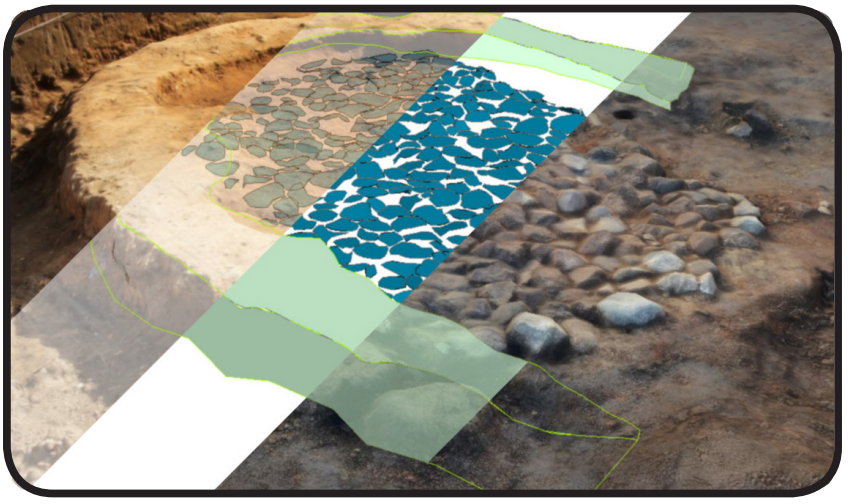
3D Delineation:

A modernisation of drawing methodology for field archaeology

Justin J.L. Kimball



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Contents

List of Figures

Abstract

A recent trend concerning archaeological research has focused on producing a real-time methodology for 3D digital models as archaeological documentation within the excavation setting. While such methodologies have now firmly been established, what remains is to examine how 3D models can be integrated more fully alongside other forms of archaeological documentation. This work explored one avenue by developing a method that combines the interpretative power of traditional archaeological drawings and the realistic visualisation capacity of 3D digital models. An experiment was initiated during archaeological excavations at Uppåkra, Sweden where photographic data was captured to produce 3D digital models through Photoscan. These models were geospatially located within ESRI's 3D GIS ArcScene where shapefile editing tools were used to draw overtop of their surfaces in three-dimensions. All drawings closely followed the single context method of drawing, were allotted context numbers, and given descriptive geodatabase attributes. This methodology resulted in the further integration of 3D models alongside other forms of archaeological documentation. The drawings increased the communicative powers of archaeological interpretation by enabling the information to be disseminated in a 3D environment alongside other formats of data that would have otherwise been disconnected in 2D space. Finally, the database attributes permitted the drawings complete integration within the geodatabase, thereby making them available for query and other analytical procedures. Archaeological information is three-dimensional; therefore, archaeologists must begin to approach documentation bearing this in mind. This technique has demonstrated that 3D models are a fluidic form of documentation allowing for accurate preservation of archaeology while enabling new forms of data to be derived all within a limited amount of time. Archaeologists must begin to affect change towards embracing 3D models and their associated applications as a standard tool within the excavator's toolbox.

Keywords: 3D modelling; multi-view stereo reconstruction; MSR; archaeological drawing; 3D drawing; field archaeology; excavation methodology; excavation documentation; archaeological photography; transparency; reconstruction; 3D/4D GIS.

Cover Image: (A still image of 3D models and 3D drawings) Presented here is a composite image showing multiple 3D models and 3D drawings from the same perspective in a 3D GIS environment. From upper left corner to lower right corner: 1) 3D model of an earlier phase of excavation of an oven feature in Trench 5, Uppåkra; 2) the same 3D model as before, reduced in transparency to reveal the 3D delineation of archaeological features that were 'at-the-time' hidden beneath the clay layer (an example of chronological—4D—layering; 3) another example showing chronological layering, this time solely with 3D drawings of the clay horseshoe-shape and the underlying stone-packing layer; 4) an image retaining the 3D polygon drawing of the horseshoe-shaped clay layer superimposed over top of the last phase of excavation (stone-packing layer); and 5) a final example of chronological layering where only the 3D polyline is visible over the 3D model representing the last phase of excavations. (Image by J.J.L. Kimball 2014; 3D Drawings by J.J.L. Kimball 2014; Base 3D model by J.J.L. Kimball 2014; Overlay 3D model by N. Dell'Unto).

Back Cover Image: (Screen-capture of 3D model/3D drawing) The top image shows completed 3D drawing for the second 3D model of Trench 5. The bottom image shows a transparent overlay of the 3D drawing overtop of 3D model. (Images by J.J.L. Kimball 2014; 3D models/3D drawings by J.J.L. Kimball 2014).

Preface

The research and its results contained herein represent an original and independent thesis work by the author Justin J.L. Kimball, under the supervision of Dr Nicolo Dell'Unto, for the degree of Master of Arts in Archaeology from the Department of Archaeology and Ancient History, Lund University (Sweden) and was awarded in 2014.

The original version of this work, in thesis format, may be found on the Lund University Publications (LUP) Student Papers website—the hyperlink to the search catalogue found in the footnote below.[1]

In accordance with *Archaeopress*, the work contained within this documented has been modified to reflect the publisher's stylistic guidelines and publication standards. Apart from these changes, the content material remains largely unaltered from the original version.

[1] Lund University Publications Student Papers search site: https://lup.lub.lu.se/student-papers/search

1 – Introduction

Field archaeology has always been a discipline that depends greatly upon technology and the way those technologies are used in order to achieve knowledge of archaeological material (Jensen 2012: 12-13). Such a fact has become reaffirmed in the last two and a half decades as digital technologies have increasingly made their presence evident throughout archaeology. This particular influx has been of tremendous benefit in that digital technologies have opened new possibilities through which new paths have been pioneered. Following such opportunities, archaeologists have now acquired the ability to look upon the excavation with new light: the application of digital technology not only enables new forms of data for analyses, it also facilitates all stages of acquisition, management, and post-processing—including not just digital, but traditional forms of data as well. Research into digital technologies thus enables an exciting and promising avenue for the documentation and understanding of archaeological resources. While an increased dependence upon digital technologies does not mark a replacement of traditional archaeological tools, it is important to recognise that digital technologies are able to play an important supplementary role—one where, through our potential to acquire and interpret both traditional and newer forms of data, the conclusions of an archaeological investigation are made more accurately, expeditious, and fruitful.

It must be recognised, however, that digital technologies are in a continuous state of development and thus these technologies, whether indirectly or directly, are also developing as viable components towards the production of archaeological knowledge. In turn, this signifies that there are yet many aspects to be explored regarding the theoretical and methodological aspects of digital technology itself and its role in concert alongside of their more traditional counterparts in archaeology. Therefore, the pronounced youth of digital technologies sets forth a profound challenge for archaeologists. Only through an all-encompassing, deliberate, and objectified amelioration of digital methodologies will these technologies be able to find their place within archaeology—a deployment where their strengths are used efficiently and, more importantly, in an archaeologically relevant manner—and further towards the development of standards aimed at achieving comprehension over targeted archaeological material and the ability to disseminate the resulting knowledge (Campana 2014: 7-8).

One of these more recent trends in the use of digital technologies in archaeology has been the introduction of and the increasing interest placed upon 3D digital data technologies. The impact is ultimately tied to advances in computer technologies: the increase in power and decrease in cost has made ‘luxuries’ such as 3D modelling more attractive. This in turn has opened up a typology of data that is so new and exciting that its role has not yet been firmly cemented within archaeology. Thus, both a heightened awareness and a desire to solidify a place for 3D digital data technologies have created an interest to pursue these technologies more thoroughly. In field archaeology for example, a continual stream of research papers has been published over the past decade where 3D models have been used to capture and generate archaeological knowledge. Some of these experiments are significant as they have been attempted within the timeframe of the excavation itself. These mark important milestones as they have shed light upon the value that 3D models present for archaeology.[1]

Thus, the methodology described and developed in this work has sought to contribute towards the exploration of innovative applications for 3D data in field archaeology. It has specifically addressed the question: in what other manners can 3D models be used in the comprehension, interpretation, and

[1] By design, the 2D medium that this work has been written on frustrates the ability to visually demonstrate certain aspects about the 3D objects discussed. This has been somewhat circumvented through a webpage that the reader may visit for additional 3D visual information (e.g. images, videos, and 3D PDFs). Wherever applicable, a link, such as the one below, will be provided in a footnote to direct the reader to the website containing additional visual media. https://sites.google.com/site/justinjlkimball/masters-data

visualisation of archaeological materials? In other words, beyond simply creating and visualising 3D models, how can these models aid field archaeologists in making explicit what has been identified as archaeologically-relevant? Utilising some of the methodologies and techniques produced in previous studies, this work has demonstrated a different approach in using 3D surface models that builds upon the strengths offered through this technology. Furthermore, this application for 3D models has been shown to fit seamlessly alongside of other traditional excavation tools—a combination that facilitates the production and communication of archaeological knowledge. These methodologies have the potential to provide researchers with unique and powerful perspectives and therefore must be considered as prosperous ventures for future research and deployment within field archaeology.