apart from the case studies presented in the 12 chapters of the book, the authors have in most cases incorporated a theoretically informed discussion, in which, they either raise issues of wider significance in archaeological computing, or discuss the decision making process and the formulation of concepts that finally led to the interpretations. However, especially in the realm of archaeological computing, the criticism is that the interpretive process may entertain greedy reductionism (Dennet 1995, 82).

3. Towards prosthesis

Reductionism is used to describe the understanding of complex phenomena by simplifying their components, and examining their individual elements by incorporating them into a broader whole, a more general reality (Jones 2000, 13-16). Reductionism has been the basis of most scientific fields and is an unavoidable step (Johnson 2010, 169) in the development of processes and explanations. Reductionist approaches (cf. holism by Smuts 1926, holistic archaeology by Marcus and Flannery 1994, 55), which were central to the scientism of processual archaeology, are necessary to explain phenomena which in other ways may have been difficult to appreciate. However, quite often, these approaches fail to consider the complexity of the datasets and the sociocultural variables that existed in the past. Due to the nature of the archaeological record, there is a general consensus regarding the impossibility of evaluating all
the variables that might have existed in archaeological reasoning. Senses, perception and identity for example, or any other non-quantifiable human factors, are variables which cannot be approached by established conventional means.

On the contrary, although computer applications in archaeology follow the same reductionist strands as any decision making process in traditional archaeological practice, they have often been criticised for a tendency for over-reductionism, described by Dennett (1995, 82) in the context of cognitive science as greedy reductionism. The term mainly refers to the misrepresentations and misinterpretations because of scientists’ eagerness to explain the unreachable. In the case of archaeology, this may be synonymous to bad archaeologists and practices. However, in the context of archaeological computing, this becomes more complicated. For instance, computational methods have lately provided the means to simulate and analyse illumination in ancient structures (Papadopoulos & Earl in press). By highlighting the paucity of means provided by traditional archaeology, we have demonstrated an eagerness to exploit these tools to their full extend. In this process, however, it is not only human agency that is responsible for bad archaeology; we often underestimate the complexities of both the archaeological record and the tools we use, resulting in unwarranted conceptual and methodological leaps. It should also be noted that these advanced computer-based methodological approaches - as with most scientific and theoretical applications in archaeology - were developed and firstly applied within other disciplines. As a result, many variables, crucial for understanding, interpreting and presenting the past, are deficient or completely missing, as they cannot be modelled and/or simulated with the tools we use. For example, complex social phenomena cannot be dealt with, since at the core of computing processes quantification is a prerequisite for any analysis. In several cases this may also mean that since we rarely have adequate knowledge to repurpose the tools used, we are often forced to revisit our research questions and interrupt our research practice or reasoning.

The spur of multidisciplinary collaborations in archaeological research and the development of purpose built computing tools were motivated by realising their limitations. In this context, reflexion and self-criticism were also encouraged. Realising that reductionism is ingrained in archaeological computing, we may have found its Achilles’ heel, leading both these practices and their practitioners to the fringes of archaeology. Considering archaeological computing as a set of tools (as a matter of meaning and not terminology) in an attempt to defend our academic and scientific integrity, we abstract by definition their essential role, reducing them to an auxiliary asset. However, the purpose of this book is to look through and think beyond any obstacles posed by the media used. The emphasis is laid upon the capabilities of these methods to work not only as physical, but also as mental, extensions of our work. As such, they boost an everlasting process of experimentation, testing and discussion in ways that would have been impossible with the use of conventional methods. They actually function as prosthetics of our body and mind constructing strands of research, knowledge and perception.

3.1. Computational tools as prosthetics

The term prosthesis, from the Greek word προσθετην, meaning addition, is used in the discourses of anthropology, media theory and computing, to refer to any artefact or device which functions as an additional part of the human body; as an instrumental extension of human performance. In essence, a tool is an artefact that functions as a mediator between us, and the environment in which we operate (Ingold 1993). Used as such, artefacts have diachronically played a key role in human innovations, from hominid stone-tools to current mobile and wearable technologies. The notion of prosthesis is also interrelated to the phenomenon of ‘technological embodiment’, the situation where machines and/or technologies assume the organic functions of the body (Balsamo 1995). The concept of cyborg, a hybrid human-machine entity, is useful here, as it is being used in cyborg theory to demonstrate that boundaries between human and machine, among other traditional binary oppositions, are blurring in our contemporary and technologically equipped society (Haraway 1991).

McLuhan (1994, 7) in his seminal book Understanding Media: The Extensions of Man, stresses the physicality of media that function as ‘any extension of ourselves’, and pinpoints that electric technology could be seen as an extension of our central nervous system. The notion of prosthetic technologies as extensions assumes a synergy between the physical and mental aspects of this human-machine interaction.

To fully comprehend how computer aided methodologies act as an extension of our research processes, we need to look beyond the tool itself, and shift our attention to the notion of the ‘awareness of the task’. This is better understood in Heidegger’s classic example of operating a hammer, where after repeated and skilful handling of the tool, awareness is gradually shifting from the tactile sense of holding the wooden shaft, to the corporeal motion of hammering, until awareness is focused on the task itself (Heidegger 1962, 70/99). Taking this example in the archaeological scenario of fieldwork, we may recall holding a trowel and experiencing a similar transition of awareness, while excavating archaeological layers. A synchronous task would be to keep mental notes about the texture and composition of the soil and the finds themselves, before recording our observations in the diary and taking levels with a total station. These tools form part of an ‘equipmental totality’, which functions ‘in a network of pragmatic relations assigning tools to contexts, to tasks, to goals, and to the ultimate underlying point of what we are doing’ (Carman 2003, 851). Computational tools and media, whether or not they were built for archaeology, are at our disposal to use within a network of other methodological approaches, all participating in a higher level of inquisition and synthesis, hence their increasing presence in
interpretation. In Heidegger’s words ‘Dealings with equipment subordinate themselves to the manifold assignments of the ‘in order to’ (Heidegger 1962, 69/98). The same dominance of ‘task’ and, ‘in order to’, rather than tool awareness occurs when excavating with a trowel, writing up our reasoning with a pen or a keyboard, and interacting with a dataset on particular software.

However, Heidegger refers also to the term ‘readiness-to-hand’ (Zuhandenheit), arguing that it requires familiarity with the object in use in order to sustain awareness to the task or the ultimate goal for which it is being used. The example of the hammer perhaps led many scholars to mistake the Heideggerian ‘readiness-to-hand’ with the Gibsonian ‘affordance’, where an object affords the agent to perform a certain action (Gibson 1977). In the hammer example, the tool affords grasping and hammering, and this does not require any previous knowledge of using the tool. Nevertheless, the inexperienced user cannot use it as the skilful carpenter does, and thus, it is more likely that he cannot transit to the stage of task awareness. Perhaps, it is more appropriate to parallel Heidegger’s term in the example of a brass musician, who during the warm up stage, is aware of his face contractions or the sense of the metal mouthpiece on his lips, whereas during performance - an immersed stage of being - the instrument becomes one with his body and mind. Appropriating Heidegger’s phenomenological observations, we could argue that a prerequisite to successfully manipulate computational tools and immerse ourselves in the interpretive process is to have attained a certain level of mastery. This notion applies to all stages of scholarship and can hardly constitute a criticism to archaeological computing. In the last decade computing analyses, for instance through GIS, are carried out by archaeologists with greater awareness of the actual mathematical structures and assumptions implemented behind each software. Nevertheless, the influence and impact they have in the interpretive process are rarely discussed or included in publications and reports. It could be said, then, that we should be able (and keen) to discuss how is that computing approaches shape archaeological interpretation, and how these extensions influence the reconstitution of our discipline.

3.2. The implications of prosthesis

Prosthesis, as a situation where technological tools become human extensions, is interwoven with the concept of amputation. Each time the human body and mind uses an extension in order to amplify a certain sense or activity, a synchronous numbness of a different area of our perception occurs (McLuhan 1994, 46). This is widely known in physiology as ‘autoamputation’. To exemplify this we will use a well-known case from heritage studies; visitors who have used audio guides during their visit to a museum or a heritage site reported to have experienced irritation and limited perception of the visited environment, a situation which also entails safety issues as Massung mentions in her paper (chapter 11). This is also a typical criticism of the use of such interpretive devices, as they distract visitor’s gaze from the actual exhibits. By valorising hearing, they diminish the rest of the perceptual mechanisms and eventually, they interrupt the exploratory nature of the visit.

Ocularcentrism: an amputation of archaeology?

The concept of amputation, as a corollary of the prosthetic nature of computational tools, could be better understood when linked to the way that visualisations have formed archaeology (and archaeological computing) and transformed the way of comprehending the past. Computer applications, in the same way as archaeology (Moser 2001, Smiles and Moser 2005, Thomas 2008), have been long haunted by fierce ocularcentrism. The production of visual material during the processing, analysis and presentation of data is a necessary step in order to evaluate and follow the interpretive process developed via and within the methodological means we use. The main problem - if one can sense a problem in that - is that the tools employed in our work analyse and present the data mainly by using different forms of visualisation. Firstly, we have to transform real world data into information that can be articulated by the tools. Therefore, the qualities of the real world are flattened in to two-dimensional senseless visuals (Tufte 1990) by a wide range of methods traditionally used in archaeology. Our input is largely based on graphical interfaces, and consequently vision dominates this stage as well. Arguably, tactility plays a significant role, as the visual interface is manipulated by the use of devices (e.g. mouse, keyboard, digitising tablet etc.), which require interaction by touch. However, our familiarity with these devices has moved this process to the ‘awareness of the task’, moving beyond the conscious interaction with them. Still, this subconscious physical interaction influences (consciously or not) our thinking about the task (cf. the adoption of iPads in Pompeii Archaeological Research Project). However, vision remains dominant. The output as well, whether it is a photorealistic rendering, an animation, a least cost path analysis in GIS, an Entity-Relation model in a database or an XML Schema, are also visual, projected on screens or printed on paper. Although this ocularcentrism may sound reasonable, since Western culture privileges vision over a multisensory perception and understanding of the world (Classen 1993; Jay 1996; MacGregor 1999), there is the underlying danger of the neglect of fundamental elements, formed by different sensoria, that mould our knowledge about the past. Consequently, have we as researchers come to terms with a form of self-amputation in the process of expanding and amplifying our understandings of the past?

Attempting to overcome the problem

The realisation of these limitations in archaeology have led to phenomenological, experiential (Tilley 1994, 2004, 2008; Ingold 2000, 2007), corporeal (Hamilakis, Pluciennik and Tarlow 2002) and kinaesthetic/multisensory approaches (Cummings 2002; Rainbird 2002; Hamilakis 2002, 2011; Skeates 2008,
2010). In addition, a series of developments in technologies, programming languages and devices indicate a premise for a more holistic experience of the past. Such approaches led to the design of computer-generated environments, which could simulate human presence and interaction in the real or in an imaginary world, involving hearing and often touch, and creating a sense of immersiveness (Reilly 1991, Gillings 1999). Virtual Reality technologies were mainly facilitating the public aspect of cultural heritage, while archaeological research also tried to benefit from this trend (see for example Gaitatzes et al. 2000, Goodrick and Gillings 2000, Ch’ng et al. 2005). Lately, the attempts to emulate immersive environments have moved to the development of devices which can simulate high-fidelity multisensory environments. A characteristic example is the virtual reality helmet called Virtual Cocoon (Chalmers et al. 2009, Chalmers and Zányi 2009), which is currently under development by leading universities in the UK, and promises a ‘real virtuality’ experience. Further developments in the field, in the ‘continuum of virtuality’ (Milgram et al. 1994) but on the opposite side of virtual reality, such as augmented reality applications (Noh et al. 2009), attempt to create or disseminate interpretation in mixed reality environments, where presumably more of our senses will be able to interact with the information. In fact, recent trends in human-computer interaction and ambient intelligence are pointing towards more subtle ways of linking technologies to human performance. In these attempts, although technologies are physically present, maintain a discreet role -and in the ultimate scenario are even transparent- in assisting human agency. Finally, the advent of Web 2.0 enabled on-line interactivity, information sharing and the creation of multi-participatory platforms (e.g. Second Life) and contributed to the formation of a cyber-archaeology (Forte 2010). All these attempts possess great potential towards promoting a synergy of human-machine interaction, as it was envisaged by futurists from the 80s and onwards. However, crucial practical, methodological, and theoretical issues still pose certain limitations to its realisation; and this is not only because human senses cannot yet be sufficiently simulated in computer-generated environments.

4. Putting the pieces together

So what is the relationship among theories of senses, ocularcentrism, amputation, prosthesis and archaeological computing? We will demonstrate this by providing an overview and raising an analogy. The discussion on senses came to the forefront after the realisation that interpretations based only on visual data and visual mechanisms for capturing, processing and analyses have certain limitations. Arguably, in certain cases visuals can activate a series of perceptive mechanisms (for example cognitive scientists argue that static visuals can evoke the presence of movement -Gibbs 2005, 55). Nevertheless, as vision remains dominant, we are subconsciously led to a self-amputation. In this context, theoretical discussions and applications related to the multisensory perception of environments were introduced, revolutionising archaeological practice and the computational methods applied to archaeological datasets. However, this attempt encountered scepticism, as well as conceptual and practical issues. By considering senses in the context of archaeology, it was thought that a major drawback of archaeological reasoning and interpretation could be overcome; however, the framework of this attempt, mainly derived from the westernised perception of sensory experience, was still problematic. Our research and explanations are dominated by a problematic concept, according to which our five senses are autonomous agents which form our perception of a given environment. In other words, each sense is independently contributing to our experience. Sensory scientists challenge the notion that only our five senses form the experience of the physical world. They argue that intermediate or additional senses, that work subconsciously, as well as the evocation of memories, transform our unilateral experience into a synaesthetic journey. By way of analogy, we could argue that senses are (extensions of) ourselves, the same way that computational tools are becoming prosthetics of ourselves. The dubious notion of five distinctive senses still stands between us and our interpretations, in the same way that the tools used in our research are still considered distinct entities, existing in a toolbox, rather than on our desk or in our mind, as physical and mental extensions of ourselves respectively. However, there is also a great difference; as archaeologists, we have not reached the point where we will consider tools synonymous to our mental and physical existence, the same way that we think (or do not think) about our senses. Senses are immanent and are developed since the time of our birth. In contrast, the tools, and consequently the knowledge and skills needed to manipulate and master them, are acquired. This brings in mind Freud’s words when he talks about science and technology in his Das Unbehagen in der Kultur (1961, 38-39):

‘Man has, as it were, become a kind of prosthetic God. When he puts on all his auxiliary organs he is truly magnificent; but those organs have not grown on to him and they still give him trouble at times...Future ages will bring with them new and probably unimaginably great advances in this field of civilization and will increase man’s likeness to God still more’

5. Conclusion

This paper, in an attempt to introduce the underlying concept of the book, presents only some preliminary thoughts on the way archaeological computing is confronted. Touching upon the ideas of prosthesis and amputation, we contributed to the discussions regarding computational approaches, not as media, but as thinking processes. We will continue acquiring knowledge and skills to dominate the tools and to come to terms with them as extensions of ourselves. Theorising and problematising our interaction with them is a crucial step in the process of learning and acquiring skills. Bringing new concepts and ideas from within archaeology and
other disciplines, communicating the processes to different audiences, and adopting diverse approaches, are key factors towards ‘thinking beyond the tool’.

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References


