



**Universiteit
Leiden**
The Netherlands

Analecta Praehistorica Leidensia 28 / Interfacing the past : computer applications and quantitative methods in archaeology CAA95 Vol. II

Kamermans, Hans; Fennema, Kelly; Kamermans, Hans; Fennema, Kelly

Citation

Kamermans, H., & Fennema, K. (1996). *Analecta Praehistorica Leidensia 28 / Interfacing the past : computer applications and quantitative methods in archaeology CAA95 Vol. II*. Retrieved from <https://hdl.handle.net/1887/32944>

Version: Not Applicable (or Unknown)

License: [Leiden University Non-exclusive license](#)

Downloaded from: <https://hdl.handle.net/1887/32944>

Note: To cite this publication please use the final published version (if applicable).

ANALECTA PRAEHISTORICA LEIDENSIA

28

PUBLICATIONS OF THE INSTITUTE OF PREHISTORY
UNIVERSITY OF LEIDEN

INTERFACING THE PAST

COMPUTER APPLICATIONS AND QUANTITATIVE
METHODS IN ARCHAEOLOGY CAA95 VOL. II

EDITED BY
HANS KAMERMANS AND KELLY FENNEMA



UNIVERSITY OF LEIDEN 1996

Graphic design: Henk de Lorm

Computer graphics: Peter Heavens

Copy editor: Marianne Wanders

Copyright 1996 by the Institute of Prehistory, Leiden

ISSN 0169-7447

ISBN 90-73368-10-3

Subscriptions to the series *Analecta Praehistorica Leidensia* and single volumes can be ordered from:

Institute of Prehistory
P.O. Box 9515
2300 RA Leiden
The Netherlands

contents

VOLUME I

Hans Kamermans
Kelly Fennema

Preface

Data Management

Jens Andresen
Torsten Madsen

IDEA – the Integrated Database for Excavation Analysis 3

Peter Hinge

The Other Computer Interface 15

Thanasis Hadzilacos
Polyxeni Myladié Stoumbou

Conceptual Data Modelling for Prehistoric Excavation Documentation 21

E. Agresti
A. Maggiolo-Schettini
R. Saccoccio
M. Pierobon
R. Pierobon-Benoit

Handling Excavation Maps in SYSAND 31

Alaine Lamprell
Anthea Salisbury
Alan Chalmers
Simon Stoddart

An Integrated Information System for Archaeological Evidence 37

Jon Holmen
Espen Uleberg

The National Documentation Project of Norway – the Archaeological sub-project 43

Irina Oberländer-Târnoveanu

Statistical view of the Archaeological Sites Database 47

Nigel D. Clubb
Neil A.R. Lang

A Strategic Appraisal of Information Systems for Archaeology and Architecture in England – Past, Present and Future 51

Nigel D. Clubb
Neil A.R. Lang

Learning from the achievements of Information Systems – the role of the Post-Implementation Review in medium to large scale systems 73

Neil Beagrie

Excavations and Archives: Alternative Aspects of Cultural Resource Management 81

Mark Bell
Nicola King

The MARS Project – an interface with England's past 87

Archaeometry

- M.J. Baxter
H.E.M. Cool
M.P. Heyworth
Detecting Unusual Multivariate Data: An Archaeometric Example 95
- Jon Bradley
Mike Fletcher
Extraction and visualisation of information from ground penetrating radar surveys 103
- Gayle T. Allum
Robert G. Aykroyd
John G.B. Haigh
Restoration of magnetometry data using inverse-data methods 111
- W. Neubauer
P. Melichar
A. Eder-Hinterleitner
Collection, visualization and simulation of magnetic prospection data 121
- A. Eder-Hinterleitner
W. Neubauer
P. Melichar
Reconstruction of archaeological structures using magnetic prospection 131
- Phil Perkins
An image processing technique for the suppression of traces of modern agricultural activity in aerial photographs 139
- Statistics and Classification**
- Clive Orton
Markov models for museums 149
- Juan A. Barceló
Heuristic classification and fuzzy sets. New tools for archaeological typologies 155
- Kris Lockyear
Dmax based cluster analysis and the supply of coinage to Iron Age Dacia 165
- Christian C. Beardah
Mike J. Baxter
MATLAB Routines for Kernel Density Estimation and the Graphical Representation of Archaeological Data 179
- John W.M. Peterson
A computer model of Roman landscape in South Limburg 185
- Sabine Reinhold
Time versus Ritual – Typological Structures and Mortuary Practices in Late Bronze/Early Iron Age Cemeteries of North-East Caucasia ('Koban Culture') 195
- Leonardo García Sanjuán
Jesús Rodríguez López
Predicting the ritual? A suggested solution in archaeological forecasting through qualitative response models 203
- Johannes Müller
The use of correspondence analysis for different kinds of data categories: Domestic and ritual Globular Amphorae sites in Central Germany 217
- J. Steele
T.J. Sluckin
D.R. Denholm
C.S. Gamble
Simulating hunter-gatherer colonization of the Americas 223

Paul M. Gibson	An Archaeofaunal Ageing Comparative Study into the Performance of Human Analysis Versus Hybrid Neural Network Analysis 229
Peter Durham Paul Lewis Stephen J. Shennan	Image Processing Strategies for Artefact Classification 235
Gijsbert R. Boekschoten Dick Stapert	A new tool for spatial analysis: "Rings & Sectors plus Density Analysis and Trace lines" 241
Susan Holstrom Loving	Estimating the age of stone artifacts using probabilities 251
Oleg Missikoff	Application of an object-oriented approach to the formalization of qualitative (and quantitative) data 263

VOLUME II

Geographic Information Systems I

David Wheatley	Between the lines: the role of GIS-based predictive modelling in the interpretation of extensive survey data 275
Roger Martlew	The contribution of GIS to the study of landscape evolution in the Yorkshire Dales, UK 293
Vincent Gaffney Martijn van Leusen	Extending GIS Methods for Regional Archaeology: the Wroxeter Hinterland Project 297
Trevor M. Harris Gary R. Lock	Multi-dimensional GIS: exploratory approaches to spatial and temporal relationships within archaeological stratigraphy 307
Philip Verhagen	The use of GIS as a tool for modelling ecological change and human occupation in the Middle Aguas Valley (S.E. Spain) 317
Federica Massagrande	The Romans in southwestern Spain: total conquest or partial assimilation? Can GIS answer? 325
Shen Eric Lim Simon Stoddart Andrew Harrison Alan Chalmers	Recent examples of geographical analysis of archaeological evidence from central Italy 331
Vincent Gaffney Krištof Oštir Tomaž Podobnikar Zoran Staničič	Satellite Imagery and GIS applications in Mediterranean Landscapes 337
Yvette Bommeljé Peter Doorn	The long and winding road: land routes in Aetolia (Greece) since Byzantine times 343

- Javier Baena Preysler Application of GIS to images and their processing: the Chiribiquete Mountains Project 353
 Concepción Blasco

Geographic Information Systems II: The York Applications

- Julian D. Richards From Site to Landscape: multi-level GIS applications in archaeology 361
- Harold Mytum Intrasite Patterning and the Temporal Dimension using GIS: the example of Kellington Churchyard 363
- A. Paul Miller Digging deep: GIS in the city 369
- Julian D. Richards Putting the site in its setting: GIS and the search for Anglo-Saxon settlements in Northumbria 379
- Jeffrey A. Chartrand Archaeological Resource Visibility and GIS: A case study in Yorkshire 389

Visualisation

- John Wilcock A description of the display software for Stafford Castle Visitor Centre, UK 405
- Christian Menard Pictorial, Three-dimensional Acquisition of Archaeological Finds as Basis for an
 Robert Sablatnig Automatic Classification 419
- Katalin T. Biró Simple fun – Interactive computer demonstration program on the exhibition of the Szentgál-Tűzköveshegy prehistoric industrial area 433
- György Csáki Documentation and modelling of a Roman imperial villa in Central Italy 437
 Ferenc Redő
- Maurizio Forte Archaeology, GIS and desktop virtual reality: the ARCTOS project 443
 Antonella Guidazzoli
- Germà Wünsch Dissecting the palimpsest: an easy computer-graphic approach to the stratigraphic
 Elisabet Arasa sequence of Túnel VII site (Tierra del Fuego, Argentina) 457
 Marta Pérez
- David Gilman Romano Remote Sensing and GIS in the Study of Roman Centuriation in the Corinthia, Greece 461
 Osama Tolba
- F.J. Baena An application of GIS intra-site analysis to Museum Display 469
 F. Quesada
 M.C. Blasco

Education and Publication

- Robin B. Boast Teaching with objects 479
 Sam J. Lucy

Martin Belcher Alan Chalmers Andrew Harrison Simon Stoddart	Teaching the Visualisation of Landscapes – Approaches in Computer based learning for Archaeologists 487
Anja C. Wolle Stephen J. Shennan	A Tool for Multimedia Excavation Reports – a prototype 493
G. Gyftodimos D. Rigopoulos M. Spiliopoulou	Exploring Archaeological Information through an Open Hypermedia System 501
Martijn van Leusen Sara Champion Jonathan Lizée Thomas Plunkett	Toward a European Archaeological Heritage Web 511
Mike Heyworth Seamus Ross Julian Richards	Internet archaeology: an international electronic journal for archaeology 521
Virgil Mihailescu-Bîrliba Vasile Chirica	A Survey of the Development of Computer Applications in Romanian Archaeology 529
Kris Lockyear	Computer-aided publication in practice 535

Martin Belcher
Alan Chalmers
Andrew Harrison
Simon Stoddart

Teaching the Visualisation of Landscapes – Approaches in Computer based learning for Archaeologists

The Visualisation of Landscapes project is a University of Bristol funded teaching initiative. This project is an inter-disciplinary exercise into the interpretation of archaeological data with the aid of computer technology, in order to visualise landscapes: from those that exist in the broad physical geographic sense, to those that make up the internal features of an individual archaeological site. The eventual results will be packaged so that they can be used in first and second year undergraduate teaching.

This paper will describe the details of the project and the implications that multi-disciplinary collaboration have for the future of archaeological education.

1 Introduction

1.1 THE VISUALISATION OF LANDSCAPES PROJECT

The Visualisation of Landscapes Project (VLP) is a University of Bristol (UK) funded teaching initiative. It is an interdisciplinary exercise in the development of computer aided interpretation of primary archaeological data. Essentially, the visualisation of landscapes in the full spectrum of scales, from that on the largest scale of physical geographic data to the smallest of the more specific internal features of an individual archaeological site. The impetus behind the initiation of the VLP was the desire to amalgamate the expertise available in several interdisciplinary research projects currently underway within the Departments of Archaeology, Computer Science and Geography. As much of the data of these projects is of a spatial nature it can be thought of as representing a variety of levels of landscape; from the highest level in the 'traditional' geographic based regional landscape, to the medium level, represented by an archaeological feature or site, right down to the smallest level, that of individual finds within an archaeological excavation.

1.2 AIMS AND OBJECTIVES

To maximise the potential of these projects the VLP was initiated with the long-term objectives involving the development of the following:

- Computer aided visualisation of landscapes.
- Teaching initiative for first and second year archaeology students.

- Increased computer literacy of archaeology students.
- Greater understanding of archaeological implications and technical parameters for Geography and Computer Science students.

2 The VLP package as Computer Based Learning

2.1 PC BASED TUTORIALS

The VLP package is being developed as a series of PC based multimedia, interactive tutorials (CBL – Computer Based Learning). Time and development costs permitting, the package will consist of three separate modules covering the concepts and techniques available to archaeologists when interpreting and visualising archaeological landscapes. These tutorials are to be used in conjunction with, and as a supplement to, more 'traditional' practical teaching sessions. Although produced as stand-alone packages, each tutorial will be accompanied by a printed workbook that will put the computer based information into context and act as a source of background reading.

2.2 INTEGRATION INTO CURRENT CURRICULUM

The introduction and usage of the tutorials will be fully integrated into the established curriculum and will introduce students to the concepts and ideas behind the visualisation of landscapes and different levels of archaeological data. The inbuilt experimental interaction within the tutorials will allow a 'hands on' approach to the techniques available in the interpretation of archaeological landscapes; enabling staff to create a need to know amongst students, ensuring greater retention and more student responsibility for learning.

2.3 MULTIMEDIA TOOLBOOK 3.0

The tutorials are being developed in Asymetrix Multimedia ToolBook 3.0; a relatively simple and easy to learn multimedia authoring package. This particular software has been adopted in many such CBL projects and has been used in Bristol before within the bounds of the TLTP (Archaeology Consortium) central government funded initiative. Issues of screen design and functionality have largely been tackled before and are not the subject for

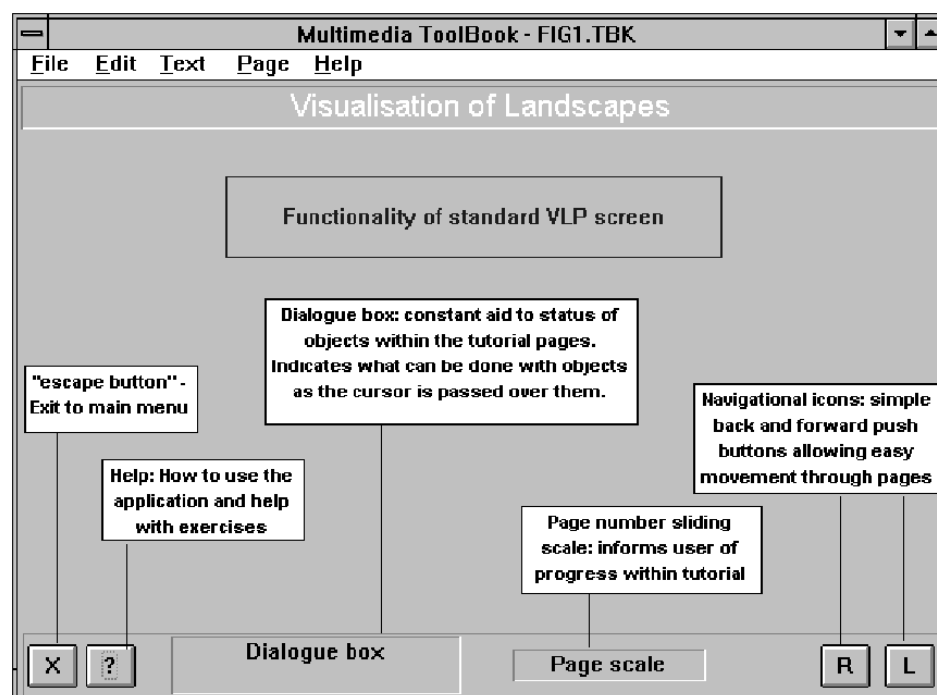


Figure 1. VLP standard page layout and functionality in ToolBook.

discussion here. However, a sample screen is shown as an indication as to the basic presentation and working medium.

2.4 EXPERIMENTAL INTERACTION

Because of the nature of the material, a degree of interaction can be built into the VLP tutorials that is often detrimentally missing from CBL. This interaction will consist of problem solving and 'original' experimental visualisation by each user. Examples of such experimental visualisation might be in the visualisation of, say, Maltese temple structures by a variety of different techniques, or some simple GIS analysis new for each user, as they select which sets of data to use in the visualisation. Because of technical parameters, the number of test landscapes that can be viewed by a user will be limited, as each computer graphic landscape will have to be rendered before inclusion in the tutorial. Hence the experimental landscape viewing will be from a limited data set, although how each student uses this data will appear original. The final result is to produce interaction that genuinely keeps the users' interest and stimulates further investigation into more detailed applications of visualisation.

3 The visualisation of landscapes

3.1 APPROACHES

One of the primary aims of the VLP is to integrate and present the techniques already being utilised by several research projects currently underway within the university.

These projects draw heavily on the interpretative value of visualising archaeological data: the INSITE project (Archaeology and Computer Science) looks at reconstruction of archaeological structures as an aid to interpreting ritual (although it also has much wider implications), while the GIS based interpretation of archaeological data (Archaeology and Geography) in central Italy has a large visual content. One of the aims of the VLP is to introduce archaeology students, particularly first and second year undergraduates, to these techniques and concepts. These areas of visualisation are to be supplemented by more traditional methods, as well as some further computer based physical and natural environment visualisation. A series of subject landscapes (in the widest geographical sense) will be used as case studies to show the suite of techniques available to archaeologists that can help them visualise the variety of different scales of landscape, as well as acting as an aid to interpretation of archaeological data.

3.2 Areas involved in the VLP

3.2.1 Gozo, Malta

The temple structures on the islands of Malta form the central thrust of the research within the INSITE project (Chalmers/Stoddart 1995; Chalmers *et al.* 1994). Their computer based reconstruction and analysis will be one of the central parts of the visualisation tutorial for this region. A developing environmental and regional study for the location of the excavated sites will form a further aspect of

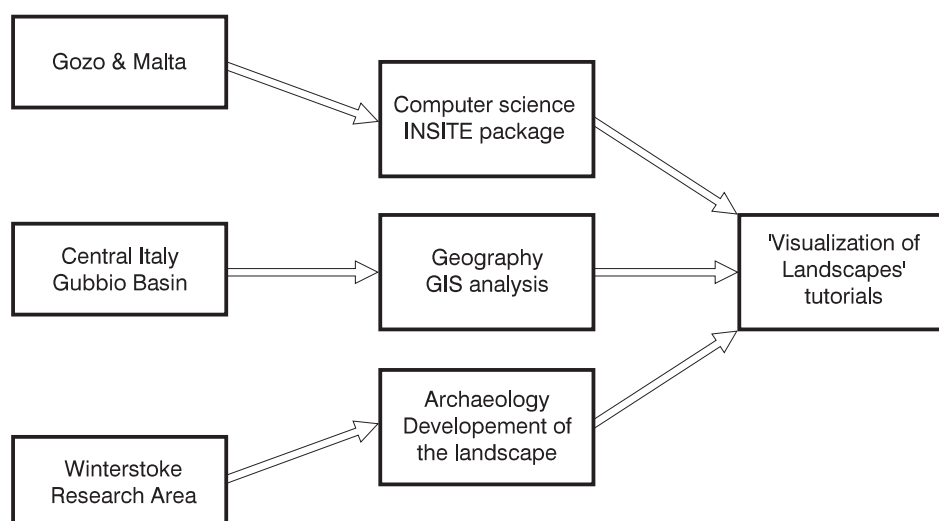


Figure 2. Interdisciplinary links and the visualisations project.

the visualisation, placing the centres of in-depth archaeological research within their wider context of a landscape setting.

3.2.2 *South Etruria, Central Italy*

The emphasis on visualisation in this area will be on introducing students to GIS and supplementing many of the GIS based analytical images with descriptive and interpretative text and complimentary images. Three-dimensional landscapes will also be modelled (with the data obtained by palaeo-environmental and geomorphological research projects currently underway), producing different landscape and vegetation models for different periods.

3.2.3 *Winterstoke research area, Avon and Somerset, UK*

The techniques and ideas developed in the previous two projects are to be utilised and built upon in this long term local research project (University of Bristol 1995), resulting in a fully integrated local landscape visualisation methodology. As in the preceding projects a large body of archaeological survey and excavation data is available for setting within its landscape.

4 **Inter-disciplinary approaches**

4.1 **INTER-DISCIPLINARY LINKS**

The landscape visualisation project makes use of the most up to date analytical tools from a range of disciplines, and thus requires a high degree of inter-disciplinary collaboration (fig. 2). Through the use of the teaching package, students will be introduced to and become familiar with the dynamic inter-disciplinary interaction necessary in order to maximise the information gleaned from the primary

archaeological data. Each tutorial will be centred on a geographic area of university research and will utilise a specific set of analytical tools to aid in the interpretation of the associated data. As the projects and VLP proceed a full set of analytical tools will become available for each area. Ultimately each area will contribute a varied approach using the same visualisation techniques which, when incorporated into the computer based tutorials, will facilitate a better understanding of the concepts behind the techniques being employed.

4.2 **INPUT AND BENEFITS**

4.2.1 *Computer Science*

Recent developments in computer graphics have made it possible to construct virtual environments on a computer and view images of these scenes. It is possible, therefore, to recreate an archaeological site on a computer and provide the viewer with an accurate representation of the actual remains. Furthermore, geometric modelling techniques enable extrapolations from existing evidence to reconstruct the site as it may have appeared to the original inhabitants. Photorealism enhances the quality of computer generated images and thus greatly improves their visualisation value.

Computer graphics is taught to final year undergraduate and Msc students within the Department of Computer Science. As well as covering the fundamentals of computer graphics, the course also examines the photo-realistic techniques of: ray tracing; radiosity; and, particle tracing. The value of any computer graphics course is not, however, merely the understanding of the mechanics of the underlying graphic models. To appreciate truly the benefit of photo-realistic computer images, the students need to see

the techniques applied to real problems. The visualisation of archaeological sites is one such problem. The VLP tutorials will enhance the learning experience of Computer Science students. They will be able to investigate the computational complexity and subsequent effect of different graphic techniques in the interpretation of archaeological sites. This will enable them to understand better the applicability of each method, and see for themselves how photo-realistic visualisation may help in the interpretation of computer modelled virtual environments.

4.2.2 Geography

Landscapes are of particular concern of Geography, and Geographic Information Systems (GIS) are a particular specialisation of the department. The department of Geography and the department of Classics and Archaeology have already been involved in the implementation of a TLTP project concerning GIS (Blake *et al.* 1995). The VLP is building upon this experience, and extending the use of the existing tutorial to first and second year undergraduate teaching in Geography. Here, in particular, it will enhance existing computer-based practical teaching in GIS and spatial analysis by providing a dynamic application of landscape analysis and visualisation. The addition of an archaeological dimension to geography teaching in this way will add important material which illustrates the principles of planning, cultural resource management and regional analysis.

4.2.3 Archaeology

It is around primary archaeological data that the other research projects are built. It is with this data analysis that the archaeologist is chiefly concerned. By introducing archaeology students to the full suite of visualisation techniques available it will facilitate a better understanding of landscape visualisation and analysis. The VLP also serves the purpose of introducing archaeology students to a dynamic inter-disciplinary environment.

5 Discussion and conclusion

5.1 DISCUSSION

The idea behind students using the VLP tutorials is not to produce archaeology graduates who can produce 3-D models of landscapes and sites, or who are experts in GIS. Neither is it the aim to produce archaeologists from Computer Science and Geography students. Rather, it is to introduce the students to the concepts and techniques behind such visualisation by showing them some of the tools and facilities that are available. If they wish to take this further they are then familiar with the tools available. This will enable archaeologically based visualisation projects to be undertaken by third year students for their final year dissertations.

The benefits for both Computer Science and Geography students are based primarily on an introduction to a dynamic application to what otherwise are often predominantly theory based areas of their study as well as on introducing users to a variety of different applications of specialisms within their field.

These tutorials will also have the complimentary benefit in that they facilitate the development in users of transferable skills for careers outside archaeology. The familiarity of computer use, database management, use and manipulation of data will be skills acquired by users of the VLP, producing archaeology graduates confident with computer applications, something all too often lacking in Arts based graduates.

5.2 CONCLUSION

The Visualisation of Landscapes Project has several important contributions to make towards education in archaeology. It presents a suite of integrated technologically explicit techniques in visualising landscapes and archaeological data, within an interactive PC based environment, for use in undergraduate teaching. It also demonstrates a simple and effective inter-disciplinary project in terms of both education and research.

references

- | | | |
|---|------|---|
| University of Bristol | 1995 | The Winterstoke Research Project. World Wide Web, University of Bristol. (http://www.bris.ac.uk/Depts/Archaeology/html/winterst.htm) |
| Blake, V.
A. Harrison
S.K.F. Stoddart | 1995 | <i>G.I.S and Archaeology</i> . Glasgow: TLTP Archaeology Consortium. |
| Chalmers A.G.
S.K.F. Stoddart
J.P. Tidmus
R.M. Miles | 1994 | INSITE: An Interactive Visualisation System for Archaeological Sites. In: J.Huggett/ N. Ryan (eds), <i>Computer Applications and Quantitative Methods in Archaeology 1994</i> , 225-228, BAR International Series 600, Oxford: Tempus Reparatum. |
| Chalmers, A.G.
S.K.F. Stoddart | 1995 | INSITE Project: An Interactive Photorealistic Visualisation System for Archaeological Sites. World Wide Web, University of Bristol. (http://www.bris.ac.uk/Depts/Archaeology/html/insite.htm) |

Martin Belcher
Department of Archaeology
11 Woodland Road
University of Bristol
Bristol BS8 1NB
United Kingdom
e-mail: Martin.Belcher@bristol.ac.uk

Alan Chalmers
Department of Computer Science
e-mail: alan@compsci.bristol.ac.uk

Andrew Harrison
Department of Geography

Simon Stoddart
Department of Archaeology
e-mail: s.k.stoddart@bristol.ac.uk