



HAL
open science

Forum Romanum: A 3D Model For Self-Service Educational Purposes

Philippe Fleury, Sophie Madeleine, Nicolas Lefèvre

► **To cite this version:**

Philippe Fleury, Sophie Madeleine, Nicolas Lefèvre. Forum Romanum: A 3D Model For Self-Service Educational Purposes. CAA2014: 21st century archaeology: concepts, methods and tools (42nd annual conference on Computer Applications and Quantitative Methods in Archaeology), Apr 2014, Paris, France. pp.569-574. hal-04183941v2

HAL Id: hal-04183941

<https://hal.science/hal-04183941v2>

Submitted on 21 Aug 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

**CAA2014
21ST CENTURY
ARCHEAEOLOGY**

CONCEPTS, METHODS AND TOOLS

**PROCEEDINGS OF THE 42ND ANNUAL
CONFERENCE ON COMPUTER
APPLICATIONS AND QUANTITATIVE
METHODS IN ARCHAEOLOGY**

Edited by

**F. Giligny, F. Djindjian, L. Costa, P. Moscati
and S. Robert**

Archaeopress Archaeology

Archaeopress

Gordon House
276 Banbury Road
Oxford OX2 7ED

www.archaeopress.com

ISBN 978 1 78491 100 3
ISBN 978 1 78491 101 0 (e-Pdf)

© Archaeopress and the individual authors 2015

Cover photograph © Emilie Lesvignes

All rights reserved. No part of this book may be reproduced, stored in retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying or otherwise, without the prior written permission of the copyright owners.

Printed in England by Oxuniprint, Oxford

This book is available direct from Archaeopress or from our website www.archaeopress.com

Contents

Foreword	v
Computers and mathematics in Archaeology, anatomy of an ineluctable success!	1
François DJINDJIAN	
Chapter 1 Historiography	
Towards a History of Archaeological Computing: An Introduction	9
Paola MOSCATI	
A retrospective on GIS and AIS platforms for Public Archaeology in Italy. Searching backward for roots and looking onwards for new methodological road-maps	17
Mirella SERLORENZI, Iliaria JOVINE, Giorgia LEONI, Andrea DE TOMMASI, Andrea VARAVALLO	
Art History of the Ancient Near East and Mathematical Models. An Overview	29
Alessandro DI LUDOVICO and Sergio CAMIZ	
Archaeology and Computer Applications: the automatic cataloging of Italian archaeological heritage	35
Alessandra CARAVALE	
Chapter 2 Field and laboratory data recording	
Practical Assessment of a Multi-Frequency Slingram EMI for Archaeological Prospection	43
François-Xavier SIMON, Alain TABBAGH, Apostolos SARRIS	
Utilizing Magnetic Prospection and GIS to Examine Settlement Organization in Neolithic Southeastern Europe	53
Alexis NIEKAMP, Apostolos SARRIS	
Historic Forest Change: New approaches to Land Use Land Cover	65
Charlotte E. STANCIOFF, Robert G. PONTIUS Jr, Scott MADRY, Elizabeth JONES	
Challenges and Perspectives of Woodland Archaeology Across Europe	73
Hauke KENZLER, Karsten LAMBERS	
Archaeological Mapping of Large Forested Areas, Using Semi-Automatic Detection and Visual Interpretation of High-Resolution Lidar Data	81
Øivind Due TRIER, Lars HOLGER PILØ	
Laser scanning and Automated Photogrammetry for Knowledge and Representation of the Rupestrian Architecture in Cappadocia: Sahinefendi and the Open Air Museum of Goreme	87
Marco CARPICECI, Carlo INGLESE	
Advantages and Disadvantages of Digital Approach in Archaeological Fieldwork	95
Carlo BIANCHINI, Francesco BORGOGNI, Alfonso IPPOLITO	
From Survey to Representation of the Model. A Documentation of Typological and Chronological Sequences of Archaeological Artefacts: Traditional and Innovative Approach	107
Alfonso IPPOLITO, Luca J. SENATORE, Barbara BELELLI MARCHESINI, Gabriella CEROLI	
Archaeology in the Third and Fourth Dimensions: A Case Study of 3D Data Collection and Analysis From Prince Rupert, BC, Canada	115
Alyssa PARKER, Morley ELDRIDGE	
Integrated RTI Approaches for the Study of Painted Surfaces	123
Eleni KOTOULA, Graeme EARL	
Survey, Documentation and Analysis of the Archeological Architecture: the House of the Knights of Rhodes in the Forum of Augustus	135
Carlo BIANCHINI, Gaia Lisa TACCHI	
Digital Research Strategies for Ancient Papyri: A Case Study on Mounted Fragments of The Derveni Papyrus	145
Eleni Kotoula, Graeme Earl	

Chapter 3. Ontologies and Standards

Towards Linked-Data in Numismatics: How the DIANA Approach can Improve the Diachrony Integrating Heterogeneous Pieces of Data	157
Maria CALTABIANO, Mariangela PUGLISI, Antonio CELESTI, Grazia SALAMONE	
Celtic Coins in context, a new database	165
Katherine GRUEL, Agnes TRICOCHÉ, Philippe CHARNOTET	
Uncertainty handling for ancient coinage	171
Karsten TOLLE, David WIGG-WOLF	
Interoperability of the ArSol (Archives du Sol) database based on the CIDOC-CRM ontology.....	179
Emeline LE GOFF, Olivier MARLET, Xavier RODIER, Stéphane CURET, Philippe HUSI	
Find the balance - Modelling aspects in Archaeological Information Systems.....	187
Franz SCHWARZBACH, Felix F. SCHÄFER, Alexander SCHULZE	
Integration of Archaeological Datasets through the Gradual Refinement of Models.....	193
Cesar GONZALEZ-PEREZ, Patricia MARTÍN-RODILLA	
Linked Open Greek Pottery.....	205
Ethan GRUBER, T.J. SMITH	
The Digital Archaeological Workflow: A Case Study from Sweden.....	215
Marcus J. SMITH	
Exploring time and space in the annotation of museum catalogues: The Sloane virtual exhibition experience.....	221
Stephen STEAD, Dominic OLDMAN, Jonathan Whitson CLOUD	
Building comprehensive management systems for cultural – historical information.....	227
Chryssoula BEKIARI, Martin DOERR, Dimitris ANGELAKIS, Flora KARAGIANNI	
Managing Time Dimension in the Archaeological Urban Information System of the Historical Heritage of Rome and Verona	235
Alberto BELUSSI, Sara MIGLIORINI, Piergiorgiana GROSSI	
Towards an Archaeological Information System: Improving the Core Data Model	245
Muriel van RUYMBEKE, Cyril CARRÉ, Vincent DELFOSSE, Pierre HALLOT, Michelle PFEIFFER, Roland BILLEN	

Chapter 4. Internet and Archaeology

Archaeological open access journals: the case of ‘Archeologia e Calcolatori’	257
Alessandra CARVALE, Alessandra PIERGROSSI	
Massive Open Online Opportunity: MOOCs and Internet–Based Communities of Archaeological Practice	265
Jeffrey P. EMANUEL	
Moving Instruction Beyond the Museum’s Walls: Priorities in Online Public Education at the Oriental Institute	271
Kathryn GROSSMAN, Catherine Kenyon, Megaera LORENZ, Brittany HAYDEN	
Crowd- and Community-Fuelled Archaeology. Early Results from the MicroPasts Project	279
Chiara BONACCHI, Andrew BEVAN, Daniel PETT, Adi KEINAN-SCHOONBAERT	
The ACCORD project: Archaeological Community Co-Production of Research Resources.....	289
Stuart JEFFREY, Alex HALE, Cara JONES, Sian JONES, Mhairi MAXWELL	

Chapter 5. Archaeological Information Systems

12000 years of human occupation, 3 meters deep stratigraphy, 12 hectares... A geographical information system (GIS) for the preventive archaeology operation at Alizay (Normandie, France).....	299
S. MAZET, C. MARCIGN, B. AUBRY, I. COMTE, P. BOULINGUIEZ	
Records and spatial representations in the context of a rescue excavation: the case of Quincieux (Rhône-Alpes, France)	305
Elleboire SEGAIN, Veronique VACHON, Bernard MOULIN, Cécile RAMPONI, Wojciech WIDLAK	

Cartography and heritage: past practice and future potential for mapping Scotland’s cultural heritage.....	315
Peter MCKEAGUE	
Visualization based on the Norwegian University Museum Database	323
Espen ULEBERG, Mieko MATSUMOTO	
An Inventory of Lucanian Heritage.....	333
Alain DUPLOUY, Vincenzo CAPOZZOLI, Alessia ZAMBON	
Integrating complex archaeological datasets from the Neolithic in a web-based GIS.....	341
Kai-Christian BRUHN, Thomas ENGEL, Tobias KOHR, Detlef GRONENBORN	
Enhanced 3D-GIS: Documenting Insula V 1 in Pompeii.....	349
Giacomo LANDESCHI, Nicolò DELL’UNTO, Daniele FERDANI, Stefan LINDGREN, Anne-Marie LEANDER TOUATI	
MAPPA Open Data Metadata. The importance of archaeological background.....	361
Francesca ANICHINI, Gabriele GATTIGLIA	
A simple way to formalize the dating of stratigraphic units.....	365
Bruno DESACHY	
Recognizing temporalities in urban units from a functional approach: three case studies	371
Julie GRAVIER	
OH_FET: A Computer Application for Analysing Urban Dynamics Over Long Time Spans	381
Laure SALIGNY, Ludovic GRANJON, Thomas HUET, Gaël SIMON, Xavier RODIER, Bastien LEFEBVRE	
An ‘alphabet’ to describe the spatio-temporal dynamics of settlement systems: a relevant representation of time?..	393
Marie-Jeanne OURIACHI, Frédérique BERTONCELLO, with the collaboration of Pierre NOUVEL, Laure NUNINGER, Elise FOVET, Stephane ALIX	
 Chapter 6. GIS and spatial analysis	
 ArkeoGIS, Merging Geographical and Archaeological Datas Online	
Loup BERNARD, Damien ERTLEN, Dominique SCHWARTZ	
Counting Sheep Without Falling Asleep: Using Gis to Calculate the Minimum Number of Skeletal Elements (Mne) And Other Archaeozoological Measures At Schöningen 13li-4 ‘Spear Horizon’	407
Alejandro GARCÍA-MORENO, Jarod M. HUTSON, Aritza VILLALUENGA, Elaine TURNER, Sabine GAUDZINSKI-WINDHEUSER	
Looking for the best. A comparison between GIS and PageRank based algorithms for preventive archaeology in urban areas	413
Dubbini NEVIO, Gabriele GATTIGLIA, Augusto PALOMBINI	
Analyses of bone modifications on human remains: a GIS approach.....	423
Elsa CIESIELSKI, Hervé BOHBOT	
Territorial organisation of the Terramare culture (Bronze Age, Italy): use of GIS methodology to tackle societal issues	431
Julie BOUDRY	
From the excavation to the territory: contributions of GIS tools to the study of the spatial organization of the archaeological site of Argentomagus (France, Indre, Saint-Marcel/Argenton-sur-Creuse).....	443
Emeline LE GOFF, Laure LAÛT, Yoann RABASTÉ, Françoise DUMASY	
The integration of landscape processes in archaeological site prediction in the Mugello basin (Tuscany/Italy)	451
Elmar SCHMALTZ, Michael MÄRKER, Hans-Joachim ROSNER, Adrew-Williams KANDEL	
The use of Burgundy stone from ancient times to the present day.....	459
Stéphane BÜTTNER, Delphine MONTANGE, Laure SALIGNY, Marion FOUCHER with the collaboration of Eric LECLERCQ, Marinette SAVONNET	
Exploring Intervisibility Networks: A Case Study From Bronze and Iron Age Istria (Croatia and Slovenia)	469
Zoran ČUČKOVIĆ	

Chapter 7. Mathematics and statistics in archaeology

Intentional Process Modeling of Statistical Analysis Methods	481
Charlotte HUG, Rebecca DENECKÈRE, Ammar AYMEN	
Ancient Mesopotamian Glyptic Products, Statistics and Data Mining: A Research Proposal	489
Alessandro DI LUDOVICO, Sergio CAMIZ	
Intrasite spatial analysis applied to the Neolithic sites of the Paris Basin: from the archaeological feature to global analysis	497
François GILIGNY	
Statistical and mathematical models for archaeological data mining: a comparison	509
Nevio DUBBINI, Adam LODOEN	

Chapter 8. 3D Archaeology and virtual Archaeology

Measuring and describing 3D texture	519
Vera MOITINHO DE ALMEIDA, Juan Antonio BARCELÓ	
Old versus new – introducing image-based 3D modeling into the general documentation workflow of archaeological rescue excavations. Case studies: the Čachtice and Bratislava castles, Slovakia	529
Jan ZACHAR, Seta ŠTUHEC	
Beyond spreadsheets: digitising the archaeological artefact inventory process	541
Arianna TRAVIGLIA, Stephen WHITE, Andrew WILSON	
Potentialities of 3D Reconstruction in Maritime Archaeology	549
Elisa COSTA, Carlo BELTRAME, Francesco GUERRA	
Cultural Heritage Documentation in Cave Environnement Using Low-Cost Means for Archaeologists. Case Study of the Larchant Caves in the Fontainebleau Forest in France	557
Aurelia LUREAU, Mehdi BELARBI, Pascal RAYMOND, Régis TOUQUET	
Forum Romanum: A 3D Model For Self-Service Educational Purposes	569
Philippe FLEURY, Sophie MADELEINE, Nicolas LEFÈVRE	
The Virtual Reconstruction of a Small Medieval Town: The Case of Briviesca (Spain)	575
Mario ALAGUERO, Andres BUSTILLO, Blanca GUINEA, Lena IGLESIAS	
25 Years of Experience in Virtual Reconstructions - Research Projects, Status Quo of Current Research and Visions for the Future	585
Mieke PFARR-HARFST	

Chapter 9. Multi-agent systems and complex system modelling

A Density-Based Simulation Approach for Evaluating Prehistoric Population Fluctuations in Finland	595
Tarja SUNDELL, Juhana KAMMONEN	
Multi-Agent Modelling of the Neolithic LBK	595
Jean-Pierre BOCQUET-APPEL, Richard MOUSSA, Jérôme DUBOULOZ	
Explaining the Adoption of ‘Innovations’ in Western Europe during Bronze Age: Towards an Agent-Based Simulation	613
Juan A. BARCELÓ, Florencia DEL CASTILLO BERNAL, Giacomo CAPUZZO, Berta MORELL, Joan NEGRE	
Spatial Interaction Simulation Methods for Ancient Settlement Distributions in Central Italy	621
Taylor OSHAN, Carson FARMER, Eoin O’DONOGHUE	
Interactions and network analysis of a rock art site in Morro do Chapéu, Bahia, Brazil	631
Carlos ETCHEVARNE, Grégoire VAN HAVRE	

Forum Romanum: A 3D Model For Self-Service Educational Purposes

Philippe FLEURY, Sophie MADELEINE, Nicolas LEFÈVRE

CIREVE / ERLIS Centre Interdisciplinaire de Réalité Virtuelle, Équipe de Recherche sur les Littératures, les
Imaginaires et les Sociétés, Maison de la Recherche en Sciences Humaines de Caen, France
philippe.fleury@unicaen.fr, sophie.madeleine@unicaen.fr, nicolas.lefevre@unicaen.fr

Abstract

The CIREVE (Centre Interdisciplinaire de Réalité Virtuelle) of the University of Caen, Basse-Normandie France has developed an experimental self-service model for educational purposes. It is an interactive 3D model of the forum romanum built from the reconstruction of the entire city of ancient Rome and intended for museums, schools, and universities with educational documentation about each building.

This paper will explain

1. The context of the experiment: the reconstruction of the entire city of Rome as it was in the 4th century A.D for scientific and educational purposes. The interactive model is the work of a research team following scientific methods. Behind the virtual model, there is permanent access to a database with ancient texts, didactic videos, 2D pictures and a bibliography. The software used is 3DSMax for modelling and CryEngine for the interactivity.

2. The aim of the experiment: to provide educational actors with an interactive tool to discover different aspects of classical Antiquity. The interactive model must be used in self-service, i.e. without a scientific mediator. Although a scientific mediator can be essential for knowledge transmission, this interactive model can work alone transmitting knowledge through interactive play.

3. Constraints of an interactive model in self-service: an interactive model, at the service of the public at large, is different from an interactive model used by a researcher for scientific purposes or a model used by a scientific mediator. Firstly, it must be fitted with easily accessible documentation (which replaces dialogue with the scientific mediator). In the experimental model of the CIREVE, there are two types of documentation: automatic documentation which appears when the user is approaching a building and documentation 'on request' (similar to that in a guidebook). Secondly, it must be conceived so that the user cannot get lost in the streets, in public buildings, in dwellings. Virtual gates must be placed in the virtual model like barriers in a real site. In 3DStudio, these are 'collisions'. The software must be legally protected to avoid manipulation and alteration in line with intellectual property rights.

Keywords: Ancient Rome, Virtual Reality, Interactivity

Introduction

Being able to use virtual reality to make a virtual visit of an archaeological site – be it a reconstruction of an ancient monument or whole town – is something we consider commonplace nowadays because of a misuse of terminology. The fact is that most of the virtual or interactive visits we read about on the net, for example, do not use virtual reality at all. At the University of Caen we have been using true virtual reality since 2006 to invite the public into a digitally reconstructed 4th century Rome. The Forum Romanum is an experiment in opening up the experience to free autonomous visiting. The context and objectives of this experiment as well as its constraints will be the subject of the following article.

1. The experiment and its context

The Forum Romanum application is taken from the global restitution of Ancient Rome carried out by the 'Plan de Rome' group in the 'Literature, Imagination and Society

Research Centre' at the University of Caen (ERLIS, N°4254) with the technical back-up of the Interdisciplinary Centre for Virtual Reality or 'Centre Interdisciplinaire de Réalité Virtuelle de l'Université de Caen' (CIREVE). To our knowledge, the virtual interactive model and the way it has been and will be used which is the fruit of this work within the ERLIS centre is unique (Fleury and Madeleine, 2008). It has made possible visits of the quasi-entirety of 4th century Rome AD for up to 200 people at a time. It offers a truly virtual interactive visit through the streets of the city guided by one of our researchers in a monoscopic or stereoscopic mode according to the numbers of visitors and allowing exploration of the facades and interiors of Rome.

The expressions 'virtual visit' or 'interactive visit' and even 'virtual interactive visit' are used in many contexts these days but rarely correspond to the full meaning of the concept of 'virtual reality'. The concept was formalized in the early 1990's but was little known; it is in fact the interaction with an artificial digitally created world which can be the reproduction of a real world, one which has

disappeared or even an imaginary one. It implies two other concepts: 'immersion' which means passing 'through the looking-glass' and entering the image and also 'interaction' which means interacting in real time with the image to manipulate and transform it. Most applications available today on line and which carry the names 'virtual visit' or 'interactive visit' are in fact simply multimedia applications that provide interaction with pre-calculated animations. There is no real-time interaction with the digital model itself.

Contrary to popular belief, virtual reality has hardly penetrated the world of archaeology and we see little evidence of its use in research centres. The modelling of archaeological objects is common in archiving and the presentation of case studies but real-time interaction with these objects is seldom found, as indeed is public access to that interaction. Yet virtual reality is a technique of representation that can be termed 'ecological' to use the vocabulary of neuropsychology, that is, that it offers conditions of experimentation close to real life situations (Klinger, 2006). It goes beyond simple virtual restitution which is already accepted in terms of its representational potential: ability to multiply viewpoints infinitely by moving the 3D camera as well as multiplying hypotheses thanks to the dematerialisation of the medium, and making updates easier. Virtual reality offers, on top of all this, the pertinence of positioning both in time and space.

The virtual model of Ancient Rome created in Caen is therefore one that can be visited as part of an immersive experience in which the conditions of physical viewing and movement through space can be reproduced. Shortcuts allow time saving and enable passage from one building to another or between sections of large public buildings. Without these shortcuts, visiting the virtual city takes the same time as it would in real life. The presence of a human-sized avatar allows the visitor to get an immediate sense of the scale of the environment. The mediating academic guide can conduct the visit through the eyes of the avatar (in his or her position so from a subjective view-point) or follow the avatar a few metres behind and thus have a third person view point. The academic guide can also show the sources that allowed the restitution of virtual Rome by using links to multimedia databases.

Today, the virtual model can be used on two levels. The first is for academic research purposes in that

the virtual model can be used to visualise the city and test theories – two essential aspects of research. The permanent link to the corpus of textual, archaeological and iconographic sources allows users to measure the accuracy of every element of the cityscape. Situational elements as well as the real-life scale helps to test the validity of hypotheses concerning topographical and architectural restitution. It can also be used to test the efficiency of mechanical systems such as the sprinkling of perfumed water in entertainment buildings or the functioning of the curtain in theatres. The second level is a pedagogical one: guided visits of virtual Rome have the same teaching

value in terms of the transmission of knowledge as do real visits of the modern city and both forms complement each other. The real visit, when it is possible, gives an idea of the present conservation of the city and enables the visitor to absorb its atmosphere and try to imagine its past. The virtual visit often makes the reading of the lost city easier: the ruins are no longer encrypted by the passing of nearly two thousand years but immediately visible to the eye as they once were.

The Forum Romanum project is an open visit that adapts itself perfectly to these two uses. It is designed for both researchers working in their offices or in libraries on particular areas of the city and for a broad general public as well as schools and universities (sources: Caretoni, 1960; Coarelli, 1994; Guidobaldi, 1998). There are two main advantages of being able to isolate and extract a particular sector of the model of Ancient Rome: the extract has all the benefits of the academic contextualisation of the global model and the reduced space allows information to be concentrated on a particular subject and material constraints are thus limited.

2. Objectives of the experiment

In all archaeological sites and museums there are generally two visit options: a guided visit and a free visit. Each has its advantages and disadvantages. The team Plan de Rome has been practising guided visits in virtual reality for over eight years now in two places: we have rooms equipped for thirty visitors next to a large 70 m² plaster model of Rome of the same time period as that of the virtual model, and secondly a lecture hall for 200 people. In both locations visitors are given 3D glasses and the academic guide moves through the virtual model in real time thanks to a video-game controller. Attendance figures have been high in both cases and the places are booked months in advance for school parties; we average 1500 entries a year and these could be higher if we had more academic guides. Visits for the general public are available once a month and these average 160 visitors per month. The virtual visit is an enormous advantage in terms of pupils gaining knowledge of Roman civilisation: teachers who come with their classes report greater interest and better knowledge acquisition among pupils.

Our present aim in Forum Romanum is to see if the concept might work as an open access visit without an academic guide. We would target a broader public than the one currently coming to the guided visits which currently necessitate the use of a large screen in a fixed location. We hope to extend our field to include ever larger publics from very different walks of life. We have noticed an upsurge in interest in classical antiquity in the past few years in France and Europe but also as part of a global renewal of interest in the period and its ancient writings (the growth and nature of digital libraries bear witness to this). Paradoxically, this is happening at the very moment when knowledge of the humanities and the mastering of Latin and Greek in schools and universities are on the wane. But if Classics as a subject is less visible in the academic landscape, it

is increasingly available today via alternative learning platforms (interactive museums, libraries and websites and smartphone applications to name but a few) which are the new spaces of engagement with the humanities.

Our objective is therefore to develop within an academic framework tools for interactive discovery and interpretation of ancient sources for use by a broad and heterogeneous public. We are studying the conditions and form in which these new spaces of urban experience and reading of ancient texts can usefully take their place alongside the academic tradition and co-exist without replacing or eclipsing it.

The Forum Romanum application offers the possibility of visiting 4th century Rome alone without an academic guide. It is a high level academic historic restitution of Rome led by an established University research group with a board of advisors and readers (Madeleine and Fleury, 2011). The mode of navigation is the same as that used in the global model with a video game controller or a keyboard with movement in real time. The user can run but can't fly or go through walls (a limitation which is also found in the more sophisticated video games which take place in historic cities like Venice, London or Paris). What is new in comparison with the guided visit is that the internaut will receive the information normally given by the guide by means of textual pop-ups. So on approaching a building, its name, its date of construction will be visible at the bottom of the screen as part of a trigger mechanism. Information panels or notice boards can be triggered by button A of the video game controller and the letter I key on touch screens and smartphones. They are the equivalent of labels or captions on objects on archaeological sites or in a museum but made available to the internaut in this case at the touch of a button or screen. If he or she wishes to go further he can touch on a table of contents and gain access to all the textual, visual and video documentation needed on a particular monument including history, functioning of the building and its civic role, academic sources and the bibliography used. The images are maps, plans, photographs of the monument in its present state today and other source material in visual form from museums, libraries. The vignettes appearing at the bottom of the screen can be made larger by the touch of a finger or movement of a mouse so that they can be worked with more easily. The videos treat the functioning of the more complex mechanical systems such as pistons and the stretching of velum.

A virtual visit must be adapted to the device available to the user. The personal computer is the easiest to configure at the moment and the one we are presently working with. We have tested it at the Vieux-la-Romaine Museum near Caen and on the stands of events like the Science Festival (Fête de la Science) with specially configured computers with controllers and mouse provided. We are also currently testing an application called 'Pantheon' which works on Android smartphones and pads. The model of Pantheon was realized in collaboration with the team of Bernard Frischer Rome Reborn. The application can be downloaded free on the 'Plan de Rome' site and a printable plan of the

Pantheon is available. Two different technologies are used by the application: augmented reality allows vision of the outside of the building by moving the plan or just turning the device around physically like a camera-eye moving over the surface of the building. Virtual reality is also used to move through the interiors of buildings with the aide of the gyroscope on the device and using a virtual joystick. The target plan is not used in this case. Documents can be read (the font size is adjustable) or listened to. All images can be viewed in full screen.

The next step for us will be to finish the modelling of the forum not yet complete along with the progressive spatial extension of the application. On PCs it is possible to extend the visit to the whole city just as in the guided visit in Caen. For handheld device the application will progress sector by sector. The final stage of this 'self-service' visit will be the uploading of these applications onto the internet. But it is at this point that the technical constraints are the strongest as we will now see.

3. Constraints

The first constraints are methodological. Certain are inherent to any free visit, be it physical or virtual while others are particular to virtual visits. Just like the visit of a real site one has to determine what can be visited and what can't. In Forum Romanum and in the application with the academic guide it is possible to visit the whole area of Rome. When the 'self-service' application will be extended to the whole city such freedom will lose its pertinence since certain sectors still remain 'hypothetical'. This absolute freedom to wander anywhere would encumber the system and confuse and disorientate users unfamiliar with the topography of Rome.

Certain streets will thus be closed off virtually as well as on a physical site where certain streets are closed to the public. For the same reason not all buildings will be open to visit: only the most important monuments will open their doors as well as a few characteristic private buildings such as collective dwellings, private houses and shops. Just as with a real site or museum the position and nature of information must be determined and it is here that we see that the virtual visit makes things a lot easier since particular types of public can be targeted with special information. From the most specialised bibliographies destined for researchers to explanations of the simplest vocabulary for school children the project provides an impressive versatility. The level of the information they receive can be chosen by users at the moment they open the application.

Then come the constraints in terms of software. Screenplay in not developed in the global restitution of Ancient Rome because of our keenness to maintain reality. But for a free visit this will have to be upgraded since a minimal navigation interface must be used, different from that used by an academic guide. This will impact on the quality of access to documentation and its ergonomic and aesthetic dimensions must be defined. Such interfaces are more

complicated to set up on portable devices such as handheld device without controller or mouse. For the navigation, particular attention must be paid to 'physicalization' for collision detection. A digital object is naturally penetrable and if we want a virtual visitor to walk on a floor, negotiate a staircase or avoid a statue or if we want an object to direct him or her to documentation then we need to make all these objects 'physical'. To do that, we need to create a physics proxy (in the technical vocabulary of CryEngine, the physics proxy is the geometry that is used for collision detection) around each object which users can reach. Quickest setup is to declare a virtual object as a physics proxy but checking for intersections on complex geometry is very expensive. Then we use as much as possible primitive geometry around an object, converting a complex visual geometry to a six faces collider for example.

This question is part of the world of video games from the 'serious game' to the 'edugame' which is closest to our concerns. The behaviour engine used for Rome is also a video game engine – Cryengine developed by Crytek. The great difference between a video game and an archeological restitution is that in the latter case it is absolutely necessary to respect historical truth and no shortcuts can be taken to make the production easier. Part of the creation of colliders has been automated but arches and staircases still pose a problem the intricacies of which we cannot explain here. Suffice to say that a great deal of manual work is needed. For a virtual visit no errors can remain which means hours and hours of testing, whereas in the guided visit the academic guide knows how to avoid the areas which are not yet solid.

The material constraints linked to the physical capacities of the engines must also be taken into account. If today video game techniques allow the development of virtual visits of huge areas with relatively good and sometimes exceptional detail, it is also true that the creation of a virtual visit of the entire expanse of Rome including details of architecture such as mouldings, ornaments, cornices, not to mention decorations such as statuary, paintings and mosaics (as well as access to a great number of interiors) remains a daunting task. If the extraction of a part of the model reduces the weight of the data to be uploaded onto the internet for example, the graphic treatment of each scene remains the same because software such as CryEngine gets rid of anything which is not visible to the user during his movement round the city. Since academic and pedagogical considerations require constant use of detail the processor and the graphics are highly solicited. The power of the materials needed for diverse user groups is growing all the time, but the fact remains that we have to work with the materials we presently have to hand.

Conclusion

Despite these constraints, our present experiments and research have given very positive results. The Forum Romanum application now has a new offshoot: an application in collaboration with the team of Robert Vergnien in Bordeaux called Circus Maximus already in

place in the Vieux-la-Romaine Museum and first set up for the occasion of the World Equestrian Games which will be held this year in Lower Normandy. We are also creating another application for our region this year to commemorate the 1944 Normandy landings; the 'Centre Interdisciplinaire de Réalité Virtuelle' at the University of Caen will set up an Android application on its site to visit the old University of Caen before the bombings (www.unicaen.fr/cireve). It will be a 'real' piece of virtual reality. The techniques developed for Ancient Rome have proved to be applicable to archaeological sites of all epochs.

References

- CARETONI, G., (1960). Excavations and Discoveries in the Forum Romanum and on the Palatine during the Last Fifty Years. *Journal of Roman Studies* 50, pp.192–203.
- COARELLI, F., (1994). *Guide archéologique de Rome*. Hachette, Paris.
- FLEURY, Ph. and MADELEINE, S. (2008). 'Problématique d'une restitution globale de la Rome antique. Une visite interactive avec accès dynamique aux sources anciennes'. In: R. Vergnien et C. Delevoie (eds.). *Actes du Colloque Virtual Retrospect 2007, Archéovision 3*, Bordeaux: Ausonius. pp. 55-60. Available from: http://archeovision.cnrs.fr/pdf/vr07_pdf/07_Madeleine.pdf
- KINGER, E., (2006). *Apports de la réalité virtuelle à la prise en charge de troubles cognitifs et comportementaux*, Thèse soutenue le 7 février 2006 à l'ENST (Télécom Paris Tech). URL: http://pastel.paristech.org/index.php?halsid=3f93vjd93rk50ggdur58nusro5&view_this_doc=tel-00161903&version=1
- MADELEINE, S. and FLEURY, Ph. (2011). Le 'Plan de Rome' de Paul Bigot à l'Université de Caen et son double virtuel : de l'objet patrimonial à l'outil scientifique. *In Situ*. Les patrimoines de l'enseignement supérieur 17. URL: <http://insitu.revues.org/840> ; DOI : 10.4000/insitu.840
- GUIDOBALDI, M.P., (1998). *Le forum romain*. Milano, Electa.



FIGURE 1 : THE FORUM ROMANUM.



FIGURE 2 : A VISIT WITH AN ACADEMIC GUIDE.



FIGURE 3 : A SELF SERVICE VISIT.

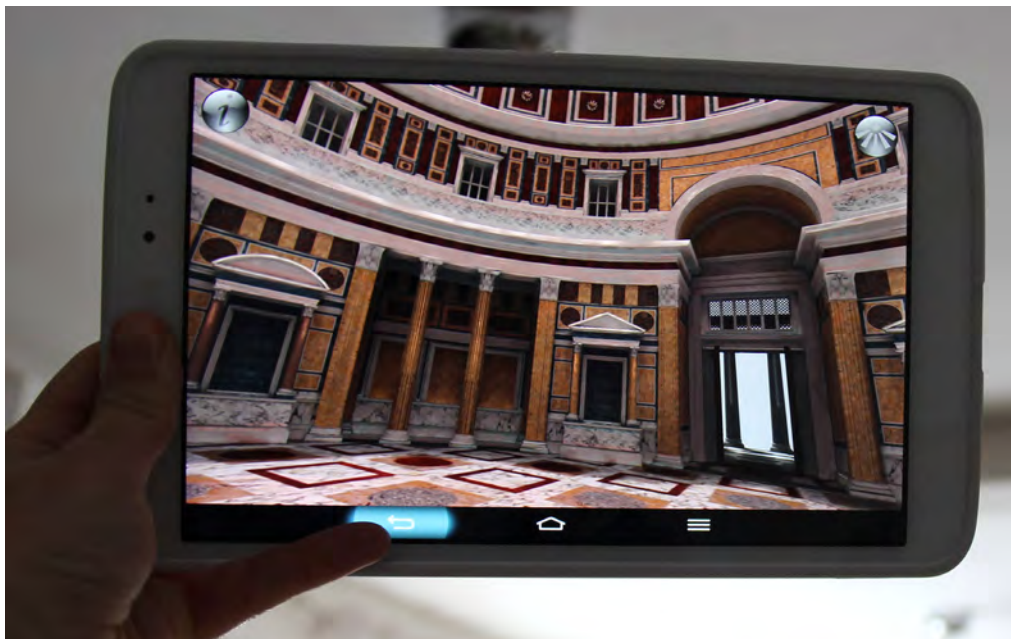


FIGURE 4 : THE APPLICATION 'PANTHEON'.