The World is in your eyes

CAA2005

Computer Applications and Quantitative Methods in Archaeology

Proceedings of the 33rd Conference, Tomar, March 2005

Edited by
Alexandra Figueiredo and Gonçalo Velho

Tomar
CAAPortugal
2007

This title published by

CAAPortugal
Associação para o Desenvolvimento das Aplicações Informáticas e Novas Tecnologias em Arqueologia
Av. Candido Madureira,13
2300-431 Tomar
PORTUGAL
email: caa2005@ipt.pt
webpage: www.caaportugal.ipt.pt

The World is in Your Eyes – CAA2005 – Computer Applications and Quatitative Methods in Archaeology: Proceedings of the 33rd Conference, Tomar, March 2005

ISBN 978-989-95313

Depósito Legal 261339/07

Printed in Portugal by Candeias Artes Gráficas
Rua Conselheiro Lobato, 179 – 4705-089 Braga. Portugal
email: geral@litografiaac.pt – webpage: www.candeiasag.com

Table of Contents

Preface 7

1 – What you see is what you get? Three-dimensional reconstructions

Measuring deformations of wheel-produced ceramics using high resolution 3D reconstructions 11
Avshalom Karasik, Hubert Mara, Robert Sablatnig, Ilan Sharon, Uzy Smilansky

Perceiving pottery: a view using 3d applications 15
D. J. Irujo-Ruíz, M. P. Prieto-Martínez

A mythological tale lived again through the virtual reality 21
Fabio Bruno, Giuseppe Crugliano, Daniela Fiorelli, Guglielmo Genovese, Maurizio Muzzupappa

Virtual Heritage Reconstruction: The Old Main Church of Curitiba, Brazil 27
Jose Manoel Kozan, Iara Beduschi Kozan

Remote Research through the Modeling and Reconstruction of a Medieval Monastery Site in Languedoc 35
Elizabeth Riorden, Bradley French, Emily Hatch

Vilars AR Project. Testing the Augmented Reality Paradigm in an archaeological site 39
Ares Vidal, Enric Tartera, Natàlia Alonso, Carles Aguiló, Emili Junyent, Jesús Lorés

Recreating a prehistoric village: from the Epipaleolithic to the Iron Age 45
D. Gutierrez, E. Sobreviela, F. Gomez, F. Seron

An interactive 3D reconstruction of a funeral in Andriuolo's Necropolis in Paestum 51
Roberto ANDREOLI, Rosario De Chiara, Ugo Erra, Vittorio Scarano, Angela Pontrandolfo, Maria Luigia Rizzo, Alfonso Santoriello

The Flavian Amphitheater (Colosseum) in Rome: An Excellent People-Mover? 55
Diego Gutierrez, Bernard Frischer, Francisco Seron

On-A-Slant Virtual Village: Constructing a 3D Stereo Imaging Exhibit 61
Aaron Bergstrom, Jeffrey T. Clark, Douglas G. Snider, Richard Frovarp, Dan Reetz, Brian Slator, James Landrum, Ryan White

Virtual Reality on Web – Why not? 65
Alexandrino Gonçalves, António José Mendes

Exploring and Interacting with Virtual Museums 73
P. Petridis, M. White, N. Mourkousis, F. Liarokapis, M. Sifniotis, A. Basu, C. Gatzidis

2 – Putting Things Together: Data Classification

Associative Multilingual Classification Architecture for historical artefact 85
Damiano Bolla

SECANTO – The SECtion ANalysis TOol 95
Vincent Mom

An Automated Pottery Fragment Classifier for Archaeological Studies 103
Gulsebnem Bishop, Sung-Hyuk Cha, Charles Tappert

OAIsistema, a simple solution for implementing OAI-PMH on small size archives of archaeological documents 109
Claudio Barchesi

Digitization of Cultural Heritage: model an integral, three-dimensional spatio temporal thesaurus 115
Rimvydas Laužikas

SIDORA Project: Requirements for an open source Archaeological Information System 119
Enric Tartera Bieto, Ares Vidal Aixalà

The Engraved Stone Plaque Registry and Inquiry Tool (ESPRIT) and the Windfalls and Pitfalls of Publishing Online Archaeological Databases 123
Dennis Crall, Katina Lillios

And XML-based open source solution for online/offline archaeological data storage and processing 131
Petko Staynov, Nikolay Genov

Transforming relational databases into XML documents. Case study 137
Manuella Kadar, Ioan Ileană

E-Mem: An Interactive Graveyard Information Management Tool & Virtual Memoriam Database 145
H. Johannsson, M. Felicori, C. Borgatti, S. Caraceni, L.Garutti, A. Vysniauskiene, I. Baliulyte, S. Zabiela, A. Sarris, E. Peraki

3 – Catching things: Fieldwork techniques

Archaeoscope – interface for 3D stratigraphy visualisation 151
Bogdan Bobowski

Linking 2D Harris Matrix with 3D Stratigraphic Visualisations: An Integrated Approach to Archaeological Documentation 155
Wendy Day, John Cosmas, Nick Ryan, Tijl Vereenooghe, Luc Van Gool, Marc Waelkens, Peter Talloen

Artifact Orientations from Total Station Proveniences 161
Shannon JP. McPherron, Harold L. Dibble

Automated simple context sheets processing 167
Bogdan Bobowski

Underwater Surveys and Remote Sensing – The 2005 Corinthian Gulf Expedition 171
Alexis Catsambis

4 – Catching moments: Photogrametry

Photogrammetric recording of the archaeological site of Pinchango Alto (Palpa, Peru) using a mini helicopter (UAV) 175
Henri Eisenbeiss, Karsten Lambers, Martin Sauerbier

3D Modeling of large cultural heritage sites from satellite and aerial images 185
M. Sauerbier, A. Gruen

For a Digital Repository of Rock Art in Portugal 193
J. Cabrita Freitas, M. Adler Abreu, Pedro Santos, António Martinho Baptista, João Zilhão

5 – Beneath: Geophysics Applications

Palaepaphos, Cyprus: The contribution of Geographical Information Systems and Geophysical Prospection in the study of the archaeological topography and settlement patterns 199
A. Sarris, G. Stamatis, N. Papadopoulos, E. Kokkinou, S. Topouzi, E. Kokkinaki, E. Moissi, M. Iacovou, V. Kassianidou, G. Papassavas, G. Papantoniou, M. Dikomitou, E. Stylianidis

Arch-Geophysical prospecting at Magura Uroiului (Romania) 205
Angelica Balos, Adriana Ardeu, Roxana Stancescu, Calin Suteu

A Multi-disciplinary Approach to Industrial Sites of the Vrokastro Region of Mirabello, Eastern Crete 211
A. Sarris, K. Kouriati, E. Kokkinou, E. Aedona, L. Karagianni, G. Vargemezis, G. Stamatis, M. Elvanidou, E. Katifori, M. Kaskanioti, S. Soetens, Th. Kalpaxis, Y. Bassiakos, C. Athanassas, B. Hayden, T. Brennan

6 – Artificial Intelligence

A Science Fiction Tale? A robot called Archaeologist 221
Juan A. Barceló

The spread of Neolithic herders – a computer aided modelling approach 231
Philipp Drechsler, Dirk Tiede

Agent-Based Holistic Simulations of Bronze Age Mesopotamian Settlement Systems 237
John Christiansen, Mark Altawee

7 – LIght Detection And Ranging (LIDAR)

Using pattern recognition to search LIDAR data for archeological sites 245
Arjan de Boer

LIDAR – High Resolution Raster Data as a survey tool 255
Sascha Schmidt, Jörg Bofinger, Ralf Keller and Siegfried Kurz

8 – Public Eyes: Museum and Public Archaeology

Developing an electronic thesaurus of terms for Byzantine Icons in the framework of a project, focused in the creation of a virtual Museum 263
Dionysios Mourelatos, Andreas Andreou, Theodora Patsalou, Drakoulis Martakos

TNT: The Neanderthal Tools and NESPOS 267
G.-C. Weniger, J. Döllner, R. Macchiarelli, M. Mandel, P. Mayer, J. Radovcic, P. Semal

Choice and inspiration: content for audio and multimedia guiding systems 271
Katerina Nikolaidou, Archontia Polyzoudi

9 – Archaeology on-line

A comparative analysis of ontological techniques in supporting online communities 277
John McAuley, Eoin Kilfeather

Bases for the creation of ontology in the context of Archaeology 285
Juan María Fernández González, Antonio Polo Márquez, Enrique Cerrillo Cuenca

10 – Dwelling and perception

The architecture evolution in pre-history: The MOMENT PAST project 293
Alexandra Figueiredo, L. Oosterbeek, S. Cura, G. Guizi, C. Peretto, M. Azarello, U. Thun Hohenstein, A. Minelli, S. Westengaard, G. Burenhult

Integrating spatial analysis and 3D approaches to the study of visual space: Late Bronze Age Akrotiri 307
Eleftheria Paliou, David Wheatley

Total and Cumulative Viewshed: An application in the Genil River Valley 313
Mar Zamora

GIS Analysis of Roman Transport Routes, Seville Province, Spain 319
Leif Isaksen

Pathways, Perception and the development of Place: Computational approaches to movement and perception of landscape in prehistory 323
Paul Cripps

11 – Predictive Modelling

The Cost Surface Analysis as a Predictive Model for the Reconstruction of the Ancient Road Network in the Territory of the Protohistorical Tarquinia 329
Giuliano Pelfer

Towards the Bronze Age Settlement Models of a Northern Apennines Valley (Val di Vara, La Spezia, Italy) 335
M. Tremari

Geographic Information Systems in Archaeological Analysis – GisArchaeo 343
Helena Rua

12 – In-site: Inter-site Analysis

Walking in a Way: Some conclusions of the recent Pré-history in Alto Ribatejo region 353
Alexandra Figueiredo

The lithic industry of the Early Neolithic at Uzzo Cave (Trapani, Sicily). A landscape perspective on the operational chains and the raw material availability 359
Carmine Collina, Rosalia Gallotti

The GIS Application to the Spatial Data Organization of the Necropolis of Poseidonia-Paestum (Salerno, Italy) 365
A. Santoriello, F. U. Scelza, R. Gallotti, R. Bove, L. Sirangelo, A. Pontrandolfo

Low Density Lithic Artefact Scatters: Consideration of the Impact of Sampling Strategy 369
John Pouncett

13 – Modelling our World: GIS Representation

Speeding up visualisation of medieval urban landscapes: John Speed, GIS and 3D 375
Steven Trick, Keith Lilley, Chris Lloyd

Hierarchical multi-view representation of spatial data; application to the analysis of Corsican Neolithic tombs 385
El-Hadi Khoumeri, Jean-François Santucci, Dominique Federici

Praise the sea, on land remain? GIS analysis of travel routes in an Iron Age island environment 391
Robert Brian Rahn

Network Analysis and Landscape Stratigraphy 397
John Pouncett

Between Creator and Reader: Towards Communicative Maps 403
Hugh Corley

Time to look for a Temporal GIS 407
Dora Constantinidis

To see or not To see. Archaeological data and surface visibility as seen by an AIS (Archaeological Information System) approach 413
F. Cavulli; S. Grimaldi

14 – GIS Patter Analysis

FORMA TARRACONIS? GIS use for urban archaeology 423
José Ignacio Fiz Fernández, Josep Maria Macias Solé

Applications of GISs to the study of Daunian settlement patterns in the pre-Roman Age 429
Barbara Pecere

Towards prehistoric landscape interpretation: GIS analysis of stratigraphical and remote sensing data in Sesto Fiorentino plain 441
Giovanna Pizziolo

The Settlement Pattern of Ancient Icaria through a GIS Approach. Part II: Data Visualization 447
Sophia Topouzi

Recapturing the Spatial Dynamics of the Venetian Occupation Period of Merabello in Eastern Crete through a GIS Approach 451
Marianna Katifori

Preface

This book contains the proceedings of the 33rd Computer and Quantitative Methods in Archaeology Conference, usual known as CAA.
For those that still didn't contact with this conference we wish say: welcome. This is the right word since CAA is more than a mere annual conference. Its spirit encourages the interaction between participants. It gives the feeling to those who get involved of almost being in a family.
A special attention as always been given to the interaction of those who have been around for some time and young researchers. This 33rd conference was mainly a students meeting. It was organised by students and students were one of our major concerns. We tried our best to present conditions that would help to lower the costs of attending this meeting, whithout compromising what we could offer to the participants. At the same time there was also a concerm for social interaction. With this in mind, we tried to fill all evenings with an event, having also in mind that this should not raise the fees to high amounts.
We hope that through these events we managed to present Portuguese culture and helped establishing new international links between the participants. Other stimulus that we tried to bring back again to the conference, was the awards for best paper and best young researcher paper. And the winners were:

- for best paper: Mark Altaweel and John Christiansen, "Agent-Based Holistic Simulations of Bronze Age Mesopotamian Settlement Systems"
- for best young researcher paper: Robert Brian Rahn, "Praise the sea, on land remain? GIS analysis of travel routes in an Iron Age island environment"

Through these proceedings it will be possible to have a glimpse of what was this meeting. Certainly the youth of the organization led us to some mistakes. We were far from achieving perfection, but we tried our best to use wisely the magnificent installations that the Instituto Politécnico de Tomar (IPT) had to offer. It was also thanks to the IPT infrastructure that we able to broadcast the conference live through Internet. All this and many other stunts (like the live presentation via web of a paper from the U.S.A, or the complete video record of all the conference) couldn't be possible without the effort of the IPT personal, mainly the Computer Office and the Audiovisual Resources Centre. We wish to thank them for all the patient and effort mainly to the person of their directors, Joaquim Pombo and António Ventura. Even in the times were we known we were asking something very similar with "impossible", they tried their best to show that this word didn't apply.
This has been in fact a team work, were every element had a very crucial role in lifting up what we never imagined has such an intense and hard task. So there are many thanks which we cannot leave in blank.
We would like to thank the peer reviewers for theirs hard task.
To Luiz Oosterbeek we wish to thank all the opportunities that were given to this team. Without him this would be an unachievable task and thanks to him these was a dream made possible from a very early start.
We would also like to thank Nick, Steve, Hans, Kelly, Juan, Franco, Jeff, Sasha and Dora (also known as the CAA Steering Committee), who opened the door for this young team, betting on their capacities and supporting them, believing that all would go for the best. Their constant good mood and understanding was a stimulus that kept us going and without it nothing would be possible.
Our last word of gratitude goes to our everyday, never tired, always helpful, cheerful, and many other good adjectives, that all aren't enough to thank to the Landscape Management Student Union, for their work and help through the many days, nights and dawns in which they completely devoted themselves in a completely volunteer task. With them we lived moments that it will be difficult to forget.
So it's time to give word to the participants. We hope that you can enjoy this pages as much as we have enjoyed the conference.

The Editors

Alexandra Figueiredo
Gonçalo Leite Velho

FORMA TARRACONIS? GIS use for urban archaeology

JOSÉ IGNACIO FIZ FERNÁNDEZ, JOSEP MARIA MACIAS SOLÉ

Seminari de Topografia Antiga, URV, Departament d'Enginyeria Informàtica i Matemàtica (DEIM), URV, Catalan Institute of Classical Archaeology (ICAC)

ABSTRACT

In this article we describe the use of a GIS for the archaeological compilation of the town of Tarragona and the inclusion of old plans of town which have been georeferenced. For this last fact we have used techniques of geometric corrections of aerial photographs.
From here on we have been able to begin a work of analyze of the collected information, allowing the confirmation of previous theories about the urban morphology of town in roman times, as so as new hypothesis of work for future investigations.

1. INTRODUCTION

At the end of XX century some projects which allowed the compilation of archaeological interventions made in Tarragona (Ted'a, 1988; Rifà, 2000; Macias, 2000; Fiz, 2000), were tried to materialize; they were always limited to the use of database associated to archaeological plans made with CAD. However, it's not until the year 2002 that the first rough estimates with GIS were begun, promoted by History Museum of Tarragona as a part of the archaeological study of harbour area of town for the composition of General Plan of Town-planning of Tarragona.
This project allowed the compilation of the plans obtained in archaeological interventions and its most important information, including it not only in a GIS (ArcView 3.2) but also in a database made with Filemaker. The project allowed the obtaining of a PhD Thesis (Fiz, 2004) which its main objective was developing an archaeological information system (SIA) that allowed the management of archaeological activity of any town.
The idea of compiling the historical cartography of town emerged from both situations, including it among several present archaeological and topographic layers. This initiative was due to the verification that certain problems associated to the interpretation of old topography of Tarraco couldn't be resolved because of the great and destructive dynamics of town-planning made since XIX century. The superimposition of these historical plans over the available archaeological information would make easy the task of archaeologists "retrieving" archaeological traces already missing but they were registered in maps by their contemporaries.
The methodology of investigation has been already applied to the study of Town-planning evolution of imperial *thermae* of harbour of Tarraco and it has allowed the comprehension of historical evolution of building as so as the reuse in Middle and Modern Age of old roman structures (idem/Macias, 2004). Since year 2004 a project is being developed, financed by *Catalan Institute of Classic Archaeology* and *History Museum of Tarragona*, which consists in the compilation of all archaeological excavations made in town since the beginning of XX century to make an archaeological global plan; the objective of this is the town-planning comprehension of a roman town as Tarraco, which reached the 80 hectares. This project has made evident the important scientific lacks caused by the urban developments and stone quarries of XIX century. It's in this phase of the process when the historical cartography and the methodology which we developed in parallel to the archaeological documentation must take part in it.

2. TECHNICAL BASIS

The historical cartography, raster images, can be georeferenced to be situated in a GIS. The registration of an image applies a geometrical transformation which relates coordinates of image (line, column) with coordinates of a reference system.
The system of transformation, adaptation and georeference of old plans is based on technology of geometrical correction used in air photographs. When an image is taken from the air, some mistakes are introduced coming from distortion of sensor (for instance distortion of lens), the slant of the medium with regard to the vertical, the speed of the platform or the altitude, among other ones. The most common method to correct an image geometrically is finding a polynomial of a certain order, that allows minimize the mistake made in the transformation of an original image to another corrected. We get this transformation making polynomials, using a series of points of control introduced by the user as coefficients. When the most adequate transformation is found, the one which minimizes the mistake, then it's applied to every pixel of the image to be transformed. The transformation can be represented using a polynomial of order **m** as:
Here **x** and **y** represent the coordinates known at the image of reference whereas **x'** and **y'** represent the coordinates of last transformation.

The use of polynomial transformation is so common in the registration of images. They establish the link between the coordinates of the image and the ones in the system of reference, through **points of control** (methodology explained in Fiz/Macias, 2004). The points of control are topographical features of easy identification not only in the image but also in the land, that is to say, they are elements which coordinates are known not only in the image to be transformed but also in the system taken as reference. Crossings of roads, runways and confluences of rivers are very common candidates used as points of control.

The determination of parameters of the polynomial transformation chosen is made by means of the resolution of a system of equations. The coordinates of points of control must be known not only in the image but also in the system of reference so that this system could be made. These coordinates of the image (line, column) are obtained by pointing the user with the mouse over one of the topographic points chosen, and looking for their parallel at the image taken as a reference for making it. So, a program of these characteristics stores a pool of points that will be useful to make the polynomial transformations needed. The main advantage is that the difficulties associated to the conversion of different local measures are avoided, for example the *vara* (unit of length equal to approximately 33 inches), previous to the generalization of the international metric system.

However, the treatment of old plans produces some problems which are different to the ones corresponding to the rectification of air photographs. One of the main problems is that the system doesn't adapt well to situations where mistakes not accumulated would have been produced when the plans would have raised. That is, the cartographer would make dispersed mistakes and not proportional ones. In these situations, it's necessary to raise the grade of the polynomial of transformation, so that it's also absolutely necessary increasing the number of points of control. But this modification means that the rest of the image has a great distortion, being only corrected if the points of control are uniformly distributed. In the treatment of old cartographies, both conditions are difficult to get because as their antiquity is increased, the number of common points is decreased. For this reason, it's necessary to collect from one plan to the previously one not only the common points of control, but also their combination with the archaeological remains contemporary to the times which the cartographies represent.

2.1 TARRACO: URBS SUPRA COLLEM

Colonia Iulia Urbs Triumphalis Tarraco, capital of the *Hispania Tarraconensis* was one of the largest cities of the Occidental Mediterranean. A prosperous town that achieved an urban area between 80 and 90 hectares and distributed, roughly, in an area within the city walls up on a hill (aprox 60 ha), a *suburbia* at the lower slopes (10-15 ha) and a large harbour area (8-10 ha). It's a town so known because of its great public buildings – *Concilium Provinciae*, the Circus, Amphiteatre, the Theatre and the Forum – and it had a lot of thermal estates. In spite of this the town-planning – *viae* and *insulae* – is one of the least known aspects of the present archaeological investigation. The reasons of this are the technical characteristics of domestic architecture and that the residential areas were changed by the urban development and the numerous fortifications of Middle and Modern Age after its abandoning in late Antiquity.

It wasn't until 1999 when a first proposal of restitution of road network was presented, and what is more, this was limited to the residential area within the city walls causing a lot of questions which have not been resolved (Macias, 2000). This theory was made with the archaeological findings of town including them in the present topographic and establishing a ratio of 1 per 2 *actus*. This is, on the other hand, one module of common *insula* in *Hispania* and that, in the case of Tarraco, is due to a town-planning program projected around the year 100 BC. Later archaeological works have proved that the residential area within the city walls was object of three town-planning phases clearly different (Fig. 1).

The first area (2 ha) developed from an Iberian settlement and its road network hasn't been identified (Díaz *et al.*, in press). The second one (24,6 ha) is due to the great town-planning of the ends of II BC century and it has a ratio of 1 per 2 *actus* with *viae* of 6 metres of width and one *kardo maximus* of 7 m. This area has a scientific lack without solution because of an excavation of an urban stone quarry during XIX century and it reached an area of 7 ha. The third urban area has 11 ha and it is due to a town-planning of the ends of republican times. In this area the urban network hasn't been able to reproduce with precision because of the great patrimonial affectation produced between XVI and XIX centuries.

In front of these lacks, we have turned to the information of historical cartography managed by a GIS. Fortunately the area within the city walls was developed on a coastal hill, which from the 15 m over the sea level, climbed progressively up to 80 m. This fact determined the roman town-planning making an urban network with great architectonic structures of retaining slope of hill and, by the other hand, an orientation of *kardines* and *cloacae* which made easy the evacuation of faecal and pluvial water to the harbour bay. A lot of these elements lasted in time, further the abandon of Later Antiquity. So, the urban roman structures were well used from medieval times on, as rural paths, the old *viae* – or as elements of farming division into plots – walls of *insulae* or embankment. Later, the medieval farming division into plots determined the form of town-planning of XIX century. Therefore, and in spite of the centuries passed, it's possible to detect the roman town-planning by means of historical cartography. The clearest example is that the nineteenth-century streets maintain the same orientation as the kardines of the end of I BC century.

2.2. CONTRIBUTIONS OF GIS

For this methodology of researching we have chosen the "*Plan of the portion of terrain which is between the high Precinct of square of Tarragona and its Harbour*", edited the year 1800 by Antonio López Sopeña. This is a document made before the appearance of facts which produced the biggest affectation in historical heritage of Tarragona: the great urban quarries and the town-planning expansion of the middle of XIX century. Moreover the chosen plan is a reliable document, which recently has been analyzed from the topographic point of view and historical evolution of the town (Gabriel, 2001).

For our self-interest the plan is useful for the definition of the urban zone within the city walls of old *Tarraco* (Fig. 1, areas 2 and 3). This part of roman town was abandoned from IV century on, when *Tarraco* recovered the urban duality characteristic from republican times: a high part on the hill and a great harbour suburb outside the city in relation with its harbour and the surrounding land (Macias, 2000b). This look remained until XIX century so that the residential area within the city walls of roman town was, between IV century and middle of XIX century, a rustic zone where the urban division into plots was continuously transformed by farming activity.

From the conceptual and technical point of view we faced up the doubt that, instead of the centuries, we had to prove that the farming occupation of this area hadn't been enough to hide the urban roman traces, the most important one would have been useful in farming division into plots or road network which join, in 1800, the high part of town with the harbour zone.

The analysis of the central part of plan shows the pre-eminence of three ways: the one of the *Piramide*, the one of the *Mig* and the *Caputxins* (Fig. 2).

The most oriental one is already known in a plan of 1641 and the other ones were documented graphically from 1769 on (cfr. Aresté, 1982). These three ways are coincident with three of the *kardine* of the town. Even the most oriental one is a reminiscence of the *kardo maximus* of the town and it has been, during modern and contemporary times, the city's main area for the communication between the high part and the harbour.

With regard to the cross-axis, the historical cartography also shows coincidences with the layout of roman *decumani* and this is useful for us to restore the *forma Tarraconis in areas* affected by the quarries of XIX century (Fig. 1). The most obvious case is the republican *decumanus* identified under the high imperial theatre of town and that, according to the cartography of 1800 and the archaeological funerary remains of the suburbs, allows us to interpret the hypothetic presence of a new roman gate of the walls, from where it must situate one of the outlying ways which created a little necropolis previous to the amphitheatre of II century AD (Fig. 4). This way would become a structure of terraces of a little hill which wasn't likely urbanized.

By the other hand, we also see farming traces – edges of farmer – of XIX century that coincide approximately with the cross-axis of the *insulae* which measured 35 m of width per 70 m of length (Fig. 3).

This is due to the great slope of the roman town (around the 7% of median), so that there would be a difference of theorical height around 5,3 m between the axis of the two adjacent *decumani*. So, in some parts of town northern front of each *insula* would be about 5 m over the southern one. The inside architectonic distribution of each *insula* might correct this slope. This fact would have required the construction of terrace and retaining walls which, according to the datum given by GIS, would have an architectonic structure suitable to be edges of farming division into plots.

The conclusion is that the datum obtained from the application of a GIS complement the experiments of reconstruction of old urban aspect. This new source of traces allows us to corroborate the previous interpretations and, at the same time, includes the urban areas which are object of an irreversible affectation of their heritage in the interpretative proposals.

REFERENCES

DÍAZ, M.; MACIAS, J. M.; TEIXELL, I. (in press) – Intervencions al carrer Sevilla núms. 12-14. Noves dades per a l'evolució urbana del "Casc Antic" de Tàrraco, Butlletí Arqueològic 26, Tarragona.

FIZ, J. I (2000) – Usos de un SIG, Sistema de Información Geográfico en la construcción de una planimetría arqueológica de Tarragona. *Revista d'Arqueologia de Ponent*, 11-12, Lleida, p. 111-122.

FIZ, J. I.; MACIAS, J. M. (2004) – El port modern i la nova poblacio de la Marina. In J. M. Macias (ed.) – *Les termes públiques de l'àrea portuaria de Tarraco. Carrer de Sant Miquel de Tarragona*. DOCUMENTA, 2, p. 14-20.

GABRIEL, R. (2001) – Aproximació a la topografia antiga de Tarragona. *Butlletí Arqueològic*, 23, Tarragona, p. 281-346.

MACIAS, J. M. (2000) – L'urbanisme de Tàrraco a partir de les excavacions de l'entorn del Fòrum de la ciutat. In Ruiz de Arbulo (ed.) – *Tàrraco 99. Arqueologia d'una capital provincial romana*. Documents d'Arqueologia Clàssica, 3, Tarragona, p. 83-106.

MACIAS, J. M. (2000b) – Tarraco en la Antigüedad Tardía: un proceso simultáneo de transformación urbana e ideológica, Ribera, A. (ed.) – *Los orígenes del Cristianismo en Valencia y su entorno*. Grandes Temas Arqueológicos, 2, València, p. 259-271.

RIFÀ, A. (2000) – El Pla Arqueològic de Tarragona I. La Base de dades. In Ruiz de Arbulo (ed.) – *Tàrraco 99. Arqueologia d'una capital provincial romana*. Documents d'Arqueologia Clàssica 3, Tarragona, p. 287-290.

TED'A. (1988) – Registro Informático y Arqueología Urbana en Tarragona. *Archeologia e Informàtica*, Roma, p. 177-191.

FIGURES

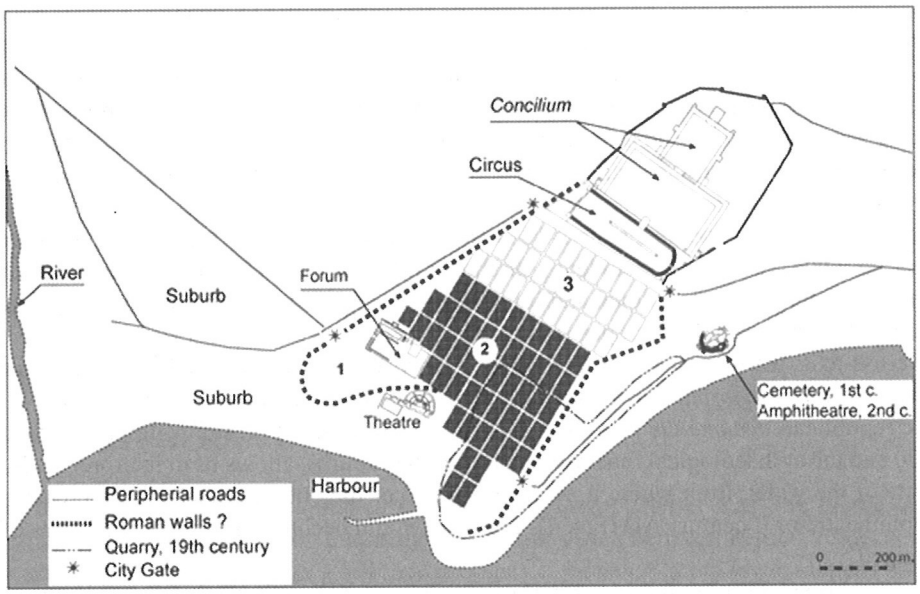

Fig. 1 – Hypothetic plan of town of *Tarraco* at beginning of II AD century according to archaeological datum (Macias, 2000) and contributions of GIS.

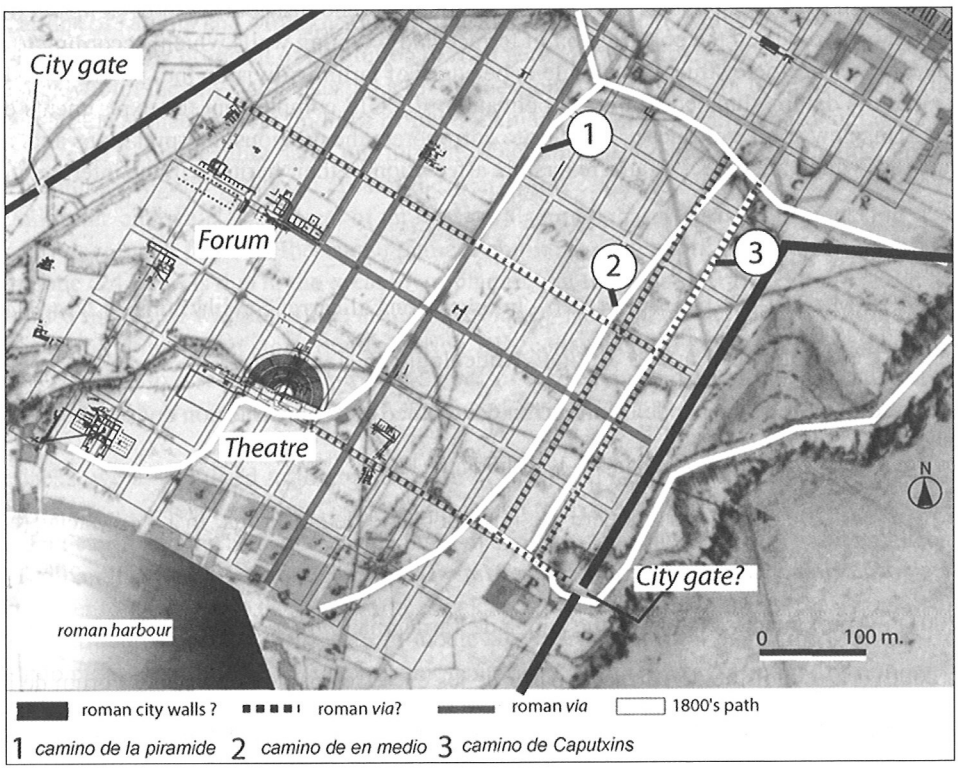

Fig. 2 – Central part of the plan of López Sopeña (1800) related to the reconstruction of roman division into plots.

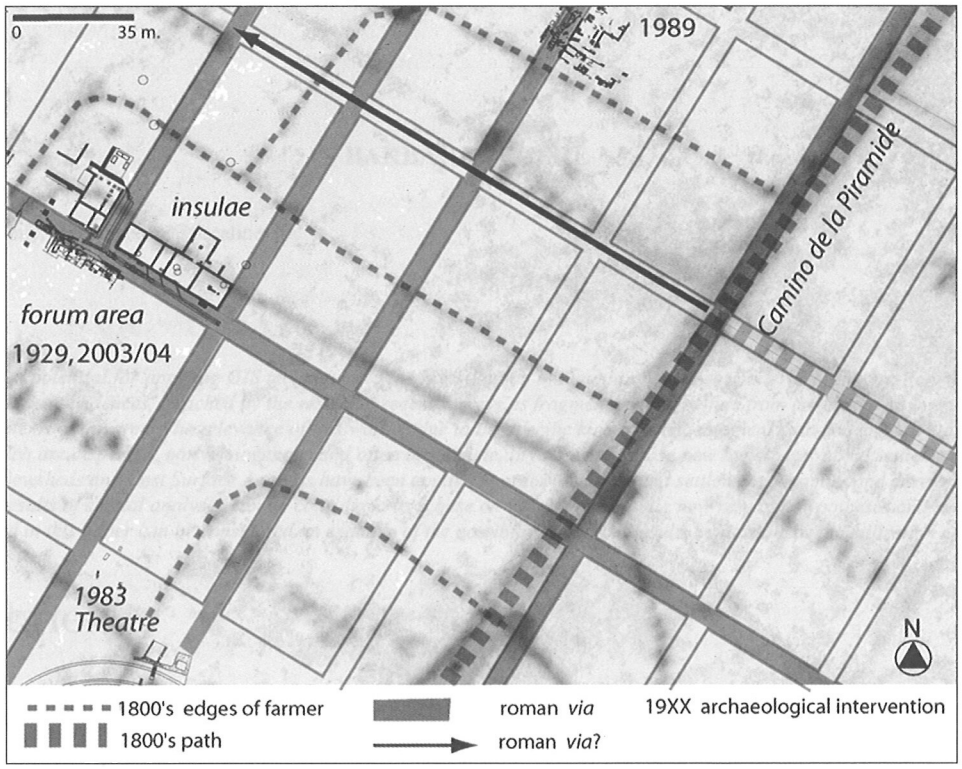

Fig. 3 – Residential area detail.

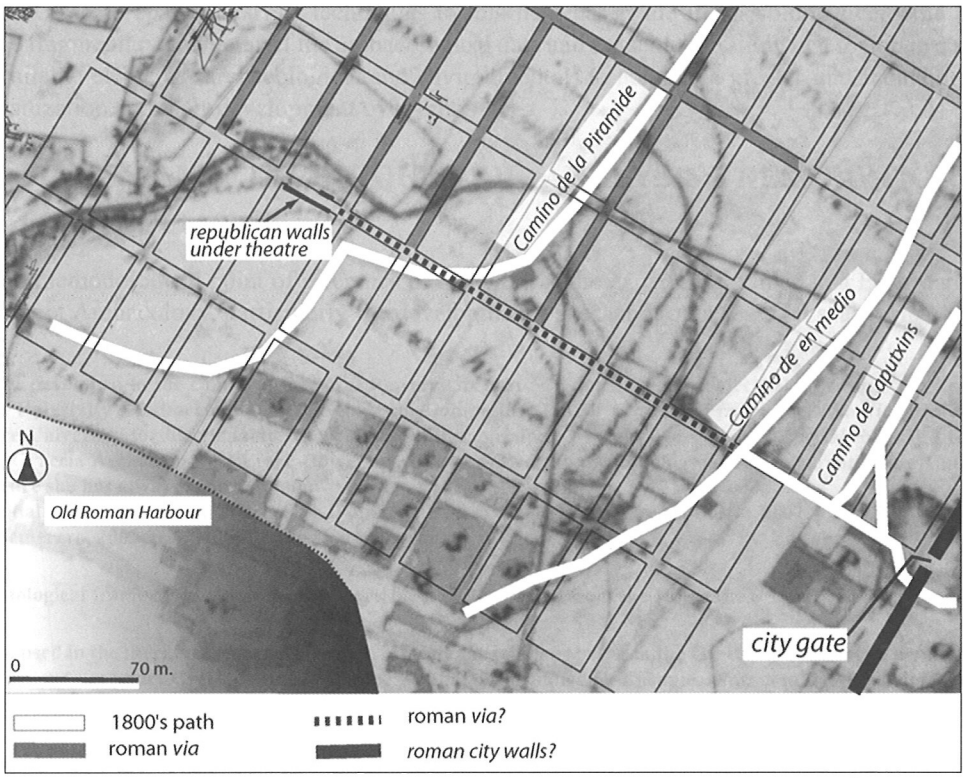

Fig. 4 – Harbour area detail.